
Project Manual | Divisions 00 - 33
WIMBISH ES STORM SHELTER, GYM RENOVATION AND ADDITION
ARLINGTON, TEXAS

Bid Set
2026-04-27

ARLINGTON INDEPENDENT SCHOOL DISTRICT



ARLINGTON ISD WIMBISH ELEMENTARY SCHOOL
ARLINGTON, TX

PROJECT MANUAL

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REVISED TECHNICAL CONTENT

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ISSUES

2026-03-30	Bid Set
2026-03-06	Permit Set
2026-02-23	75% Construction Development
2026-01-16	Design Development

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2026-03-30	☒	00 3100	Available Project Information	HKS
2026-03-30	☒	00 5200	Agreement Form	HKS
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2026-03-30	☒	01 1000	Summary	HKS
2026-03-30	☒	01 2100	Allowances	HKS
2026-03-30	☒	01 2200	Unit Prices	HKS
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2026-03-30	☒	01 2500	Substitution Procedures	HKS
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2026-03-30	☒	01 3300	Submittal Procedures	HKS
2026-03-30	☒	01 4000	Quality Requirements	HKS
2026-03-30	☒	01 4200	References	HKS
2026-03-30	☒	01 4323	Special Inspections	HKS
2026-03-30	☒	01 4339	Visual Mock-Up Requirements	ARM
2026-03-30	☒	01 4519	Field Testing for Air and Water Leakage	HKS
2026-03-30	☒	01 4541	Preconstruction Laboratory Mockup Testing for Building Enclosure Systems	HKS
2026-03-30	☒	01 5000	Temporary Facilities and Controls	HKS
2026-03-30	☒	01 5639	Tree Protection, Removal, And Pruning	CCA
2026-03-30	☒	01 6000	Product Requirements	HKS
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DIVISION 02 - EXISTING CONDITIONS

2026-03-30	☒	02 4100	Demolition	MJT
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2026-03-30	☒	03 0150	Concrete Patching	HKS
2026-03-30	☒	03 1100	CIP Concrete Forming	HKSS
2026-03-30	☒	03 1100A	Concrete Forming	MJT
2026-03-30	☒	03 1500	CIP Concrete Accessories	HKSS
2026-03-30	☒	03 2000	Concrete Reinforcing	MJT
2026-03-30	☒	03 2000A	Concrete Reinforcing	HKSS
2026-03-30	☒	03 3300	Cast-In-Place Concrete	MJT
2026-03-30	☒	03 3300A	CIP Concrete	HKSS
2026-03-30	☒	03 3500	Concrete Finishing	HKS
2026-03-30	☒	03 4100	Plant - Precast Structural Concrete	HKSS
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2026-03-30	☒	03 5416	Hydraulic Cement Underlayment	HKS

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2026-03-30	☒	04 0523	Through-Wall and Substrate Flashing System	ARM
2026-03-30	☒	04 2100	Masonry Veneer	HKS
2026-03-30	☒	04 7500	Adhered Masonry Veneer	HKS

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2026-03-30	☒	05 1200	Structural Steel Short Version	HKSS

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2026-03-30	☒	06 1053	Miscellaneous Rough Carpentry	HKS
2026-03-30	☒	06 4023	Interior Architectural Woodwork	HKS

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2026-03-30	☒	07 1326	Sheet Waterproofing	HKS
2026-03-30	☒	07 1900	Water Repellents	HKS
2026-03-30	☒	07 2100	Thermal Insulation	HKS
2026-03-30	☒	07 2216	Roof Board Insulation	ARM
2026-03-30	☒	07 2617	Below Slab Vapor Retarders	HKS
2026-03-30	☒	07 5113	Four-ply BUR Roof System	ARM
2026-03-30	☒	07 6200	Sheet Metal and Miscellaneous Accessories	ARM
2026-03-30	☒	07 7200	Roof Accessories	HKS
2026-03-30	☒	07 7200.01	Roof Accessories	ARM
2026-03-30	☒	07 8413	Penetration Firestopping	HKS
2026-03-30	☒	07 8446	Fire-Resistive Joint Firestopping	HKS
2026-03-30	☒	07 9200	Joint Sealants	HKS
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2026-03-30	☒	08 1113	Hollow Metal Doors and Frames	HKS
2026-03-30	☒	08 1170	Steel Fire Door and Frame Assembly	HKS
2026-03-30	☒	08 1426	Hollow Core Wood Doors	HKS
2026-03-30	☒	08 3113	Access Doors and Frames	HKS
2026-03-30	☒	08 4400	Glazed Aluminum Framing Systems	HKS
2026-03-30	☒	08 7100	Door Hardware	ALLE
2026-03-30	☒	08 7100A	Door Index	ALLE
2026-03-30	☒	08 7101	Door Hardware Sets	ALLE
2026-03-30	☒	08 8000	Glazing	HKS

DIVISION 09 - FINISHES

2026-03-30	☒	09 2900	Gypsum Board Assemblies	HKS
2026-03-30	☒	09 3000	Tiling	HKS
2026-03-30	☒	09 5113	Acoustical Panel Ceilings	HKS
2026-03-30	☒	09 6500	Resilient Flooring	HKS
2026-03-30	☒	09 6513	Resilient Base and Accessories	HKS
2026-03-30	☒	09 8433	Acoustical Wall Panels	HKS
2026-03-30	☒	09 9100	Painting	HKS

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2026-03-30	☒	10 1100	Visual Display Boards	HKS
2026-03-30	☒	10 1146	Visual Display Fabrics	HKS
2026-03-30	☒	10 1400	Interior Signage	HKS
2026-03-30	☒	10 2113	Toilet Compartments	HKS
2026-03-30	☒	10 2613	Wall and Corner Guards	HKS
2026-03-30	☒	10 2813	Toilet Accessories	HKS
2026-03-30	☒	10 4116	Emergency Key Cabinets	HKS
2026-03-30	☒	10 4400	Fire Protection Specialties	HKS
2026-03-30	☒	10 4450	Automated External Defibrillators (AED)	HKS

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2026-03-30	☒	11 4911	Gymnasium Equipment	HKS
2026-03-30	☒	11 5213	Projection Screens	HKS

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2026-03-30	☒	12 2413	Roller Window Shades	HKS
2026-03-30	☒	12 3550	Educational Casework	HKS

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2026-03-30	☒	13 2613	Storm Shelter Products	HKS

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2026-03-30	☒	21 0100	Fire Protection Operating and Maintenance Manuals	SOB
2026-03-30	☒	21 0500	Fire Protection General Provisions	SOB
2026-03-30	☒	21 0510	Fire Protection Contract Quality Control	SOB
2026-03-30	☒	21 0512	Fire Protection Shop Drawings, Coordination Drawings & Product Data	SOB
2026-03-30	☒	21 0513	Electrical Provisions of Fire Protection Work	SOB
2026-03-30	☒	21 0514	Fire Protection of Alterations Project Procedures	SOB
2026-03-30	☒	21 1000	Fire Sprinkler System	SOB
2026-03-30	☒	21 3113	Fire Pump System	SOB

DIVISION 22 - PLUMBING

2026-03-30	☒	22 0100	Plumbing Operating and Maintenance Manuals	SOB
2026-03-30	☒	22 0500	Plumbing General Provisions	SOB
2026-03-30	☒	22 0510	Plumbing Contract Quality Control	SOB
2026-03-30	☒	22 0512	Shop Drawings, Coordination Drawings & Product Data	SOB
2026-03-30	☒	22 0513	Electrical Provisions of Plumbing Work	SOB
2026-03-30	☒	22 0514	Plumbing Alterations Project Procedures	SOB
2026-03-30	☒	22 0515	Plumbing Earthwork	SOB
2026-03-30	☒	22 0517	Plumbing Access Doors	SOB
2026-03-30	☒	22 0519	Pressure and Temperature Instruments	SOB
2026-03-30	☒	22 0523	Valves, Strainers and Vents	SOB
2026-03-30	☒	22 0533	Pipe Heat Tracing	SOB
2026-03-30	☒	22 0719	Plumbing Piping Insulation	SOB
2026-03-30	☒	22 0800	Plumbing Commissioning Coordination	SOB
2026-03-30	☒	22 1116	Domestic Water Piping and Appurtenances	SOB
2026-03-30	☒	22 1123	Domestic Water Pumps	SOB
2026-03-30	☒	22 1316	Soil, Waste and Sanitary Drain Piping, Vent Piping and Appurtenances	SOB
2026-03-30	☒	22 1413	Roof Drainage Piping and Appurtenances	SOB
2026-03-30	☒	22 1423	Reinforced Concrete Storm Sewers	MJT
2026-03-30	☒	22 2000	Plumbing Pipe and Pipe Fittings General	SOB
2026-03-30	☒	22 3333	Electric Water Heater (Commercial ASME)	SOB
2026-03-30	☒	22 3432	Gas-Fired Domestic Water Heater	SOB
2026-03-30	☒	22 4000	Plumbing Fixtures and Fixture Carriers	SOB
2026-03-30	☒	22 6311	Gas Piping and Appurtenances	SOB

DIVISION 23 – HEATING, VENTILATION AND AIR CONDITIONING (HVAC)

2026-03-30	☒	23 0100	HVAC Operating and Maintenance Manuals	SOB
2026-03-30	☒	23 0500	Mechanical General Provisions	SOB
2026-03-30	☒	23 0510	HVAC Contract Quality Control	SOB

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2026-03-30	☒	23 0511	Mechanical Alterations Project Procedures	SOB
2026-03-30	☒	23 0512	Shop Drawings, Coordination Drawings and Product Data	SOB
2026-03-30	☒	23 0513	Electrical Provisions of HVAC Work	SOB
2026-03-30	☒	23 0514	HVAC Condensate Drain Piping System	SOB
2026-03-30	☒	23 0517	Mechanical Access Doors	SOB
2026-03-30	☒	23 0548	Vibration Isolation	SOB
2026-03-30	☒	23 0593	Testing, Balancing and Adjusting (TAB) of Environmental Systems	SOB
2026-03-30	☒	23 0594	Coordination of Testing and Balancing	SOB
2026-03-30	☒	23 0713	External Duct Insulation	SOB
2026-03-30	☒	23 0719	HVAC Piping Insulation	SOB
2026-03-30	☒	23 0800	Mechanical Commissioning Coordination	SOB
2026-03-30	☒	23 0933	Building Management and Control System	SOB
2026-03-30	☒	23 2000	Mechanical Pipe and Pipe Fittings – General	SOB
2026-03-30	☒	23 2300	Refrigerant Piping and Appurtenances	SOB
2026-03-30	☒	23 3113	Ductwork	SOB
2026-03-30	☒	23 3416	Fans	SOB
2026-03-30	☒	23 3713	Air Devices	SOB
2026-03-30	☒	23 4100	Air Filtration	SOB
2026-03-30	☒	23 4300	Air Purification System	SOB
2026-03-30	☒	23 8121	Single Package Rooftop Air Conditioners (w/gas-fired heat)	SOB
2026-03-30	☒	23 8218	Ductless Mini Split DX Units	SOB
2026-03-30	☒	23 8239	Electric Unit Heaters	SOB

DIVISION 26 - ELECTRICAL

2026-03-30	☒	26 0100	Commissioning of Electrical Systems	SOB
2026-03-30	☒	26 0105	Operating and Maintenance Manuals	SOB
2026-03-30	☒	26 0500	Electrical General Provisions	SOB
2026-03-30	☒	26 0505	Electrical Alterations Project Procedures	SOB
2026-03-30	☒	26 0510	Contract Quality Control	SOB
2026-03-30	☒	26 0512	Electrical Shop Drawings, Coordination Drawings and Product Data	SOB
2026-03-30	☒	26 0519	Conductors and Connectors	SOB
2026-03-30	☒	26 0526	Electrical Grounding	SOB
2026-03-30	☒	26 0527	Expansion of Existing Electrical Grounding System	SOB
2026-03-30	☒	26 0533	Conduit Systems	SOB
2026-03-30	☒	26 0535	Electrical Connections for Equipment	SOB
2026-03-30	☒	26 0537	Electrical Boxes and Fittings	SOB
2026-03-30	☒	26 0540	Electrical Gutters and Wireways	SOB
2026-03-30	☒	26 0550	Firestops	SOB
2026-03-30	☒	26 0573	Arc Flash Hazard Analysis, Short-Circuit Coordination	SOB
2026-03-30	☒	26 0800	Commissioning of Electrical Systems	SOB
2026-03-30	☒	26 0925	Electrical Contactors	SOB
2026-03-30	☒	26 0944	Lighting Controls – Stand Alone Operation	SOB

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2026-03-30	☒	26 1215	Dry Type Transformers	SOB
2026-03-30	☒	26 2315	Three Phase Centralized Emergency Lighting Inverter	SOB
2026-03-30	☒	26 2416	Panelboards	SOB
2026-03-30	☒	26 2417	Fusible Branch Circuit Panelboards	SOB
2026-03-30	☒	26 2425	Enclosed Switches and Circuit Breakers	SOB
2026-03-30	☒	26 2430	Fuses	SOB
2026-03-30	☒	26 2773	Line Voltage Wiring Devices	SOB
2026-03-30	☒	26 4300	Surge Protection Devices	SOB
2026-03-30	☒	26 5113	Lighting Fixtures	SOB
2026-03-30	☒	26 5600	Site Lighting	SOB

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2026-03-30	☒	27 0100	Operating and Maintenance (O&M) Manuals of Communication Systems	SOB
2026-03-30	☒	27 0500	Communications Basic Materials, Methods and General Provisions	SOB
2026-03-30	☒	27 0507	Communications Shop Drawings, Coordination Drawings & Product Data	SOB
2026-03-30	☒	27 0509	Contract Quality Control	SOB
2026-03-30	☒	27 0510	Firestops	SOB
2026-03-30	☒	27 1000	Structured Cabling System	SOB
2026-03-30	☒	27 4116.20	Audio and Video Distribution Systems for Special Venues	SOB
2026-03-30	☒	27 5000	Expansion of Existing School Communication System	SOB

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2026-03-30	☒	28 0100	Electronic Safety and Security Operating and Maintenance Manuals	SOB
2026-03-30	☒	28 0500	Safety and Security Basic Materials, Methods and General Provisions	SOB
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2026-03-30	☒	28 0510	Contract Quality Control	SOB
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2026-03-30	☒	28 1000	Access Control System	SOB
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2026-03-30	☒	28 3100	Intrusion Detection System	SOB
2026-03-30	☒	28 4600	Fire Detection and Alarm System	SOB

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2026-03-30	☒	31 0000	Earthwork	MJT
2026-03-30	☒	31 0513	Soils for Earthwork	MJT
2026-03-30	☒	31 0516	Aggregates for Earthwork;	MJT
2026-03-30	☒	31 1100	Clearing and Grubbing	MJT

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2026-03-30	☒	31 1400	Site Preparation	MJT
2026-03-30	☒	31 2333	Trenching and Backfilling	MJT
2026-03-30	☒	31 2400	Earthwork for Structures	HKSS
2026-03-30	☒	31 2500	Erosion and Sedimentation Controls	MJT
2026-03-30	☒	31 3116	Termite Control	HKS
2026-03-30	☒	31 4133	Trench Shielding	MJT
2026-03-30	☒	31 6316	Augered Cast In Place Piles	HKSS

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2026-03-30	☒	32 1313	Concrete Paving	MJT
2026-03-30	☒	32 1373	Sealants and Caulkings	MJT
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MJ Thomas Engineering, LLC.

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31 0513 Soils for Earthwork
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31 1100 Site Preparation
31 1400 Trenching and Backfilling
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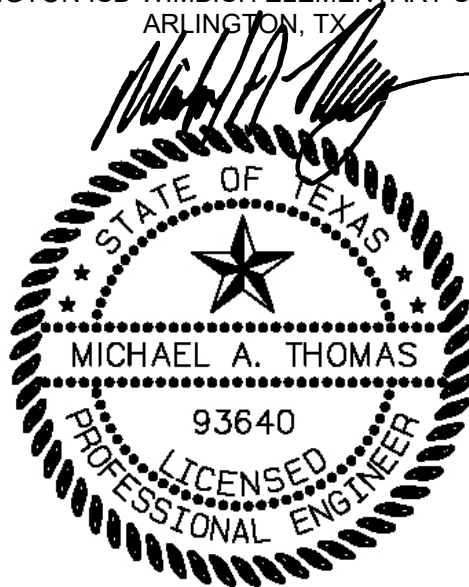
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32 1373 Sealants and Caulkings
32 1723 Pavement Markings
32 3113 Chain Link Fence and Gates

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MJ Thomas Engineering, LLC.
03/30/2026
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32 3117	Gate Operators	HKS

DIVISION 33 - UTILITIES

33 4613	Foundation Drainage System	HKS

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DOCUMENT 000107

PROFESSIONAL SEALS PAGE

The following Specification Sections have been prepared by or under the direct supervision of the Architect:

HKS Inc

DOCUMENTS & SPECIFICATIONS

DIVISION 03 -: CONCRETE

03 1100 Cast-in-Place Concrete Forming
03 1500 Cast-in-Place Concrete Accessories
03 2000 Concrete Reinforcing
03 3000 Cast-in-Place Concrete
03 4100 Plant-Precast Structural Concrete

DIVISION 05 -: METALS

05 1200 Structural Steel Framing

DIVISION 31 -: EARTHWORK

31 2400 Earthwork for Structures
31 6316 Augered Cast-in-Place Piles



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DOCUMENT 00 0107

PROFESSIONAL SEALS PAGE

The following Specification Sections have been prepared by or under the direct supervision of the Architect:

CCA Landscape Architects

DOCUMENTS & SPECIFICATIONS

DIVISION 01 -: GENERAL REQUIREMENTS

01 5639 Tree Protection, Removal, and Pruning

DIVISION 32 -: EXTERIOR IMPROVEMENTS

32 8400 Landscape Irrigation Systems
32 9200 Turf and Grasses
32 9300 Landscaping

DIVISION 33 -: UTILITIES

33 4114 Landscape Drainage System



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PROFESSIONAL SEALS PAGE

The following Specification Sections have been prepared by or under the direct supervision of the Architect:

Salas O'Brien

DOCUMENTS & SPECIFICATIONS

DIVISION 21 -: FIRE PROTECTION

210100	Fire Protection Operating and Maintenance Manuals
210500	Fire Protection General Provisions
210510	Fire Protection Contract Quality Control
210512	Fire Protection Shop Drawings, Coordination Drawings & Product Data
210513	Electrical Provisions of Fire Protection Work
210514	Fire Protection of Alterations Project Procedures
211000	Fire Sprinkler Systems
213113	Fire Pump System

DIVISION 22 -: PLUMBING

220100	Plumbing Operating and Maintenance Manuals
220500	Plumbing General Provisions
220510	Plumbing Contract Quality Control
220512	Shop Drawings, Coordination Drawings & Product Data
220513	Electrical Provisions of Plumbing Work
220514	Plumbing Alterations Project Procedures
220515	Plumbing Earthwork
220517	Plumbing Access Doors
220519	Pressure and Temperature Instruments
220523	Valves, Strainers and Vents
220533	Pipe Heat Tracing
220719	Plumbing Piping Insulation
220800	Plumbing Commissioning Coordination
221116	Domestic Water Piping and Appurtenances
221123	Domestic Water Pumps
221125	Domestic Water Booster Pump (In-Line Vertical)
221316	Soil, Waste and Sanitary Drain Piping, Vent Piping and Appurtenances
221413	Roof Drainage Piping and Appurtenances
222000	Plumbing Pipe and Pipe Fittings General
223334	Electric Water Heater (Light Commercial Non-ASME)
224000	Plumbing Fixtures and Fixture Carriers
226311	Gas Piping and Appurtenances

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DIVISION 23 -: MECHANICAL

230100	HVAC Operating and Maintenance Manuals
230500	Mechanical General Provisions
230510	HVAC Contract Quality Control
230511	Mechanical Alterations Project Procedures
230512	Shop Drawings, Coordination Drawings and Product Data
230513	Electrical Provisions of HVAC Work
230514	HVAC Condensate Drain Piping System
230517	Mechanical Access Doors
230548	Vibration Isolation
230593	Testing, Balancing and Adjusting (TAB) of Environmental Systems
230594	Coordination of Testing and Balancing
230713	External Duct Insulation
230719	HVAC Piping Insulation
230800	Mechanical Commissioning Coordination
230933	Building Management and Control System
232000	Mechanical Pipe and Pipe Fittings – General
232300	Refrigerant Piping and Appurtenances
233113	Ductwork
233416	Fans
233713	Air Devices
234100	Air Filtration
234300	Air Purification System
238121	Single Package Rooftop Air Conditioners (w/gas-fired heat)
238218	Ductless Mini Split DX Units
238239	Electric Unit Heaters

DIVISION 26 -: ELECTRICAL

260100	Commissioning of Electrical Systems
260105	Operating and Maintenance Manuals
260500	Electrical General Provisions
260505	Electrical Alterations Project Procedures
260510	Contract Quality Control
260512	Electrical Shop Drawings, Coordination Drawings and Product Data
260519	Conductors and Connectors
260526	Electrical Grounding
260527	Expansion of Existing Electrical Grounding System
260533	Conduit Systems
260535	Electrical Connections for Equipment
260537	Electrical Boxes and Fittings
260540	Electrical Gutters and Wireways
260550	Firestops
260573	Arc Flash Hazard Analysis / Short-Circuit / Coordination Study
260925	Electrical Contactors
260944	Lighting Controls – Stand Alone Operation
261215	Dry Type Transformers
262315	Three Phase Centralized Emergency Lighting Inverter
262416	Panelboards and Enclosures
262417	Fusible Branch Circuit Panelboards
262425	Enclosed Switches and Circuit Breakers
262430	Fuses

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262773	Line Voltage Wiring Devices
264300	Surge Protection Devices
265113	Lighting Fixtures
265600	Site Lighting

DIVISION 27 -: COMMUNICATIONS

270100	Operating and Maintenance (O&M) Manuals of Communication Systems
270500	Communications Basic Materials, Methods and General Provisions
270507	Communications Shop Drawings, Coordination Drawings & Product Data
270509	Contract Quality Control
270510	Firestops
271000	Structured Cabling System
274116.20	Audio and Video Distribution Systems for Special Venues
275000	Expansion of Existing School Communication System

DIVISION 28 -: SAFETY AND SECURITY

280100	Electronic Safety and Security Operating and Maintenance Manuals
280500	Safety and Security Basic Materials, Methods and General Provisions
280507	Shop Drawings, Coordination Drawings & Product Data
280510	Contract Quality Control
280550	Firestops
281000	Access Control System
282000	Video Surveillance System
283100	Intrusion Detection System
284600	Fire Detection and Alarm System



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PROFESSIONAL SEALS PAGE

The following Specification Sections have been prepared by or under the direct supervision of the Architect:

Armko

DOCUMENTS & SPECIFICATIONS

DIVISION 00 -: BID DOCUMENTS

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DIVISION 01 -: GENERAL

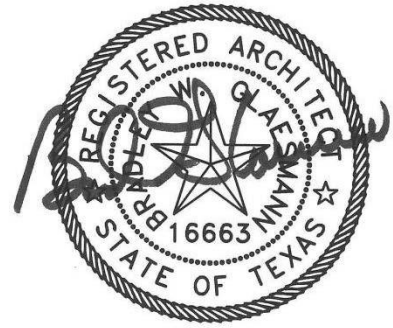
01 39 Mock-Up Construction

DIVISION 04 -: MASONRY

05 23 Through-Wall and Substrate Flashing System

DIVISION 07 -: THERMAL AND MOISTURE PROTECTION

22 16 Roof Board Insulation
51 13 Built-up Asphalt Roofing
62 00 Sheet Metal and Miscellaneous Accessories
72 00 Roof Accessories



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END OF PROFESSIONAL SEALS PAGE

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SECTION 003100
AVAILABLE PROJECT INFORMATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section references other information relevant to the construction of this Project that is available project information.
- B. At the request of the Owner, the information identified below represents services that have been provided by others, not as an Architect's Consultant, regarding conditions that affect this Project that are beyond the responsibilities of the Architect and Architect's Consultants. Reference to such information herein is solely for the convenience of the Owner. Architect makes no representation, express or implied, as to the accuracy or validity of the information.
- C. Bidders are expected to examine the site and the information available from the Owner to determine for themselves the conditions to be encountered.
- D. If conditions other than those indicated in the information available from the Owner are encountered before or during construction, notify the Owner before work continues.

1.2 PROPERTY SURVEY

- A. The Owner's Surveyor has performed a property survey and the some of the survey information is included on the Drawings for the convenience of the Contractor. These Documents and attachments are not part of the Contract Documents prepared by the Architect.
- B. Copies of the documents are available from the Owner.
- C. Copies of the documents are included in the Contract Documents prepared by the Architect for the convenience of the Owner.
- D. The Owner retained the following company:

1.3 GEOTECHNICAL REPORT

- A. The Owner's Geotechnical Consultant has made subsurface borings at the Project site, has performed an investigation of the geotechnical conditions, and has prepared a report of the investigation that contains specific requirements of the Contractor. These Documents and attachments are not part of the Contract Documents prepared by the Architect.
- B. The information was obtained for use in preparing the foundation design but is indicative only of the soil conditions where the borings are taken.
- C. Copies of the documents are available from the Owner.
- D. Copies of the documents are included in the Contract Documents prepared by the Architect for the convenience of the Owner.
- E. The Owner retained the following company:

1.4 INFECTION CONTROL RISK ASSESSMENT REPORT

- A. The Owner's Risk Assessment Consultant has assessed the environmental impact of the work on the existing, adjacent healthcare functions, and has prepared an Infection Control Risk Assessment (ICRA) report that includes specific requirements of the Contractor. These Documents and attachments are not part of the Contract Documents prepared by the Architect.

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- B. The ICRA establishes strategic infection control provisions and requirements for the purpose of controlling the dissemination of airborne micro-organism contaminants encountered or generated during the construction process through the use of containment protocols and environmental monitoring.
- C. Copies of the documents are available from the Owner.
- D. Copies of the documents are included in the Contract Documents prepared by the Architect for the convenience of the Owner.
- E. The Owner retained the following company:

1.5 EXISTING CONDITIONS REPORT

- A. The following existing conditions that will affect or influence the construction of this Project include the following:

1.6 CIVIL CONSTRUCTION DOCUMENTS

- A. The Owner's Civil Engineering Consultant has developed civil designs for the Owner's property and has prepared construction documents. These Documents and attachments are not part of the Contract Documents prepared by the Architect.
- B. Copies of the documents are available from the Owner.
- C. Copies of the documents are included in the Contract Documents prepared by the Architect for the convenience of the Owner.
- D. The Owner retained the following company:

1.7 LANDSCAPING CONSTRUCTION DOCUMENTS

- A. The Owner's Landscape Architect Consultant has developed landscaping designs for the Owner's property and has prepared construction documents. These Documents and attachments are not part of the Contract Documents prepared by the Architect.
- B. Copies of the documents are available from the Owner.
- C. Copies of the documents are included in the Contract Documents prepared by the Architect for the convenience of the Owner.
- D. The Owner retained the following company:

1.8 MEDICAL EQUIPMENT DOCUMENTS

- A. The Owner's Medical Equipment Planning Consultant has developed medical equipment documents for the Owner's facility and has prepared construction documents. These Documents and attachments are not part of the Contract Documents prepared by the Architect.
- B. Copies of the documents are available from the Owner.
- C. Copies of the documents are included in the Contract Documents prepared by the Architect for the convenience of the Owner.
- D. The Owner retained the following company:

1.9 DEMOLITION CONTRACT DOCUMENTS

- A. The Owner's Demolition Consultant has determined demolition provisions for the Owner's existing property and has prepared documents indicating demolition requirements. These Documents and attachments are not part of the Contract Documents prepared by the Architect.

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- B. Copies of the documents are available from the Owner.
- C. Copies of the documents are included in the Contract Documents prepared by the Architect for the convenience of the Owner.
- D. The Owner retained the following company:

1.10 WIND TUNNEL TEST REPORT

- A. The Owner's Wind Investigation Consultant has conducted wind tunnel testing of the building design and has prepared a report. These Documents and attachments are not part of the Contract Documents prepared by the Architect.
- B. Copies of the documents are available from the Owner.
- C. Copies of the documents are included in the Contract Documents prepared by the Architect for the convenience of the Owner.
- D. The Owner retained the following company:

1.11 AVIATION AIRSPACE REQUIREMENTS

- A. The Federal Aviation Agency has assessed the impact of the Work on the existing, adjacent facilities and areas, and has prepared a report that includes specific requirements of the Contractor. These Documents and attachments are not part of the Contract Documents prepared by the Architect.
 - 1. Report No.
- B. Copies of the documents are available from the Owner.
- C. Copies of the documents are included in the Contract Documents prepared by the Architect for the convenience of the Owner.

1.12 RADIATION PROTECTION REPORT

- A. The Owner's Radiation Protection Consultant has determined the radiation protection that is required, and has prepared a report that contains specific requirements of the Contractor. These Documents and attachments are not part of the Contract Documents prepared by the Architect.
- B. Copies of the documents are available from the Owner.
- C. Copies of the documents are included in the Contract Documents prepared by the Architect for the convenience of the Owner.
- D. The Owner retained the following company:

1.13 ENVIRONMENTAL STUDY AND ASSESSMENT REPORT

- A. The Owner's Environmental Consultant has assessed the impact on the surrounding environment, and has prepared a report that contains specific requirements of the Contractor. These Documents and attachments are not part of the Contract Documents prepared by the Architect.
- B. Copies of the documents are available from the Owner.
- C. Copies of the documents are included in the Contract Documents prepared by the Architect for the convenience of the Owner.
- D. The Owner retained the following company:

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1.14 TAX EXEMPTION STATUS INFORMATION

A. This Project qualifies for exemption from taxes as indicated in the letter following this Section.

1. Letter from , dated .

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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SECTION 005200

AGREEMENT FORM

PART 1 - GENERAL

1.1 GENERAL

- A. The Form of Agreement Between Owner and Contractor where the basis for payment is a STIPULATED SUM will be the form used as a Contract for this Project.
- B. The Form of Agreement Between Owner and Contractor where the basis for payment is the COST OF THE WORK PLUS A FEE with a negotiated Guaranteed Maximum Price will be the form used as a Contract for this Project.
- C. A copy of the Document is available from the Owner.
- D. A copy of the Document is included in this Project Manual.

PART 2 - (NOT USED)

PART 3 - (NOT USED)

END OF SECTION

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SECTION 007200
GENERAL CONDITIONS

PART 1 - GENERAL

1.1 GENERAL

- A. The General Conditions of this Contract are available from the Owner, hereinafter referred to as the "General Conditions."
- B. The General Conditions of this Contract are are referenced in the Owner-Contractor Agreement, hereinafter referred to as the "General Conditions."
- C. The General Conditions shall apply to each, and every Section of the Work as though written in full therein and are part of the Contract Documents.
- D. A copy of the General Conditions is included in this Project Manual. The General Conditions shall apply to each, and every Section of the Work as though written in full therein and are part of the Contract Documents.

PART 2 - (NOT USED)

PART 3 - (NOT USED)

END OF SECTION

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SECTION 007300
SUPPLEMENTARY CONDITIONS

PART 1 - GENERAL

1.1 GENERAL

- A. The Supplementary Conditions modify, change, delete from or add to the General Conditions and shall apply to each, and every Section of the Work as written in full therein.
- B. The following paragraphs and subparagraphs take precedence over the General Conditions. Where any part of the General Conditions is modified or deleted by the Supplementary Conditions, the unaltered provisions remain in effect.
- C. Correlation and Intent of the Contract Documents:
 - 1. Sections of Division 01 - General Requirements govern the execution of all sections of the specifications.
 - 2. Summary paragraphs placed at the beginning of the Sections present a brief indication of the principal Work included in that Section, but do not limit Work to subject mentioned nor purport to itemize Work that may be included.
 - 3. The Relation of Specifications and Drawings shall be equal authority and priority. Should they disagree in themselves, or with each other, bids shall be based on the most expensive combination of quality and quantity of work indicated. The appropriate Work, in the event of the above mentioned disagreements, shall be determined by the Architect.
 - 4. Should the Drawings disagree themselves, figures shall govern over scaled measurements, large scaled Drawings shall govern over small scale Drawings, the greater quantity of work or materials shall be furnished and performed; the descriptive writings shall govern over legends indicating material or conditions and the Agreement takes precedence over all other Contract Documents.
 - 5. Should there be a conflict in Contract Documents, the Contractor shall proceed in the more expensive manner unless determined otherwise by the Architect.
 - 6. Instructions, directions and requirements as specified shall be considered to be followed by the phrase "unless otherwise specified or indicated".

1.2 INTERPRETATION

- A. In the interest of brevity the Contract Documents frequently omit modifying words such as "all" and "any" and articles such as "the" and "an," but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

1.3 INFORMATIONAL SUBMITTALS

- A. Informational Submittals: Informational submittals may be identified as such in the Contract Documents.

1.4 PROFESSIONAL CERTIFICATION

- A. When professional certification of performance criteria of materials, systems or equipment is required by the Contract Documents, the Architect shall be entitled to rely upon the accuracy and completeness of such calculations and certifications.

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PART 2 - (NOT USED)

PART 3 - (NOT USED)

END OF SECTION

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SECTION 011000

SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Project information.
2. Phased construction.
3. Work by Owner.
4. Work under separate contracts.
5. Future work.
6. Purchase contracts.
7. Owner-furnished, Owner-installed (OFOI) products.
8. Owner-furnished, Contractor-installed (OFCI) products.
9. Worker conduct and appearance - work rules.
10. Healthcare facility renovation work.
11. Access to site.
12. Coordination with occupants.
13. Work restrictions.
14. Specification and drawing conventions.
15. Miscellaneous provisions.

1.2 PROJECT INFORMATION

Project Identification: ARLINGTON ISD WIMBISH ELEMENTARY SCHOOL

1. Project Location: Arlington, Texas
- B. Owner: Arlington Independent School District
1. Owner's Representative: <Insert name and contact information for Owner's representative>.
- C. Architect: HKS Inc,
- D. Architect's Consultants: The Architect has retained the following design professionals who have prepared designated portions of the Contract Documents:
1. <Insert title of design discipline>: <Insert name and contact information for consultant>.
- E. Other Owner Consultants: The Owner has retained the following design professionals who have prepared designated portions of the Contract Documents:
1. <Insert title of design discipline>: <Insert name and contact information for consultant>.
<Insert title of design discipline> has prepared the following portions of the Contract Documents:
 - a. <Insert description of scope of service for other Owner consultant>.
- F. Contractor: <Insert name and contact information for Contractor> has been engaged as Contractor for this Project.
- G. Construction Manager: <Insert name and contact information for Construction Manager>.
1. Construction Manager has been engaged for this Project to serve as an advisor to Owner and to provide assistance in administering the Contract for Construction between Owner

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and Contractor, according to a separate contract between Owner and Construction Manager.

2. Construction Manager for this Project is Project's constructor. In Divisions 01 through 33 Sections, the terms "Construction Manager" and "Contractor" are synonymous.

H. Design-BUILDER: <Insert name and contact information for Design-BUILDER>.

1. Design-BUILDER has been engaged for this Project to provide architectural and engineering services and to serve as Project's constructor. In Divisions 01 through 33 Sections, the terms "Design-BUILDER" and "Contractor" are synonymous.

I. Project Web Site: A project Web site administered by Architect will be used for purposes of managing communication and documents during the construction stage.

1. See Division 01 Section "Project Management and Coordination" for requirements for establishing, administering, and using the Project Web site.

1.3 PHASED CONSTRUCTION

- A. The Work shall be conducted in multiple phases as indicated on the drawings, with each phase substantially complete and ready for occupancy before commencement of subsequent phases.
- B. Before commencing Work of each phase, submit an updated copy of Contractor's construction schedule showing the sequence, commencement and completion dates, and move-out and -in dates of Owner's personnel for all phases of the Work.

1.4 WORK BY OWNER

- A. General: Cooperate fully with Owner so work may be carried out smoothly, without interfering with or delaying work under this Contract or work by Owner. Coordinate the Work of this Contract with work performed by Owner.
- B. Preceding Work: Owner will perform the following construction operations at Project site. Those operations are scheduled to be substantially complete before work under this Contract begins.
 1. <Insert a brief description of work performed by Owner>.
- C. Concurrent Work: Owner will perform the following construction operations at Project site. Those operations will be conducted simultaneously with work under this Contract.
 1. <Insert a brief description of work performed by Owner>.
- D. Subsequent Work: Owner will perform the following additional work at site after Substantial Completion. Completion of that work will depend on successful completion of preparatory work under this Contract.
 1. <Insert a brief description of work performed by Owner>.

1.5 WORK UNDER SEPARATE CONTRACTS

- A. General: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract or other contracts. Coordinate the Work of this Contract with work performed under separate contracts.
- B. Preceding Work: Owner [has awarded] [will award] separate contract(s) for the following construction operations at Project site. Those operations are scheduled to be substantially complete before work under this Contract begins.
 1. <Insert name of the Contract>: To <Insert name of separate Contractor> [to] [for] <Insert a brief description of work performed under separate contract>.

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- C. Concurrent Work: Owner [has awarded] [will award] [and will assign to Contractor] separate contract(s) for the following construction operations at Project site. Those operations will be conducted simultaneously with work under this Contract.
 - 1. <Insert name of the Contract>: To <Insert name of separate Contractor> [to] [for] <Insert a brief description of work performed under separate contract>.
- D. Subsequent Work: Owner [has awarded] [will award] separate contract(s) for the following additional work to be performed at site following Substantial Completion. Completion of that work will depend on successful completion of preparatory work under this Contract.
 - 1. <Insert name of the Contract>: To <Insert name of separate Contractor> [to] [for] <Insert a brief description of work performed under separate contract>.

1.6 FUTURE WORK

- A. The Contract Documents include requirements that will allow Owner to carry out future work following completion of this Project; provide for the following future work:
 - 1. <Insert description of future work requiring consideration during construction of the Work of this Contract>.

1.7 PURCHASE CONTRACTS

- A. General: Owner has negotiated purchase contracts with suppliers of material and equipment to be incorporated into the Work. Owner will assign these purchase contracts to Contractor. Include costs for purchasing, receiving, handling, storage if required, and installation of material and equipment in the Contract Sum, unless otherwise indicated.
 - 1. Contractor's responsibilities are same as if Contractor had negotiated purchase contracts, including responsibility to renegotiate purchase and to execute final purchasing agreements.
- B. Purchase Contracts Information:
 - 1. <Insert product name>: See Division <Insert MF04 Division number> Section "<Insert MF04 Section name>."
 - a. Purchase Contract Firm and Representative: <Insert name and contact information for purchase contract firm and representative.>
 - b. Purchase Contract Scope: [Furnishing material] [Material and installation labor] <Insert description of contract>.
 - c. Purchase Status: [Price negotiated by Owner, to be incorporated in the Contract Sum by Contractor; see Division 01 Section "Allowances" for cash allowance for purchase contract] [Price negotiated and incorporated in the Contract Sum by Contractor] [Product reserved by Owner] [Order placed and deposit paid by Owner] [Order to be placed by Contractor] <Insert description of status of purchase contract>.
 - d. Quantity: <Insert quantity ordered>.
 - e. Other Requirements: <Insert special requirements>.

1.8 OWNER-FURNISHED, OWNER-INSTALLED (OFOI) PRODUCT

- A. The specific product is not in this contract, and actual installation of the product will be made by the Owner.
- B. Products will be indicated as follows:
 - 1. Product prefixed with "Space for"
 - 2. N.I.C.

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3. Owner Furnished - Owner Installed
 4. Product noted as "Future"
 - C. Roughing-in for Owner Furnished, Owner Installed Product is provided by applicable Sections governing the type of work. Obtain rough-in requirements from Owner.
- 1.9 OWNER-FURNISHED, CONTRACTOR-INSTALLED (OFICI) PRODUCT
- A. Install products indicated as follows:
 1. "Owner Furnished, Contractor Installed".
 2. "Reuse".
 3. "Relocate".
 - B. Provide labor, transportation, materials, tools, appliances and utilities necessary for the following:
 1. Relocated Products:
 - a. Removing installed product from the Owner's existing facility, as required.
 - b. Transportation of product from Owner's facility to the job site.
 2. Receiving and storage of Owner furnished, Contractor installed product, as required.
 3. Providing materials and components for the product as necessary to install in an operating condition, but not including repairing of existing damages to the product.
 4. Modification of product only as specified under the particular item.
 5. Installation of product in this project, complete and in operating condition, including the adjusting and calibration of the product as necessary for proper operation.
 6. Testing of product.
 7. Paying of fees, licenses, and taxes in conjunction with the installation of the product.
 8. Roughing-in and final utility connections for the Owner furnished, Contractor installed product remains the work of Sections governing the specific utility.
- 1.10 WORKER CONDUCT AND APPEARANCE - WORK RULES
- A. General: The conduct and appearance of each worker at the jobsite is of paramount importance. The Owner reserves the right to require any worker to be reassigned to work outside the Owner's property.
 1. Privacy: Where applicable, conduct work of the Contract with the maximum effort to maintain the privacy of the Owner's operations, staff, and clientele. Do not permit workers to peer into other areas of the building visible from the work area. Invasion of privacy is a major infraction of the work rules.
 2. Conduct and Demeanor: Construction workers shall treat other construction workers, Owner's staff, clientele, and visitors (as applicable) professionally with respect and courtesy.
 3. Physical Appearance: Require each worker to dress appropriately in a clean, neat, and professional manner.
 4. Radios and Television: The use of entertainment devices including personal devices with headphones or earphones is prohibited at all times. Control the volume of communication radios and loudspeakers to avoid creating a nuisance.
 5. Tobacco Products: The use of tobacco products is prohibited.
 6. Language: The use of foul language is prohibited.
 7. Loud Conduct: Screaming, yelling, and unnecessary loud conduct is prohibited.
 8. Physical Actions: Running, horseplay, fighting, and other unprofessional conduct is prohibited. Fighting is a major infraction of the work rules.
 9. Stealing: Stealing of any material, objects, furnishings, equipment, fixtures, supplies, clothing, or other items is prohibited and a major infraction.

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10. Sexual Harassment: All forms of physical and verbal sexual harassment including, without limitation: touching; whistling; sexually explicit stories, jokes, drawings, photos, and representations; exhibitionism; and all other sexually oriented offensive behavior is prohibited.
 11. Roaming: Construction personnel shall not be allowed to roam, or wander about, the existing facilities.
 12. Eating: Construction personnel shall not use the existing Dining Area for breakfast, lunch, or dinner.
 13. Parking: Construction personnel shall only park in designated areas reserved for construction parking.
 14. Penalties: First infraction of the work rules shall result in a verbal warning from the Owner. Second infractions shall result in being requested to leave the Owner's property. Owner's decision in such matters shall be final with no exceptions.
- B. Warnings and Dismissal: For minor infraction of the rules, the Owner may issue a warning. Only one warning will be allowed per worker, and a second infraction shall result in immediate dismissal of the worker from the Owner's property. For major infractions such as invasion of privacy, the worker shall be dismissed immediately without warning and possibly subject to criminal prosecution.
- C. Notification of Workers: Clearly notify and educate each worker about these Work Rules and the requirements for worker conduct and appearance.
- 1.11 HEALTHCARE FACILITY RENOVATION WORK
- A. Interim Life Safety Measures (ILSM): The following Interim Life Safety Measures (ILSM) as established by the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) shall be implemented, documented and enforced in and adjacent to all construction areas:
1. Ensure that exits provide free and unobstructed egress. Personnel shall receive training, and the Hospital shall be notified if alternative exits must be designated. Buildings/areas under construction must maintain escape facilities for construction workers at all times. Means of egress in construction areas must be inspected daily.
 2. Ensure free and unobstructed access to emergency department/service and for emergency forces.
 3. Ensure that fire alarm, detection, and suppression systems are not impaired. A temporary, but equivalent, system shall be provided, and the Hospital shall be notified, when any fire system is impaired. Temporary systems must be inspected and tested monthly.
 4. Ensure temporary construction partitions are smoke tight and built of non-combustible or limited combustible materials that will not contribute to the development or spread of fire.
 5. Provide additional fire-fighting equipment and use training for personnel.
 6. Prohibit smoking in or adjacent to all construction areas.
 7. Develop and enforce storage, housekeeping, and debris-removal practices that reduce the flammable and combustible fire load of the building to lowest level necessary for daily operations.
 8. Conduct a minimum of two fire drills per shift per quarter.
 9. Increase hazard surveillance of buildings, grounds, and equipment with special attention to excavations, construction areas, construction storage, and field offices.
 10. Train personnel, and notify the Hospital, when structural or compartmentation features of fire safety are compromised.
 11. Conduct organization wide safety education programs to assure awareness of deficiencies, construction hazards, and these ILSM.

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1.12 ACCESS TO SITE

- A. General: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.
- B. General: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.
- C. Use of Site: Limit use of Project site to work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
 - 1. Confine constructions operations to work in areas indicated on drawings.
 - 2. Allow for Owner occupancy of site and use by the public.
 - 3. Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times.
 - 4. Do not use drives and entrances for parking or storage of materials.
 - 5. Schedule deliveries to minimize use of driveways and entrances.
 - 6. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
 - 7. Coordinate use of premises under direction of Owner.
 - 8. Assume full responsibility for the protection and safekeeping of Products under this Contract, stored on the site.
 - 9. Move any stored Products, under Contractor's control, which interfere with operations of the Owner or separate contractor.
 - 10. Obtain and pay for the use of additional storage or work areas needed for operations.
- D. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.

1.13 COORDINATION WITH OCCUPANTS

- A. Full Owner Occupancy: Owner will occupy site and existing and/or adjacent building(s), as applicable, during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits unless otherwise indicated.
 - 1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.
 - 2. Notify Owner not less than 72 hours in advance of activities that will affect Owner's operations.
- B. Partial Owner Occupancy: Owner will occupy the premises during entire construction period, with the exception of areas under construction. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations. Maintain existing exits unless otherwise indicated.
 - 1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.
 - 2. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.

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- C. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.
1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied prior to Owner acceptance of the completed Work.
 2. Obtain a Certificate of Occupancy from authorities having jurisdiction before limited Owner occupancy.
 3. Before limited Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of Work.
 4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of Work.

1.14 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Limit work in the existing building to normal business working hours of <Insert time> a.m. to <Insert time> p.m., Monday through Friday, unless otherwise indicated.
1. Weekend Hours: <Insert restrictions on times permitted for weekend work>.
 2. Early Morning Hours: <Insert restrictions or references to regulations by authorities having jurisdiction for restrictions on noisy work>.
 3. Hours for Utility Shutdowns: <Insert Owner's restrictions>.
 4. Hours for [Core Drilling] <Insert noisy activity>: <Insert Owner's restrictions>.
- C. On-Site Work Hours: Coordinate the limitations relative to working hours in the existing building with Owner.
- D. Existing Utility Interruptions: Refer to Division 01 Section "Execution" for requirements.
- E. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.
1. Notify Owner not less than 72 hours in advance of proposed disruptive operations.
 2. Obtain Owner's written permission before proceeding with disruptive operations.

1.15 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
1. Abbreviated Language: Language used in Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be interpolated as the sense requires. Singular words will be interpreted as plural and plural words interpreted as singular where applicable as the context of the Contract Documents indicates.
 2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by the Contractor. At certain locations in the Text, subjective language is used for clarity to describe

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responsibilities that must be fulfilled indirectly by the Contractor, or by others when so noted.

3. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:

1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings.

1.16 MISCELLANEOUS PROVISIONS

A. <Insert miscellaneous provisions>.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 012100

ALLOWANCES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements governing allowances.
 - 1. Certain items are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order.
- B. Types of allowances include the following:
 - 1. Lump-sum and unit-cost allowances.
 - 2. Contingency allowances.
 - 3. Testing and inspecting allowances.

1.2 SELECTION AND PURCHASE

- A. At the earliest practical date after award of the Contract, advise Architect of the date when final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.
- B. At Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.
- C. Purchase products and systems selected by Architect from the designated supplier.

1.3 SUBMITTALS

- A. Proposals: Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.
- B. Material Invoices: Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.
- C. Labor Documentation: Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.
- D. Coordination: Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.4 COORDINATION

- A. Coordinate allowance items with other portions of the Work. Furnish templates as required to coordinate installation.

1.5 LUMP-SUM AND UNIT-COST ALLOWANCES

- A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes, freight, and delivery to Project site.
- B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by

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Owner or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.

- C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.

1. If requested by Architect, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

1.6 CONTINGENCY ALLOWANCES

- A. Use the contingency allowance only as directed by Architect for Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance.
- B. Contractor's overhead, profit, and related costs for products and equipment ordered by Owner under the contingency allowance are included in the allowance and are not part of the Contract Sum. These costs include delivery, installation, taxes, insurance, equipment rental, and similar costs.
- C. Change Orders authorizing use of funds from the contingency allowance will include Contractor's related costs and reasonable overhead and profit margins.
- D. At Project closeout, credit unused amounts remaining in the contingency allowance to Owner by Change Order.

1.7 TESTING AND INSPECTING ALLOWANCES

- A. Testing and inspecting allowances include the cost of engaging testing agencies, actual tests and inspections, and reporting results.
- B. The allowance does not include incidental labor required to assist the testing agency or costs for retesting if previous tests and inspections result in failure. The cost for incidental labor to assist the testing agency shall be included in the Contract Sum.
- C. Costs of services not required by the Contract Documents are not included in the allowance.
- D. At Project closeout, credit unused amounts remaining in the testing and inspecting allowance to Owner by Change Order.

1.8 ADJUSTMENT OF ALLOWANCES

- A. Allowance Adjustment: To adjust allowance amounts, prepare a Change Order proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.
 1. Include installation costs in purchase amount only where indicated as part of the allowance.
 2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.
 3. Submit substantiation of a change in scope of work, if any, claimed in Change Orders related to unit-cost allowances.
 4. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.
- B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.

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1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of work has changed from what could have been foreseen from information in the Contract Documents.
2. No change to Contractor's indirect expense is permitted for selection of higher- or lower-priced materials or systems of the same scope and nature as originally indicated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

- A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES

- A. Schedule of Allowances to be determined.
- B. Face Brick: Allow the unit cost of \$XXX per 1,000 for purchase and delivery of Face Brick.
- C. Door Hardware: Allow the lump sum of \$XXX for purchase and delivery of Door Hardware.
- D. Wall Covering: Allow the unit cost of \$XXX per sq. yd. for purchase and delivery of Wall Covering.
- E. Carpeting: Allow the unit cost of \$XXX per sq. yd. for purchase and delivery of Carpeting.
- F. Elevator Car Enclosures: Allow the unit cost of \$XXX per car for purchase and delivery of Elevator Car Enclosures.
- G. Graphics: Allow the lump sum of \$XXX for purchase, delivery, and installation of Graphics.
- H. Landscaping: Allow the lump sum of \$XXX for purchase, delivery, and installation of Landscaping.
- I. Trowelable Polymer-Modified Cementitious Underlayment: Refer to Division 09 Section "Floor Preparation for Renovation Work" for allowance description and price.
- J. Self-Leveling Cementitious Underlayment: Refer to Division 09 Section "Floor Preparation for Renovation Work" for allowance description and price.
- K. Moisture Floor Treatment: Refer to Division 09 Section "Floor Preparation for Renovation Work" for allowance description and price.

END OF SECTION

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SECTION 012200

UNIT PRICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for unit prices.

1.2 DEFINITIONS

- A. Unit price is an amount incorporated in the Agreement, applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

1.3 PROCEDURES

- A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.
- B. Measurement and Payment: See individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.
- C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.
- D. List of Unit Prices: A schedule of unit prices is included in Part 3. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

- A. Schedule of Unit Prices to be determined.
- B. Item No. 1 - Rock Excavation:
1. Description: Rock excavation in accordance with Division 31 Section Earthwork.
 2. Unit of Measurement: Cubic yard of rock excavated.
- C. Item No. 2 - Drilled Piers, 36 in (900 mm), 30 in (750 mm), 24 in (600 mm), and 18 in (450 mm) diameters:
1. Description: Change in length of drilled piers from lengths indicated in accordance with Division 31 Section Drilled Piers, includes drilling and placing concrete and reinforcement (add for additional length for each diameter; deduct for reduced length for each diameter - not less than 65% of add cost).
 2. Unit of Measurement: Linear foot of pier, for each pier diameter.
- D. Item No. 3 - Cased Piers, 36 in (900 mm), 30 in (750 mm), 24 in (600 mm), and 18 in (450 mm) diameters:

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1. Description: Change in length of cased piers from lengths indicated in accordance with Division 31 Section Drilled Piers, includes drilling and placing concrete and reinforcement (add for each pier diameter; deduct for reduction of base bid casing for each pier diameter - not less than 65% of add cost).
 2. Unit of Measurement: Linear foot of cased pier, for each pier diameter.
- E. Item No. 4 - Prestressed Precast Concrete Piles:
1. Description: Change in length of pile from lengths indicated in accordance with Division 31 Section Prestressed Precast Concrete Piles.
 2. Unit of Measurement: Linear foot of pile driven.
- F. Item No. 5 - Reinforcing Steel:
1. Description: Adding additional reinforcing steel from amount indicated in accordance with Division 3 Section Reinforcing Steel, includes furnishing, fabricating, and installing.
 2. Unit of Measurement: Ton of reinforcing steel installed.
- G. Item No. 6 - Structural Steel Framing:
1. Description: Adding additional structural steel from amount indicated in accordance with Division 5 Section Structural Steel Framing, includes furnishing, fabricating, and installing.
 2. Unit of Measurement: Ton of structural steel installed.
- H. Item No. 7 - Carpet:
1. Description: Wool carpet type 1 including urethane foam carpet cushion and tackless strip in accordance with Division 9 Section Sheet Carpeting.
 2. Unit of Measurement: Square yard of carpet installed.
- I. Item No. 8 - Fire Alarm Devices:
1. Description: Fire alarm system devices as follows, including outlet boxes, wiring, connectors, and coverplates:
 - a. Fire alarm smoke detectors
 - b. Fire alarm audio / visual devices
 - c. Fire alarm visual only devices
 - d. Fire alarm pull stations
 2. Unit of Measurement: Each device installed.
- J. Item No. 9 - Electrical Devices:
1. Description: Electrical system devices as follows, including outlet boxes, wiring, connectors, and coverplates:
 - a. Duplex receptacles
 - b. Quad receptacles
 - c. Exit lights
 - d. Telephone / data devices
 2. Unit of Measurement: Each device installed.
- K. Item No. 10 - Electrical Outlets:
1. Description: Galvanized steel outlet boxes, including general duty type, 125-volt, duplex receptacles, connectors and satin finish stainless steel wallplates.
 2. Unit of Measurement: Each outlet installed.

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- L. Item No. 11 - Trowelable Polymer-Modified Cementitious Underlayment:
 - 1. Description: Refer to Division 09 Section "Floor Preparation for Renovation Work" Unit Price.
- M. Item No. 12 - Self-Leveling Cementitious Underlayment:
 - 1. Description: Refer to Division 09 Section "Floor Preparation for Renovation Work" Unit Price.
- N. Item No. 13 - Moisture Floor Treatment:
 - 1. Description: Refer to Division 09 Section "Floor Preparation for Renovation Work" Unit Price.

END OF SECTION

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SECTION 012300

ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for alternates.

1.2 DEFINITIONS

- A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
 2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.3 PROCEDURES

- A. Documentation: Show compliance with requirements for accepted alternates and the following, as applicable:
1. Coordination information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate accepted alternates.
 2. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 3. Samples, where applicable or requested.
 4. Certificates and qualification data, where applicable or requested.
 5. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 6. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
 7. Detailed comparison of Contractor's construction schedule using accepted alternates with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
 8. Cost information, including change in the Contract Sum.
- B. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.
- C. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated revisions to alternates.

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- D. Execute accepted alternates under the same conditions as other work of the Contract.
- E. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.
- F. Acceptance of Alternates will be exercised at option of Owner in any order or combination.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

- A. Schedule of Alternates to be determined.
- B. ALTERNATE NO. 1: <Title of Alternate>
 - 1. Refer to Division <DIVISION NUMBER> Section "<NAME OF SECTION>"
 - 2. [Add] [Delete] [Change] [Description of Alternate].
- C. ALTERNATE NO. 2: <Title of Alternate>
 - 1. Refer to Division <DIVISION NUMBER> Section "<NAME OF SECTION>"
 - 2. [Add] [Delete] [Change] [Description of Alternate].
- D. ALTERNATE NO. 3: <Title of Alternate>
 - 1. Refer to Division <DIVISION NUMBER> Section "<NAME OF SECTION>"
 - 2. [Add] [Delete] [Change] [Description of Alternate].
- E. ALTERNATE NO. 4: <Title of Alternate>
 - 1. Refer to Division <DIVISION NUMBER> Section "<NAME OF SECTION>"
 - 2. [Add] [Delete] [Change] [Description of Alternate].

END OF SECTION

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SECTION 012500
SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.

1.2 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.3 SUBMITTALS

- A. Substitution Requests: Submit electronic copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
1. Substitution Request Form: Submit electronic file using Architect's Substitution Request Form.
 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
 - b. Coordination information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. Certificates and qualification data, where applicable or requested.
 - g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
 - h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 - i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
 - j. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided

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within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.

- k. Cost information, including a proposal of change, if any, in the Contract Sum.
 - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
 - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. Architect's Action: If necessary, with reasonable promptness, Architect will request additional information or documentation for evaluation. Architect will notify Contractor of acceptance or rejection of proposed substitution with reasonable promptness. Acceptance of proposed substitution does not constitute approval or inclusion in Contract Documents. Pay applications certification, change orders, and certificate of substantial completion will contain such qualification.

1.4 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.5 PROCEDURES

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

- A. Prior to starting Substitution Process, review proposed recommendations with Architect.
- B. Contractor's submittal and Architect's acceptance of Shop Drawings, Product Data or Samples for construction activities not complying with Contract Documents does not constitute acceptable or valid request for substitution, nor does it constitute approval.
- C. Contractor Representations: By making substitution request, Contractor:
 - 1. Recognizes burden of proof of equality for requested substitution rests with Contractor.
 - 2. Represents and warrants that Contractor has personally investigated requested substitution and determined that it is equal to or superior in all respects to specified Work.
 - 3. Represents and warrants that Contractor will provide same warranties for requested substitution that Contractor would for specified Work.
 - 4. Certifies that cost data presented is complete and includes all related costs under this Contract except for Architect's redesign cost, and waives all claims for additional costs related to requested substitution which may subsequently become apparent.
 - 5. Will coordinate installation of accepted substitution, making such other changes as may be required to make Work complete in all respects.
 - 6. Represents and warrants that accepted substitution will perform same as specified Work would have performed. Should accepted substitution fail to perform as required, Contractor shall replace accepted substitution with specified Work at no additional cost to Owner.

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- D. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change.
1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
- a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - b. Requested substitution provides sustainable design characteristics that specified product provided.
 - c. Substitution request is fully documented and properly submitted.
 - d. Requested substitution will not adversely affect Contractor's construction schedule.
 - e. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - f. Requested substitution is compatible with other portions of the Work.
 - g. Requested substitution has been coordinated with other portions of the Work.
 - h. Requested substitution provides specified warranty.
- E. Substitutions for Convenience:
1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
- a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 - b. Requested substitution does not require extensive revisions to the Contract Documents.
 - c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - d. Requested substitution provides sustainable design characteristics that specified product provided.
 - e. Substitution request is fully documented and properly submitted.
 - f. Requested substitution will not adversely affect Contractor's construction schedule.
 - g. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - h. Requested substitution is compatible with other portions of the Work.
 - i. Requested substitution has been coordinated with other portions of the Work.
 - j. Requested substitution provides specified warranty.

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 012600
CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

1.2 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, using Architect's Supplemental Instructions Form.

1.3 PROPOSAL REQUESTS

- A. Owner-Initiated Proposed Change: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time using Architect Proposed Change Form. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Proposed Changes issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within time specified in Proposed Change or with reasonable promptness, when not otherwise specified, after receipt of Proposed Change, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.
 - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - e. Include updated Submittal Schedule showing effect of the change.
- B. Contractor-Initiated Proposed Change: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect using Contractor's Standard Form.
 - 1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
 - 2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - 4. Include costs of labor and supervision directly attributable to the change.
 - 5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times,

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and activity relationship. Use available total float before requesting an extension of the Contract Time.

6. Include updated Submittal Schedule showing effect of the change.
7. Comply with requirements in Division 01 Section "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.

1.4 ADMINISTRATIVE CHANGE ORDERS

- A. Allowance Adjustment: If applicable, see Division 01 Section "Allowances" for administrative procedures for preparation of Proposed Change for adjusting the Contract Sum to reflect actual costs of allowances.
- B. Unit-Price Adjustment: If applicable, see Division 01 Section "Unit Prices" for administrative procedures for preparation of Proposed Change for adjusting the Contract Sum to reflect measured scope of unit-price work.
- C. Alternates: If applicable, see Division 01 Section "Alternates" for administrative procedures for preparation of Proposed Change for adjusting the Contract Sum to reflect measured scope of alternate work.

1.5 CHANGE ORDER PROCEDURES

- A. Upon Owner's approval of a Proposed Change, Architect will issue a Change Order for signatures of Owner and Contractor using Architect's Change Order Form.

1.6 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive using Architect's Construction Change Directive Form. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 012900
PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

1.2 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
1. Coordinate line items in the schedule of values with other required administrative forms and schedules, including the following:
 - a. Application for Payment forms with continuation sheets.
 - b. Submittal schedule.
 - c. Accepted Alternates.
 2. Submit the schedule of values to Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
 3. Subschedules for Phased Work: Where the Work is separated into phases requiring separately phased payments; provide subschedules showing values coordinated with each phase of payment.
 4. Subschedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work; provide subschedules showing values coordinated with each element.
 5. Subschedules for Separate Design Contracts: Where the Owner has retained design professionals under separate contracts who will each provide certification of payment requests, provide subschedules showing values coordinated with the scope of each design services contract.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Name of Architect.
 - c. Architect's project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
 2. Arrange the schedule of values in tabular form, in format accepted by Architect, with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or Division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders.
 - g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.

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- 1) Labor.
 - 2) Materials.
 - 3) Equipment.
3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts, where appropriate.
 4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
 5. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance or bonded warehousing.
 6. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
 7. Allowances (If Applicable): Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances (if applicable), as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
 8. Alternates (If Applicable): Provide a separate line item in the schedule of values for each accepted alternate.
 9. Change Orders: Provide a separate line item in the schedule of values for each change order.
 10. Separate Owner-Consultant Contracts: Provide a separate line item in the schedule of values for each separate Owner-Consultant related Work item.
 11. Purchase Contracts: When applicable, provide a separate line item in the schedule of values for each purchase contract. Show line-item value of purchase contract. Indicate owner payments or deposits, if any, and balance to be paid by Contractor.
 12. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
 - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.
 13. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.
- 1.3 ARCHITECTS COST DATA
- A. In addition to the Schedule of Values, submit itemized cost data reporting using Architect's Project Cost Summary Form. Initial submission shall be included with contractors first Application for Payment. Final updated submission shall be included with contractors final Application for Payment.
- 1.4 APPLICATIONS FOR PAYMENT
- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
 1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

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- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
1. If the Agreement does not state payment dates, establish dates at preconstruction conference.
 2. Submit draft, or pencil, copy of Application for Payment seven days prior to due date for review by Architect.
- C. Application for Payment Forms: Unless directed otherwise by Owner, use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 2. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
- E. Stored Materials: If accepted by Owner, include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
 3. Provide summary documentation for stored materials indicating the following:
 - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
 - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
 - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- F. Transmittal: Submit 3 signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's liens from General Contractor, subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.
1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 2. When an application shows completion of an item, submit conditional final or full waivers.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 4. Waiver Delays: Submit each Application for Payment with Contractor's waiver of mechanic's lien for construction period covered by the application.

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- a. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
- 5. Waiver Forms: Submit executed waivers of lien on forms, acceptable to Owner.
- H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
 - 1. List of subcontractors.
 - 2. Schedule of values.
 - 3. Contractor's construction schedule (preliminary if not final).
 - 4. Products list (preliminary if not final).
 - 5. Schedule of unit prices.
 - 6. Submittal schedule (preliminary if not final).
 - 7. List of Contractor's staff assignments.
 - 8. List of Contractor's principal consultants.
 - 9. Copies of building permits.
 - 10. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 - 11. Initial progress report.
 - 12. Report of preconstruction conference.
 - 13. Certificates of insurance and insurance policies.
 - 14. Performance and payment bonds.
- I. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
 - 1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 - 2. When applicable, this application shall reflect Certificate(s) of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- J. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
 - 1. Evidence of completion of Project closeout requirements.
 - 2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 - 3. Updated final statement, accounting for final changes to the Contract Sum.
 - 4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
 - 5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
 - 6. AIA Document G707, "Consent of Surety to Final Payment."
 - 7. Evidence that claims have been settled.
 - 8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
 - 9. If applicable, final liquidated damages settlement statement.

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PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 013100
PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. Coordination drawings.
 - 3. Requests for Information (RFIs).
 - 4. Project Web site.
 - 5. Project meetings.

1.2 DEFINITIONS

- A. Project communications documents shall be defined as the following:
 - 1. Letters.
 - 2. Memoranda.
 - 3. E-Mail Communications/Internet Communications/Project Management Software Communications.
 - 4. RFI (Request for Information - Contractor).
 - 5. RFI-A (Request for Information - Architect).

1.3 FORMAT

- A. Letters and Memoranda: Submit in formats acceptable to the Architect.
- B. E-Mail Communications/Internet Communications/Project Management Software Communications: Submit in forms and formats acceptable to and as approved by the Architect.
- C. RFI (Request for Information - Contractor): Submit using Architect's Request for Information Form, or on other forms approved by the Architect.
- D. RFI-A (Request for Information - Architect): Architect will submit to Contractor using Architect's standard form.

1.4 PROJECT COMMUNICATIONS DOCUMENTS

- A. Letters and Memoranda documents shall be submitted in a timely manner so as to facilitate project delivery and coordination. Routing of communications shall be as established in the Contract, the Contract Documents and the Pre-Construction Conference. Communications documents shall be transmitted or forwarded in a manner consistent with the schedule and progress of the work.
- B. E-Mail Communications, Internet Communications, and Project Management Software programs must be compatible with the Architect's and Owner's computer systems and equipment. The responsibility for all costs for management of these systems, including, but not limited to, licensing, onsite training or other training necessary for the proper operation of such systems, shall be by the Contractor. The Contractor shall keep written records and hard file copies of all electronic communications. Failure of the Contractor to keep such records shall waive the Contractor's right to rely on such communications and such communications shall be deemed to have not taken place.

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- C. RFI (Request for Information - Contractor) shall be defined and limited to a request from the Contractor seeking interpretation or clarification of the requirements of the Contract Documents. Such requests shall comply with the following requirements:
1. RFI requests shall be submitted in a timely manner, well in advance of related work, and allow sufficient time for the resolution of issues relating to the request for interpretation or clarification. Contractor shall schedule the submission of RFI's so as to moderate and manage the flow of RFI requests. RFI's shall be submitted in a manner consistent with the schedule and progress of the work, and shall not be submitted in a sporadic and/or excessive manner.
 2. RFI requests shall be numbered in a sequential manner and contain a detailed description of the areas of work requiring interpretation or clarification. Include drawing and specification references, sketches, technical data, brochures, or other supporting data as deemed necessary by the Architect, for the Architect to provide the interpretations and clarifications requested.
 - a. The Contractor shall include a "Proposed Solution" to the issue requiring interpretation or clarification.
 3. RFI's submitted to the Contractor by Sub-Contractors, vendors, suppliers, or other parties to the work shall be reviewed by the Contractor prior to submission to the Architect. If the Architect deems that such RFI requests have not been adequately reviewed by the Contractor, such requests will be returned to the Contractor for further action. Sub-Contractor's RFI shall contain a "Proposed Solution".
 4. RFI requests shall not contain submittals, substitutions requests, routine communications, correspondence, memos, claims, or any information required by other areas of the Contract Documents. RFI requests containing such information will be returned to the Contractor without action by the Architect.
 5. RFI requests are limited to a request for interpretation or clarification of the requirements of the Contract Documents. Interpretations provided by the Architect shall not change the requirements of the Contract or the Contract Documents. If the Contractor determines that the Architect's response to an RFI gives cause for a change in the Contract or the Contract Documents, the Contractor shall promptly, within 5 working days, give written notice to the Architect of request for adjustments. Requests for adjustments to the Contract shall be submitted in a manner consistent with the terms and conditions of the Contract Documents.
 6. If the Architect, after review, determines that any RFI has been submitted in an incomplete manner, is unnecessary, or does not otherwise comply with the requirements of this Section, the RFI will be returned without action to the Contractor. The Contractor shall delete the original submittal date from the RFI log and enter a new submittal date at the time of re-submittal.
 7. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Use software log that is part of Project Web site. Software log with not less than the following:
 - a. Project name.
 - b. Name and address of Contractor.
 - c. Name and address of Architect.
 - d. RFI number including RFIs that were returned without action or withdrawn.
 - e. RFI description.
 - f. Date the RFI was submitted.
 - g. Date Architect's response was received.

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8. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.
 - a. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.

D. RFI-A (Request for Information - Architect) shall be defined as a request by the Architect for information relating to the obligations of the Contractor under the Contract.

1. After receipt of an RFI-A the Contractor shall provide a written response to the Architect within 5 working days. Responses shall be thorough, complete and shall contain all information requested by the Architect.
2. An RFI-A shall be limited to a request by the Architect for information related to the project. The RFI-A shall not be construed as authorizing or directing a change in the Contract or the Contract Documents.

E. Revisions to Construction Documents: Responses to requests for information (RFI) shall not serve as construction documents; and the Contractor shall not incorporate RFI responses into construction of the Project, unless such answers bear the seal and signature of a licensed design professional.

1.5 INFORMATIONAL SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, and telephone number of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.

B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1. Post copies of list in project meeting room, in temporary field office, and Project Web site. Keep list current at all times.

1.6 GENERAL COORDINATION PROCEDURES

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

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- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
 - 1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
 - 1. Preparation of Contractor's construction schedule.
 - 2. Preparation of the schedule of values.
 - 3. Installation and removal of temporary facilities and controls.
 - 4. Delivery and processing of submittals.
 - 5. Progress meetings.
 - 6. Preinstallation conferences.
 - 7. Project closeout activities.
 - 8. Startup and adjustment of systems.
- D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.

1.7 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
 - 1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
 - b. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - c. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 - d. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
 - e. Indicate required installation sequences.
 - f. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
 - 1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.

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2. File Submittal Format: Submit or post coordination drawing files using Portable Data File (PDF) format.
3. BIM File Incorporation: When applicable, develop coordination drawing files from Building Information Model (BIM) established for Project.
 - a. Perform three-dimensional component conflict analysis as part of preparation of coordination drawings. Resolve component conflicts prior to submittal. Indicate where conflict resolution requires modification of design requirements by Architect.
4. If approved by Owner, Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
 - a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
 - b. Digital Data Software Program: Drawings are available in Autodesk Revit and/or Autocad; and compatible with Microsoft Windows operating system.
 - c. Distribution: Digital data files shall be distributed via the Architect's file transfer site with acceptance of Architect's data licensing agreement.

1.8 PROJECT WEB SITE

- A. Use Architect's Project Web site implementing Architect's electronic project management software system for purposes of managing project communication and documentation until Final Completion.

1.9 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
 1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within 3 days of the meeting.
 4. Attendance: Document attendance of all participants.
- B. Preconstruction Conference: Architect will schedule and conduct a preconstruction conference before starting construction.
 1. Conduct the conference to review responsibilities and personnel assignments.
 2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.
 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.

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2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, and coordination with adjacent activities. Prepare agenda appropriate to Work.
 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, at a time to be decided prior to the scheduled date of Substantial Completion.
1. Conduct the conference to review requirements and responsibilities related to Project closeout.
 2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
 - a. Preparation of record documents.
 - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
 - c. Submittal of written warranties.
 - d. If applicable, requirements for completing sustainable design documentation.
 - e. Requirements for preparing operations and maintenance data.
 - f. Requirements for delivery of material samples, attic stock, and spare parts.
 - g. Requirements for demonstration and training.
 - h. Preparation of Contractor's punch list.
 - i. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
 - j. Submittal procedures.
 - k. If applicable, coordination of separate contracts.
 - l. If applicable, Owner's partial occupancy requirements.
 - m. Installation of Owner's furniture, fixtures, and equipment.
 - n. Responsibility for removing temporary facilities and controls.
 4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
- E. Progress Meetings: Conduct progress meetings at regular intervals.
1. Coordinate dates of meetings with preparation of payment requests.
 2. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

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- a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period.
 - b. Review present and future needs of each entity present, including the following or as needed:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) If applicable, resolution of BIM component conflicts.
 - 4) Status of submittals.
 - 5) If applicable, status of sustainable design documentation.
 - 6) Deliveries.
 - 7) Off-site fabrication.
 - 8) Access.
 - 9) Site utilization.
 - 10) Temporary facilities and controls.
 - 11) Work hours.
 - 12) Hazards and risks.
 - 13) Progress cleaning.
 - 14) Quality and work standards.
 - 15) Status of correction of deficient items.
 - 16) Field observations.
 - 17) Status of RFIs.
 - 18) Status of proposal requests.
 - 19) Pending changes.
 - 20) Status of Change Orders.
 - 21) Documentation of information for payment requests.
4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
- a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.
- F. Coordination Meetings: Conduct Project coordination meetings on an as-needed basis. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
- 1. Attendees: Each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 2. Agenda: Review items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Review present and future needs of each contractor present, including the following:
 - 1) Interface requirements.

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- 2) Sequence of operations.
- 3) If applicable, resolution of BIM component conflicts.
- 4) Status of submittals.
- 5) Deliveries.
- 6) Off-site fabrication.
- 7) Access.
- 8) Site utilization.
- 9) Temporary facilities and controls.
- 10) Work hours.
- 11) Hazards and risks.
- 12) Progress cleaning.
- 13) Quality and work standards.
- 14) Change Orders.

PART 2 - PRODUCTS

2.1 ARCHITECT'S ELECTRONIC PROJECT MANAGEMENT SOFTWARE

- A. General: So as to expedite electronic review process, process all documents through a web-based software service. Sending documents via email, FTP or paper will not be accepted.
 1. Basis of Design (Product Standard):
 - a. Newforma, Inc.; Newforma Project Cloud, web-based software.
 - 1) Website: www.NewformaProjectCloud.com
 - 2) E-mail: projectcloud@newforma.com
 - 3) Phone: (800) 303-4650
- B. Performance Requirements:
 1. Project License:
 - a. Cloud based (no hardware required).
 - b. Unlimited user accounts.
 - c. Functionality to support subcontractors, contractors, architects and consultants.
 - d. Provide access to data for all project team members at no cost to the individual users.
 2. Training and Support:
 - a. Dedicated project training.
 - b. Phone support.
 3. Archive:
 - a. Export all data to an offline archive at the completion of the project.
 - b. Provide archive to architect, contractor and owner.
 - c. Archive shall include all attachments, meta data, review comments and time stamp history.
 4. Submittals and RFIs:
 - a. Customizable logs and reporting accessible by all users.
 - b. Logs shall automatically update as submittals and RFIs are processed.
 - c. Automated routing of submittals and RFIs to design team based on trade.
 - d. Automated email notifications when submittal or RFI has been assigned or returned to a user.

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- e. Automated weekly email to design team users of overdue items.
 - f. Automatic sequential numbering per spec section for submittals.
 - g. Two sets of due dates - one overall due date and a consultant due date.
 - h. Built-in web-based markup tools to support a concurrent review of submittal and RFI.
5. Submittal Register:
- a. Software vendor shall take specifications and build the required list of submittals and import into the software.
6. Drawing Management:
- a. Provide current set of drawings and specifications through a centralized index.
 - b. Automated association of PDFs to the centralized index.
 - c. Manage drawing revisions with customizable review states.
 - d. Drawings shall be accessible offline via mobile devices.
7. File Sharing:
- a. Integrated file sharing tool (FTP) to transfer any miscellaneous files such as BIM and CAD files.
 - b. Access permissions (view/edit) at a folder level.
8. Punch List and other Field Task Management:
- a. Unlimited customizable field task types including punch list.
 - b. Locate and assign tasks from a mobile device.
 - c. No additional fees to individual users to access mobile apps.
 - d. Data shall be accessible offline on mobile devices.

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 013200
CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work.
- B. Related Section:
 - 1. Provide Construction Photographs in accordance with Division 01 Section "Photographic Documentation".

1.2 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
 - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.
- B. Major Area: A story of construction, a separate building, or a similar significant construction element.
- C. Milestone: A key or critical point in time for reference or measurement.
- D. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.
- E. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- F. Network Diagram: A graphic diagram of a network schedule, showing activities and activity relationships.
- G. Event: The starting or ending point of an activity.
- H. Float: The measure of leeway in starting and completing an activity.
 - 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
 - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
 - 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
- I. Fragnet: A partial or fragmentary network that breaks down activities into smaller activities for greater detail.

1.3 SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:

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1. PDF electronic file.
 - B. Startup Construction Schedule.
 - C. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.
 - D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
 - E. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
 1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.
 2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
 3. Total Float Report: List of all activities sorted in ascending order of total float.
 4. Earnings Report: Compilation of Contractor's total earnings from the Notice to Proceed until most recent Application for Payment.
 - F. Construction Schedule Updating Reports: Submit with Applications for Payment.
 - G. Daily Construction Reports: Submit at weekly intervals.
 - H. Material Location Reports: Submit at monthly intervals.
 - I. Site Condition Reports: Submit at time of discovery of differing conditions.
 - J. Special Reports: Submit at time of unusual event.
- 1.4 COORDINATION
- A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.
 - B. Coordinate Contractor's construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.
 1. Secure time commitments for performing critical elements of the Work from entities involved.
 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Time Frame: Extend schedule from date established for the Notice to Proceed to date of final completion.
 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

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- B. Activities: Treat each story or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
1. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 2. Submittal Review Time: Include review and resubmittal times indicated in Division 01 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
 3. Startup and Testing Time: Include no fewer than 7 days for startup and testing.
 4. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
 5. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.
- C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule (where applicable), and show how the sequence of the Work is affected.
1. Phasing: Arrange list of activities on schedule by phase.
 2. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
 3. Products Ordered in Advance: Include a separate activity for each product.
 4. Owner-Furnished Products: Include a separate activity for each product.
 5. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - c. Uninterruptible services.
 - d. Partial occupancy before Substantial Completion.
 - e. Use of premises restrictions.
 - f. Provisions for future construction.
 - g. Seasonal variations.
 - h. Environmental control.
 6. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
 - a. Subcontract awards.
 - b. Submittals.
 - c. Purchases.
 - d. Mockups.
 - e. Fabrication.
 - f. Sample testing.
 - g. Deliveries.
 - h. Installation.
 - i. Tests and inspections.
 - j. Adjusting.
 - k. Curing.
 - l. Building flush-out.
 - m. Startup and placement into final use and operation.

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7. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
 - a. Structural completion.
 - b. Temporary enclosure and space conditioning.
 - c. Permanent space enclosure.
 - d. Completion of mechanical installation.
 - e. Completion of electrical installation.
 - f. Substantial Completion.
 8. Other Constraints include but are not limited to the following:
 - a. Roads.
 - b. Parking.
 - c. Landscape.
- D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, punch list activities, Substantial Completion, and final completion.
- E. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.
- F. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.
- 2.2 STARTUP CONSTRUCTION SCHEDULE
- A. Bar-Chart Schedule: Submit startup, horizontal, bar-chart-type construction schedule within 14 days of date established for the Notice of Award.
 - B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 60 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.
 - C. Startup Network Diagram may be submitted in lieu of Bar-Chart Schedule.
- 2.3 CONTRACTOR'S CONSTRUCTION SCHEDULE (BAR CHART/GANTT CHART)
- A. Bar Chart/Gantt Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's construction schedule within 30 days of date established for the Notice to Proceed. Base schedule on the startup construction schedule and additional information received since the start of Project.
 - B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
 1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.
- 2.4 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)
- A. General: Prepare network diagrams using AON (activity-on-node) format.

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- B. Startup Network Diagram: Submit diagram within 14 days of date established for the Notice to Proceed. Outline significant construction activities for the first 60 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.
- C. CPM Schedule: Prepare Contractor's construction schedule using a time-scaled CPM network analysis diagram for the Work.
 - 1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 30 days after date established for the Notice to Proceed.
 - a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of Architect's approval of the schedule.
 - 2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
 - 3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
 - 4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule in order to coordinate with the Contract Time.
- D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.
 - 1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
 - a. Preparation and processing of submittals.
 - b. Purchase of materials.
 - c. Delivery.
 - d. Fabrication.
 - e. Installation.
 - f. Punch list and final completion.
 - 2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
 - 3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
 - 4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
 - a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
- E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment, fragnet, to demonstrate the effect of the proposed change on the overall project schedule.
- F. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:

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1. Contractor or subcontractor and the Work or activity.
 2. Description of activity.
 3. Main events of activity.
 4. Immediate preceding and succeeding activities.
 5. Early and late start dates.
 6. Early and late finish dates.
 7. Activity duration in workdays.
 8. Total float or slack time.
 9. Average size of workforce.
 10. Dollar value of activity (coordinated with the schedule of values).
- G. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
1. Identification of activities that have changed.
 2. Changes in early and late start dates.
 3. Changes in early and late finish dates.
 4. Changes in activity durations in workdays.
 5. Changes in the critical path.
 6. Changes in total float or slack time.
 7. Changes in the Contract Time.
- H. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.
1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.
 2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
 3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.
 4. Prepare list for ease of comparison with payment requests; coordinate timing with progress meetings.
 - a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.
 - b. Submit value summary printouts one week before each regularly scheduled progress meeting.

2.5 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
1. List of subcontractors at Project site.
 2. List of separate contractors at Project site.
 3. Approximate count of personnel at Project site.
 4. High and low temperatures and general weather conditions, including presence of rain or snow.
 5. Accidents.
 6. Meetings and significant decisions.
 7. Unusual events (see special reports).
 8. Stoppages, delays, shortages, and losses.
 9. Meter readings and similar recordings.
 10. Emergency procedures.
 11. Orders and requests of authorities having jurisdiction.

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12. Change Orders received and implemented.
13. Construction Change Directives received and implemented.
14. Services connected and disconnected.
15. Equipment or system tests and startups.
16. Partial completions and occupancies.
17. Substantial Completions authorized.

- B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site.
- C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.6 SPECIAL REPORTS

- A. General: Submit special reports directly to Owner within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.
- B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Scheduling Consultant: Engage a consultant to provide planning, evaluation, and reporting using CPM scheduling.
1. In-House Option: Owner may waive the requirement to retain a consultant if Contractor employs skilled personnel with experience in CPM scheduling and reporting techniques. Submit qualifications.
 2. Meetings: Scheduling consultant shall attend all meetings related to Project progress, alleged delays, and time impact.
- B. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 3. As the Work progresses, indicate final completion percentage for each activity.
- C. Distribution: Distribute copies of approved schedule to Architect-Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

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1. Post copies in Project meeting rooms and temporary field offices.
2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION

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SECTION 013233
PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for the following:

1. Preconstruction photographs.
2. Periodic construction photographs.
3. Final completion construction photographs.
4. Preconstruction video recordings.
5. Periodic construction video recordings.
6. Web-based construction photographic documentation.

1.2 INFORMATIONAL SUBMITTALS

A. Qualification Data: For photographer and Web-based photographic documentation service provider.

B. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph or video recording. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.

C. Digital Photographs: Submit image files within 3 days of taking photographs.

1. Digital Camera: Minimum sensor resolution of 12 megapixels.
2. Format: Minimum 4288 by 2848 pixels, in unaltered original files, with same aspect ratio as the sensor, uncropped, date and time stamped, in folder named by date of photograph, accompanied by key plan file.
3. Image File Naming Convention (separate by an underscore _):
 - a. Project Job Number / Year-Month-Day / Image Number . file extension
4. Identification: Provide the following information with each image description in file metadata tag:
 - a. HKS Job Number and Add Service Number (e.g. 07425.000).
 - b. Name of Project.
 - c. Name and contact information for photographer.
 - d. Name of Architect.
 - e. Name of Contractor.
 - f. Date photograph was taken.
 - g. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
 - h. Unique sequential identifier keyed to accompanying key plan.

D. Video Recordings: Submit video recordings within 7 days of recording.

1. Video Recordings, General:
 - a. Submit in digital video disc format acceptable to Architect.
 - b. Submit by posting to Project Web site.
 - c. Submit by posting to Web-based photographic documentation service provider's Web site.
2. Identification: With each submittal, provide the following information:
 - a. Name of Project.

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- b. Name and address of photographer.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Date video recording was recorded.
 - f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
 - g. Weather conditions at time of recording.
 - 3. Transcript: Provide Portable Data (PDF) Electronic File. Include a cover page with same label information as corresponding video recording. Include name of Project and date of video recording on each page.
- E. Web-Based Photographic Documentation: Submit time-lapse sequence video recordings simultaneously with recording.
- 1. Real-time posting: Post in real-time, time-lapse sequence video recordings:
 - a. Post to Project Web site.
 - b. Post to Web-based photographic documentation service provider's Web site.
 - 2. Periodic Posting: Monthly on digital video disc.
 - 3. Identification: For each recording, provide the following information:
 - a. Name of Project.
 - b. Name and contact information for photographer.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Date(s) and time(s) video recording was recorded.
 - f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
 - g. Weather conditions at time of recording.
- 1.3 QUALITY ASSURANCE
- A. Photographer Qualifications: An individual who has been regularly engaged as a professional photographer of construction projects for not less than three years.
 - B. Web-Based Photographic Documentation Service Provider: A firm specializing in providing photographic equipment, Web-based software, and related services for construction projects, with record of providing satisfactory services similar to those required for Project.
- 1.4 USAGE RIGHTS
- A. Obtain and transfer copyright usage rights from photographer to Owner for unlimited reproduction of photographic documentation.

PART 2 - PRODUCTS

2.1 PHOTOGRAPHIC MEDIA

- A. Digital Images: Provide images in JPG format, produced by a digital camera with minimum sensor size of megapixels, and at an image resolution of not less than 4288 by 2848 pixels.
- B. Digital Video Recordings: Provide high-resolution, digital video disc in format acceptable to Architect.

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2.2 WEB-BASED PHOTOGRAPHIC DOCUMENTATION

- A. Project Camera: Provide fixed exterior camera installation, mounted to provide unobstructed view of construction site from location approved by Architect.
 - 1. Provide 4 fixed-location camera(s), with the following characteristics:
 - a. Remotely controllable view with mouse-click user navigation for horizontal pan, vertical tilt, and optical zoom of 500 percent minimum.
 - b. Capable of producing minimum 3 megapixel pictures.
 - c. Provide power supply, active high-speed data connection to service provider's network, and static public IP address for each camera.
- B. Web-Based Image Access: Password-protected access for Project team administered by Contractor, providing current image access and archival image access by date and time, with images downloadable to viewer's device.
 - 1. Provide public viewer open access to most recent project camera image.

PART 3 - EXECUTION

3.1 CONSTRUCTION PHOTOGRAPHS

- A. Photographer: Engage a qualified photographer to take construction photographs.
- B. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.
 - 1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- C. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
 - 1. Date and Time: Include date and time in file name for each image.
 - 2. Field Office Images: Maintain one set of images accessible in the field office at Project site, available at all times for reference. Identify images in the same manner as those submitted to Architect.
- D. Preconstruction Photographs: Before starting construction, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect.
 - 1. Flag construction limits before taking construction photographs.
 - 2. Take a minimum of 20 photographs to show existing conditions adjacent to property before starting the Work.
 - 3. Take a minimum of 20 photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.
 - 4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.
- E. Periodic Construction Photographs: Take 20 photographs monthly, coinciding with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.
- F. Time-Lapse Sequence Construction Photographs: Take 20 photographs as indicated, to show status of construction and progress since last photographs were taken.

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1. Frequency: Take photographs monthly, coinciding with the cutoff date associated with each Application for Payment.
 2. Vantage Points: Following suggestions by Architect and Contractor, photographer to select vantage points. During each of the following construction phases, take not less than 2 of the required shots from same vantage point each time to create a time-lapse sequence as follows:
 - a. Commencement of the Work, through completion of subgrade construction.
 - b. Above-grade structural framing.
 - c. Exterior building enclosure.
 - d. Interior Work, through date of Substantial Completion.
 - G. Drones (If Applicable): Flight Schedule per mutual agreement between the Owner and Contractor to show status of construction and progress.
 - H. Final Completion Construction Photographs: Take 20 color photographs after date of Substantial Completion for submission as project record documents. Architect will inform photographer of desired vantage points.
 1. Do not include date stamp unless directed otherwise by Architect.
 - I. Additional Photographs: Architect may request photographs in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum.
 1. Three days' notice will be given, where feasible.
 2. In emergency situations, take additional photographs within 24 hours of request.
 3. Circumstances that could require additional photographs include, but are not limited to, the following:
 - a. Special events planned at Project site.
 - b. Immediate follow-up when on-site events result in construction damage or losses.
 - c. Photographs to be taken at fabrication locations away from Project site.
 - d. Substantial Completion of a major phase or component of the Work.
 - e. Extra record photographs at time of final acceptance.
 - f. Owner's request for special publicity photographs.
- 3.2 CONSTRUCTION VIDEO RECORDINGS
- A. Video Recording Photographer: Engage a qualified videographer to record construction video recordings.
 - B. Recording: Mount camera on tripod before starting recording unless otherwise necessary to show area of construction. Display continuous running time and date. At start of each video recording, record weather conditions from local newspaper or television and the actual temperature reading at Project site.
 - C. Narration: Describe scenes on video recording by dubbing audio narration off-site after video recording is recorded. Include description of items being viewed, recent events, and planned activities. At each change in location, describe vantage point, location, direction (by compass point), and elevation or story of construction.
 1. Confirm date and time at beginning and end of recording.
 2. Begin each video recording with name of Project, Contractor's name, videographer's name, and Project location.
 - D. Transcript: Provide a typewritten transcript of the narration. Display images and running time captured from video recording opposite the corresponding narration segment.

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- E. Preconstruction Video Recording: Before starting construction, record video recording of Project site and surrounding properties from different vantage points, as directed by Architect.
 - 1. Flag construction limits before recording construction video recordings.
 - 2. Show existing conditions adjacent to Project site before starting the Work.
 - 3. Show existing buildings either on or adjoining Project site to accurately record physical conditions at the start of construction.
 - 4. Show protection efforts by Contractor.
- F. Periodic Construction Video Recordings: Record video recording monthly, coinciding with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last video recordings were recorded. Minimum recording time shall be 30 minutes(s).
- G. Time-Lapse Sequence Construction Video Recordings: Record video recording to show status of construction and progress.
 - 1. Frequency: During each of the following construction phases, set up video recorder to automatically record one frame of video recording every 5 minutes, from same vantage point each time, to create a time-lapse sequence of 30 minutes in length as follows:
 - a. Commencement of the Work, through completion of subgrade construction.
 - b. Above-grade structural framing.
 - c. Exterior building enclosure.
 - 2. Timer: Provide timer to automatically start and stop video recorder so recording occurs only during daylight construction work hours.
 - 3. Vantage Points: Following suggestions by Architect and Contractor, photographer shall select vantage points.

3.3 WEB-BASED CONSTRUCTION PHOTOGRAPHIC DOCUMENTATION

- A. Live Streaming Construction Site Images: Provide Web-accessible image of current site image from viewer-controlled location camera(s), updated at 15 minute intervals during daytime operation.
- B. Time-Lapse Sequence Construction Site Recordings: Provide video recording from a fixed-location camera to show status of construction and progress.
 - 1. Frequency: Record one frame of video recording every 15 minutes, from same vantage point each time, to create a time-lapse sequence of construction activities.
 - 2. Timer: Provide timer to automatically start and stop video recorder so recording occurs only during daylight construction work hours.
- C. Maintain cameras and Web-based access in good working order according to Web-based construction photographic documentation service provider's written instructions until final completion. Provide for service of cameras and related networking devices and software.

END OF SECTION

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SECTION 013300
SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's review. Architect's responsive action is required.
- B. Digital Signature: A digital signature or digital signature scheme is a mathematical scheme for demonstrating the authenticity of a digital message or document.
- C. Electronic Signature: An electronic signature is any legally recognized electronic means that indicates that a person adopts the contents of an electronic message.
- D. Informational Submittals: Written and graphic information other than action submittals that require Architect's review. Architect's responsive action is required on informational submittals that do not comply with the information given and design concept expressed in the Drawings and Specifications.
- E. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.3 SUBMITTALS

- A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.
 - 1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
 - 2. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
 - 3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.
 - a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.
 - 4. Format: Arrange the following information in a tabular format:
 - a. Scheduled date for first submittal.
 - b. Specification Section number and title.
 - c. Submittal category: Action; informational.
 - d. Name of subcontractor.
 - e. Description of the Work covered.
 - f. Scheduled date for Architect's final release or approval.

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1.4 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Architect's Digital Data Files: If approved by Owner, Architect will furnish Contractor one set of digital data files of Drawing files for use in preparing submittals. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
 - 1. Distribution: Digital data files shall only be distributed with acceptance of HKS data licensing agreement.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 - 3. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow sufficient and reasonable time for submittal review, including time for resubmittals. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
 - 1. The Architect's action will be taken in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness while allowing sufficient time in the Architect's professional judgment to permit adequate review.
- D. Paper Submittals: Architect reserves the right to require paper submittals.
- E. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:
 - 1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 - 2. Name file with submittal number, including revision identifier.
 - a. File Naming Convention (separate by dashes - or underscores _):
 - 1) Specification Number / Revision Number / Submittal Sequence (A, B, C, etc.).pdf
 - 3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
 - 4. Transmittal Form for Electronic Submittals: Use software-generated form from electronic project management software or electronic form acceptable to Owner, containing the following information:
 - a. Project name.
 - b. Date.
 - c. Name and address of Architect.
 - d. Name of Contractor.

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- e. Name of firm or entity that prepared submittal.
 - f. Names of subcontractor, manufacturer, and supplier.
 - g. Category and type of submittal.
 - h. Submittal purpose and description.
 - i. Specification Section number and title.
 - j. Specification paragraph number or drawing designation and generic name for each of multiple items.
 - k. Drawing number and detail references, as appropriate.
 - l. Location(s) where product is to be installed, as appropriate.
 - m. Related physical samples submitted directly.
 - n. Indication of full or partial submittal.
 - o. Transmittal number, numbered consecutively.
 - p. Submittal and transmittal distribution record.
 - q. Other necessary identification.
 - r. Remarks.
5. Metadata: Include the following information as keywords in the electronic submittal file metadata:
- a. HKS Job Number and Add Service Number (e.g. 14424.000)
 - b. Project name.
 - c. Number and title of appropriate Specification Section.
 - d. Manufacturer name.
 - e. Product name.
 - f. Submittal revision number.
6. Utilize electronic project management software program to process submittals when feasible with the type and extent of submittals. Refer to Division 01 Section "Project Management and Coordination" for description of electronic project management software.
- F. Options: Identify options requiring selection by Architect.
- G. Deviations and Additional Information: On page, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.
- H. Resubmittals: Make resubmittals in same form as initial submittal.
- 1. Note date and content of previous submittal.
 - 2. Note date and content of revision in file name and clearly indicate extent of revision.
 - 3. Resubmit submittals until they are marked with notation from Architect's action stamp not requiring additional submittals.
- I. Distribution: Furnish electronic copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- J. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with appropriate notation from Architect's action stamp indicating for construction. Retain a separate copy for Owner to be delivered to Owner with Project Closeout documents.

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PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
1. Submit electronic submittals as PDF electronic files directly to Architect's Project Web site specifically established for Project.
 - a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
 - b. Provide PDF electronic files from scanned paper originals at 300 dpi, minimum.
 2. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
 - a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.
 - b. When one or more individual Specification Sections includes requirements for notarized signature on certificates and certifications, provide a notarized statement on original paper copy certificates and certifications where indicated.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
 2. Mark each copy of each submittal to show which products and options are applicable.
 3. Include the following information, as applicable:
 - a. Manufacturer's written recommendations.
 - b. Manufacturer's installation instructions.
 - c. Mill reports.
 - d. Standard product operating and maintenance manuals.
 - e. Certification that products are appropriate for installation indicated.
 - f. Manufacturer's catalog cuts.
 - g. Manufacturer's product specifications.
 - h. Standard color charts.
 - i. Statement of compliance with specified referenced standards.
 - j. Testing by recognized testing agency.
 - k. Application of testing agency labels and seals.
 - l. Notation of coordination requirements.
 - m. Availability and delivery time information.
 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams showing factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 5. Submit Product Data before or concurrent with Samples.
 6. Submit Product Data in the following format:

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- a. PDF electronic file.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
- 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Dimensions.
 - c. Fabrication and installation drawings.
 - d. Roughing-in and setting diagrams.
 - e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
 - f. Shopwork manufacturing instructions.
 - g. Templates and patterns.
 - h. Design calculations.
 - i. Schedules.
 - j. Compliance with specified standards.
 - k. Notation of coordination requirements.
 - l. Notation of dimensions established by field measurement.
 - m. Relationship and attachment to adjoining construction clearly indicated.
 - n. Seal and signature of professional engineer.
 - 2. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.
 - 3. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches (212 by 275 mm), but no larger than 30 by 42 inches (750 by 1050 mm).
 - 4. Submit Shop Drawings in the following format:
 - a. PDF electronic file.
 - 5. BIM File Incorporation: When applicable, develop and incorporate Shop Drawing files into Building Information Model established for Project.
 - a. Prepare Shop Drawings in the following format: Same digital data software program, version, and operating system as the original Drawings.
 - b. Refer to Division 01 Section "Project Management and Coordination" for requirements for coordination drawings.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
- 1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 - 2. Identification: Attach label on unexposed side of Samples that includes the following:
 - a. Generic description of Sample.
 - b. Product name and name of manufacturer.
 - c. Sample source.
 - d. Number and title of applicable Specification Section.
 - e. Specification paragraph number and generic name of each item.
 - 3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record. This is in addition to physical samples.

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4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit 4 full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit 4 sets of Samples. Architect will retain 2 Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record sample.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least 4 sets of paired units that show approximate limits of variations.
- E. Coordination Drawing Submittals: Comply with requirements specified in Division 01 Section "Project Management and Coordination."
- F. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."
- G. Application for Payment and Schedule of Values: Comply with requirements specified in Division 01 Section "Payment Procedures."
- H. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Division 01 Section "Quality Requirements."
- I. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Division 01 Section "Closeout Procedures."
- J. Maintenance Data: Comply with requirements specified in Division 01 Section "Operation and Maintenance Data."
- K. Sustainable Construction Submittals: Where applicable, comply with requirements specified in Division 01 sustainable construction requirements Section.

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- L. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- M. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.
- N. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
- O. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- P. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- Q. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- R. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- S. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- T. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - 1. Name of evaluation organization.
 - 2. Date of evaluation.
 - 3. Time period when report is in effect.
 - 4. Product and manufacturers' names.
 - 5. Description of product.
 - 6. Test procedures and results.
 - 7. Limitations of use.
- U. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- V. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- W. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

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- X. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.2 DELEGATED-ENGINEERING SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Engineering Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file and three paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
 - 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.
- C. BIM File Incorporation: Where applicable, incorporate delegated-design drawing and data files into Building Information Model established for Project.
 - 1. Prepare delegated-design drawings in the following format: Same digital data software program, version, and operating system as the original Drawings.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Project Closeout and Maintenance Material Submittals: See requirements in Division 01 Section "Closeout Procedures."
- C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S ACTION

- A. Action Submittals: Architect will review submittal, make marks to indicate corrections or revisions required, and return it. Architect will stamp and mark submittal appropriately, as follows:
 - 1. Final but Restricted Release: When submittals are marked "Accepted as Noted," the Work covered by the submittal may proceed provided it complies with both the Architect's notations and corrections on the submittal and requirements of the Contract Documents. Final acceptance will depend on that compliance.
 - 2. Returned for Resubmittal: When submittal is marked "Revise Resubmit," do not proceed with the Work covered by the submittal, including purchasing, fabrication, delivery, or

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other activity. Revise or prepare a new submittal in accordance with the Architect's notations. Resubmit without delay. Repeat if necessary to obtain a different action mark.

- a. Do not permit submittals marked "Revise Resubmit" to be used at the Project site, or elsewhere where construction is in progress.
- 3. Submittals Not Required: Where a submittal is primarily for record purposes, special processing, or other Contractor activity, the submittal will be returned, marked "Not Reviewed; Submittal not required by Contract Documents".
- B. Architect's Acceptance of Shop Drawings, Samples or Product Data which deviates from the Contract Documents does not authorize changes to the Contract Sum. Submit in writing at the time of submission any changes to the Contract Sum affected by such Shop Drawings, Samples or Product Data, otherwise, claim for extras will not be considered.
- C. Informational Submittals: Architect will review submittal, and return it in accordance with submittal Processing Time indicated if it does not comply with requirements. Architect will stamp and mark submittal appropriately.
- D. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect. Review shall not be final until complete submittal has been reviewed by Architect.
- E. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- F. Submittals not required by the Contract Documents may be returned by the Architect without action.
- G. Electronic File of Submittal Documents: Provide Architect with an independent electronic archive of project submittal documents using electronic project management software as defined in Division 01 Section "Project Management and Coordination".

END OF SECTION

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SECTION 014000
QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

1.2 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.
- C. Mockups: Full-size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Mockups establish the standard by which the Work will be judged.
 - 1. Integrated Exterior Cladding Mockups: Mockups of the exterior envelope erected separately from the building but on Project site, consisting of multiple products, assemblies, and subassemblies.
 - 2. Typical Room Mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes, doors, windows, millwork, casework, specialties, furnishings and equipment, and lighting.
 - 3. Preconstruction Laboratory Mockups: Full-size physical assemblies constructed at testing facility to verify performance characteristics.
- D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.
- E. Product Testing: Tests and inspections that are performed by an NRTL (Nationally Recognized Testing Laboratories), an NVLAP (National Voluntary Laboratory Accreditation

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Program), or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

- F. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.
- G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
 - 1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
- J. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction and with the qualification requirements of individual specification section governing their work.

1.3 CONFLICTING REQUIREMENTS

- A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements to Architect for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.
- C. If work is required in a manner that makes it impossible to produce such work of the quality required by or reasonably inferred from the Contract Documents, or should discrepancies appear among the Construction Documents, the Contractor shall request in writing an interpretation from the Architect before proceeding with the work. If the Contractor fails to make such request, no excuse will be entertained thereafter for failure to carry out work in the required manner or to produce required guarantees, warranties, or bonds, and the Contractor shall not be entitled to any change in the Contract Sum or the Contract Time on account of such failure.

1.4 CONTRACTOR'S QUALITY-CONTROL PLAN

- A. Quality-Control Plan, General: Submit quality-control plan prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.

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- B. Quality-Control Personnel Qualifications: Engage qualified full-time personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
 - 1. Project quality-control manager may be the Project superintendent or be an individual with no other Project responsibilities, as accepted by the Architect.
 - C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.
 - D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
 - 1. Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections.
 - 2. Special inspections required by authorities having jurisdiction and indicated on the "Statement of Special Inspections."
 - 3. Owner-performed tests and inspections indicated in the Contract Documents, including tests and inspections indicated to be performed by the Commissioning Authority when Commissioning is included in the Project.
 - E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.
 - F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results, including Owner acceptance of nonconforming work. Include work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.
- 1.5 REPORTS AND DOCUMENTS
- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
 - 1. Date of issue.
 - 2. Project title and number.
 - 3. Name, address, and telephone number of testing agency.
 - 4. Dates and locations of samples and tests or inspections.
 - 5. Names of individuals making tests and inspections.
 - 6. Description of the Work and test and inspection method.
 - 7. Identification of product and Specification Section.
 - 8. Complete test or inspection data.
 - 9. Test and inspection results and an interpretation of test results.
 - 10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
 - 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 - 12. Name and signature of laboratory inspector.
 - 13. Recommendations on retesting and reinspecting.

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- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of technical representative making report.
 2. Statement on condition of substrates and their acceptability for installation of product.
 3. Statement that products at Project site comply with requirements.
 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 6. Statement whether conditions, products, and installation will affect warranty.
 7. Statement whether conditions, products, and installation exceed manufacturer's statements.
 8. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of factory-authorized service representative making report.
 2. Statement that equipment complies with requirements.
 3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 4. Statement whether conditions, products, and installation will affect warranty.
 5. Other required items indicated in individual Specification Sections.
- D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.6 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.

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- F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
- H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
1. Contractor responsibilities include the following:
 - a. Provide test specimens representative of proposed products and construction.
 - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
 - c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
 - d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
 - e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
 - f. When testing is complete, remove test specimens, assemblies, mockups, and laboratory mockups; do not reuse products on Project.
 2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
- K. Mock-ups: Prior to fabrication and installation, build mock-up for each form of construction and finish required to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mock-up to comply with the following requirements, using materials indicated for the completed Work:
1. Build mock-up in the location and of the size indicated or, if not indicated, as directed by Architect. Contractor shall provide structural support framework.

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- a. Show typical components, attachments to building structure, and requirements of installation.
 2. Clean exposed faces of mock-up.
 3. Notify Architect seven days in advance of the dates and times when mock-up will be installed.
 4. Demonstrate the proposed range of aesthetic effects and workmanship.
 5. Protect accepted mock-up from the elements with weather-resistant membrane.
 6. Obtain Architect's acceptance of mock-ups before starting fabrication.
 7. Maintain mock-ups during construction in an undisturbed condition as a standard for review of the completed Work.
 8. Acceptance of mock-ups does not constitute acceptance of deviations from the Contract Documents contained in mock-ups unless such deviations are specifically noted by Contractor, submitted to Architect in writing, and accepted by Architect in writing.
 9. Demolish and remove mock-ups when directed by Architect unless accepted to become part of the completed Work.
- L. Integrated Exterior Cladding Mockups: See Division 01 Section Visual Mock-Ups.
- M. Typical Room Mockups: See Division 01 Section Visual Mock-Ups.
- N. Preconstruction Laboratory Mockups: See Division 01 Section "Preconstruction Laboratory Mockup Testing for Building Enclosure Systems."
- 1.7 QUALITY CONTROL
- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
 2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.
1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
 - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 3. Notify testing agencies at least 48 hours in advance of time when Work that requires testing or inspecting will be performed.
 4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

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- C. **Manufacturer's Field Services:** Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 01 Section "Submittal Procedures."
- D. **Manufacturer's Technical Services:** Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- E. **Retesting/Reinspecting:** Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- F. **Testing Agency Responsibilities:** Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
 - 1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 - 2. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 - 3. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 - 4. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 - 5. Do not perform any duties of Contractor.
- G. **Associated Services:** Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
 - 1. Access to the Work.
 - 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 - 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 - 4. Facilities for storage and field curing of test samples.
 - 5. Delivery of samples to testing agencies.
 - 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 - 7. Security and protection for samples and for testing and inspecting equipment at Project site.
- H. **Coordination:** Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
 - 1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- I. **Schedule of Tests and Inspections:** Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's construction schedule.
 - 1. **Distribution:** Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.
 - a. Prepare in tabular form and include the following:

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- 1) Specification Section number and title.
- 2) Entity responsible for performing tests and inspections.
- 3) Description of test and inspection.
- 4) Identification of applicable standards.
- 5) Identification of test and inspection methods.
- 6) Number of tests and inspections required.
- 7) Time schedule or time span for tests and inspections.
- 8) Requirements for obtaining samples.
- 9) Unique characteristics of each quality-control service.

1.8 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Owner may engage a qualified to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:
1. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
 2. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
 3. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
 4. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
 5. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
1. Date test or inspection was conducted.
 2. Description of the Work tested or inspected.
 3. Date test or inspection results were transmitted to Architect.
 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas in a manner that eliminates evidence of patching. Comply with the Contract Document requirements for cutting and patching in Division 01 Section "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

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END OF SECTION

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SECTION 014200
REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms, including "requested," "authorized," "selected," "required," and "permitted," have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms, including "shown," "noted," "scheduled," and "specified," have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.2 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
 - 1. For standards referenced by applicable building codes, comply with dates of standards as listed in building codes.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
 - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.3 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities indicated in Gale's

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"Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books'
"National Trade & Professional Associations of the United States."

- B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.
1. DIN - Deutsches Institut für Normung e.V.; www.din.de.
 2. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
 3. ICC - International Code Council; www.iccsafe.org.
 4. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.
- C. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.
1. CPSC - U.S. Consumer Product Safety Commission; www.cpsc.gov.
 2. DOC - U.S. Department of Commerce; www.commerce.gov.
 3. DOD - U.S. Department of Defense; www.defense.gov.
 4. DOE - U.S. Department of Energy; www.energy.gov.
 5. DOJ - U.S. Department of Justice; www.ojp.usdoj.gov.
 6. DOS - U.S. Department of State; www.state.gov.
 7. EPA - United States Environmental Protection Agency; www.epa.gov.
 8. FAA - Federal Aviation Administration; www.faa.gov.
 9. GPO - U.S. Government Publishing Office; www.gpo.gov.
 10. GSA - U.S. General Services Administration; www.gsa.gov.
 11. HUD - U.S. Department of Housing and Urban Development; www.hud.gov.
 12. LBNL - Lawrence Berkeley National Laboratory; Energy Technologies Area; www.lbl.gov/.
 13. NIST - National Institute of Standards and Technology; www.nist.gov.
 14. OSHA - Occupational Safety & Health Administration; www.osha.gov.
 15. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; www.trb.org.
 16. USACE - U.S. Army Corps of Engineers; www.usace.army.mil.
 17. USDA - U.S. Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
 18. USDA - U.S. Department of Agriculture; Rural Utilities Service; www.usda.gov.
 19. USP - U.S. Pharmacopeial Convention; www.usp.org.
 20. USPS - United States Postal Service; www.usps.com.
- D. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
1. CFR - Code of Federal Regulations; Available from U.S. Government Publishing Office; www.govinfo.gov.
 2. DOD - U.S. Department of Defense; Military Specifications and Standards; Available from DLA Document Services; www.dsp.dla.mil/Specs-Standards/.
 3. DSCC - Defense Supply Center Columbus; (see FS).
 4. FED-STD - Federal Standard; (see FS).
 5. FS - Federal Specification; Available from DLA Document Services; www.dsp.dla.mil/Specs-Standards/.
 - a. Available from Defense Standardization Program; www.dsp.dla.mil.

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- b. Available from U.S. General Services Administration; www.gsa.gov.
 - c. Available from National Institute of Building Sciences/Whole Building Design Guide; www.wbdg.org.
 - 6. MILSPEC - Military Specifications and Standards; (see DOD).
 - 7. USAB - United States Access Board; www.access-board.gov.
 - 8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (see USAB).
- E. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
- 1. BEARHFTI; California Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation; (see BHGS).
 - 2. BHGS; State of California Bureau of Household Goods and Services; (Formerly: California Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation); www.bhgs.dca.ca.gov.
 - 3. CCR; California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; www.oal.ca.gov/publications/ccr/.
 - 4. CDPH; California Department of Public Health; Indoor Air Quality Program; www.cdph.ca.gov/Programs/CCDPPH/DEODC/EHLB/IAQ/Pages/Main-Page.aspx.
 - 5. CPUC; California Public Utilities Commission; www.cpuc.ca.gov.
 - 6. SCAQMD; South Coast Air Quality Management District; www.aqmd.gov.
 - 7. TFS; Texas A&M Forest Service; Sustainable Forestry and Economic Development; <https://tfsweb.tamu.edu/>.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 014323
SPECIAL INSPECTIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Special Inspections required by Authorities Having Jurisdiction including supplementary work necessary to complete inspections.

1.2 RESPONSIBILITY

- A. Special Inspections do not relieve the Contractor of the responsibility to provide construction in accordance with the Contract Documents.

1.3 INSPECTOR'S RESPONSIBILITY

- A. Special Inspector shall be acceptable to the Authorities Having Jurisdiction for this project.
- B. Special Inspector shall be completely familiar with the Contract Documents relating to inspection responsibility.

1.4 COOPERATION

- A. Contractor shall cooperate with and assist Special Inspector in performing Special Inspections. Special Inspector shall have access to the project without restriction.
 - 1. Contractor shall advise Special Inspector in advance of construction schedules and planned operations to assure timely and appropriate observation and inspection of items requiring Special Inspections.
 - 2. Contractor shall make available approved Shop Drawings to the Special Inspector at jobsite.

1.5 OWNER'S RESPONSIBILITY

- A. Cost of employing the Special Inspector shall be the responsibility of the Owner.
- B. Final interpretation of the Contract Documents shall rest with the Architect and Engineers of Record.

1.6 GENERAL DUTIES OF SPECIAL INSPECTOR

- A. Special Inspector shall cooperate with the Contractor on timely observations and inspections of Work. Special Inspector shall not supervise or direct the Work.
- B. Special Inspector shall immediately alert the Contractor of discrepancies and deviations from the Contract Documents and approved Shop Drawings.
- C. Special Inspection Reports shall be submitted within 24 hours of the time and date of the observation and inspection.
 - 1. Special Inspector shall submit his reports to the Authorities Having Jurisdiction for the project. In addition, Special Inspector shall submit copies of reports to the Owner and to the Contractor.
 - 2. Upon completion of the building and prior to the issuance of a Certificate of Occupancy, a signed and sealed statement by the Special Inspector shall be submitted to the Authorities Having Jurisdiction, stating the portion of the project subject to Special Inspections has been constructed in accordance with the Contract Documents. This statement shall be provided in accordance with the governing building codes and ordinances.

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1.7 SCHEDULE OF SPECIAL INSPECTIONS

- A. Refer to Summary of Special Inspections.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION

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SECTION 01 43 39 – MOCK-UP WALL CONSTRUCTION

PART 1 – GENERAL

1.1 DESCRIPTION

- A. An Envelope Pre-construction meeting shall be held with all of the subcontractors responsible for erecting the envelope related materials.
 - 1. Attendees shall include (but are not limited to): General Contractor, framing and sheathing subcontractor, masonry subcontractor, weather barrier subcontractor, storefront and glazing subcontractor, roofing and sheet metal subcontractors, ACM and metal panel subcontractor, mechanical and electrical subcontractors, and any other trade that will install products in the exterior building envelope, or penetrate through the exterior envelope.
- B. Work includes: Constructing mock-up, including all reviewed submittals required by the Contract Documents, to establish compliance with the design intent as well as the specified requirements to provide a complete and watertight facility.
- C. Providing a photo manifest of as-built conditions as the mock-up is being constructed. Photos shall be kept at the job site during construction for reference.
- D. Mock-up fabrication must be completed and reviewed and approved by the Owner and Architect prior to starting installation of building envelope construction.

1.2 RELATED REQUIREMENTS

- A. Individual sections of these specifications for each material indicated for use in the mock-up wall construction.

1.3 SUBMITTALS

- A. Section 01 30 00 – Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate dimensions, layout, joints, construction details, methods of anchorage, etc. as required for items to be installed in the mock-up wall construction.
- C. All submittals for materials required in the mock-up walls shall be approved prior to beginning work on the mock-up wall construction.

1.4 PURPOSE

- A. The mock-up wall panels are to be constructed as indicated on the drawings, including toothed masonry construction to allow exposed flashings, etc. Construction of the mock-up walls are intended to:
 - 1. Provide an acceptable quality standard for the completed work.
 - 2. Identify color and finish selections of the various materials used, as well as the acceptable range of color and variations within those materials.
 - 3. Establish the required coordination between trades and the sequence of necessary installations to provide a complete and watertight building envelope.

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1.5 QUALITY ASSURANCE

- A. Coordination of product submittals and construction installation:
 - 1. Prior to each submittal, carefully review and coordinate all aspects of each item being submitted.
 - 2. Verify that each item being submitted is in conformance in all respects with the specified requirements.
 - 3. By affixing the Contractor's signature to each submittal for the mock-up, the contractor certifies that this coordination has been performed.
 - 4. Contractor shall construct the site built mock-up with the same manner of specified construction as the new construction.
 - 5. Contractor shall construct the site built mock-up with the same workmanship and quality as being implemented on the new construction.
 - 6. All material to be installed shall be reviewed by architect and consultants for conformance.

PART 2 – PRODUCTS

2.1 MOCK-UP REQUIREMENTS

- A. Build mock-ups to verify selections made under sample submittals and to demonstrate aesthetic effects and qualities of materials and execution. Mock-up wall construction shall be coordinated by the General Contractor and constructed by the subcontractor responsible for the actual construction work. All conditions and materials to be used on the job shall be included in the mock-up. Build mock-ups to comply with the listed requirements, using materials indicated for the completed Work.
- B. Contractor shall start the construction of the mock-up based on, but not limited to, the following list:
 - 1. Foundation if subgrade is present
 - 2. Waterproofing membrane
 - 3. Damproofing material
 - 4. Flexible Through-Wall Flashing Membrane
 - 5. Metal Through-Wall Flashing
 - 6. Preformed Flashing Pieces
 - 7. Face Brick with Mortar and Weeps
 - 8. CMU with mortar and weeps
 - 9. Wall Ties
 - 10. Weather Barrier
 - 11. Portland Cement Plaster
 - 12. Metal Panels, Wall and Soffit
 - 13. Metal Roof Panels
 - 14. Low Slope Roof System
 - 15. Weeps
 - 16. Window Unit
 - 17. Louver Unit
 - 18. ICF Wall Systems with weather barriers
- C. Samples and Manufacturer's Submittals: Submit prior to delivery or installation.
 - 1. Samples of all building system components including all specified accessories.
 - 2. Submit samples of proposed warranties complete with any addenda necessary to meet the warranty requirements as specified.
 - 3. Submit latest edition of manufacturer's specifications and installation procedures. Submit only those items applicable to this project.

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4. A written statement from the materials manufacturer approving the installer, specifications and drawings as described and/or shown for this project and stating the intent to guarantee the completed project.
 5. Follow submitted shop drawings, product data of all sheet metal.
- D. Scale and Measurements: Make Shop Drawings accurately to a scale sufficiently large enough to show all pertinent aspects of the item and its method of connection to the work.
- E. Shop Drawings and Product Data: Provide manufacturer's approved details of all conditions, projection conditions, and any additional special job conditions which require details other than indicated in the drawings.
1. Manufacturer's Details: All termination details and other details normally required by the manufacturer's Technical Specifications, including both standard details and special details, shall be furnished by the Contractor and shall be approved in writing by the manufacturer, the company project manager, and the Owner's representative prior to final installation.
- F. Provide manufacturer's approved details, of all perimeter conditions, project conditions, and any additional special job conditions which require details other than indicated in the drawings.

2.2 MANUFACTURER'S LITERATURE

- A. Work provided on the mock-up shall follow all of the submitted literature from manufacturers.
- B. Manufacturer's literature shall be the minimum for basis of design and shall be in conjunction with construction documents. All manufacturers' warranties shall remain in effect as specified.

2.3 SAMPLES

- A. Provide sample or samples identical to the precise article proposed to be provided.

2.4 COLORS AND PATTERNS

- A. Unless the precise color and pattern are specifically called out in the Contract Documents, and whenever a choice of color or pattern is available in the specified products, submit accurate color and pattern charts to the Architect/Project Manager for selection in advance of the Envelope Pre-Construction meeting.
- B. Contractor shall coordinate with Architect for exact layout or design of patterns and textures and how they are to be installed on the mock-up.

PART 3 – EXECUTION

3.1 ENVELOPE PRE-CONSTRUCTION MEETING

- A. Convene a minimum of one week prior to initiation of the mock-up wall construction.
- B. Verify that all required submittals have been approved and that color/finish selections have been made.
- C. Establish coordination between trades and establish sequencing of material installations to ensure a complete and watertight assembly.
- D. Distribute meeting minutes and agreed upon sequencing to all subcontractors.

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- E. Construct mock-up walls in accordance with the established procedures and installation sequencing.

3.2 INSTALLATION OF MATERIALS

- A. Contractor shall install all materials on mock-up in same manner required for the main structure. Refer to specification sections for basis of design of all material being installed on this mock-up.
- B. During installation, Contractor shall maintain a photo manifest of mock-up construction for Architect and Owner to review.
- C. Quality of installation is of utmost importance and shall be monitored for completeness and conformance with the design intent and manufacturer's installation recommendations.
- D. Once mock-up is complete, it shall be reviewed by the Architect and Owner's Representative for conformance to construction documents.
- E. Contractor shall install material in same sequencing as required by industry standards.

3.3 INSTALLATION OF WINDOWS AND ASSOCIATED FLASHING

- A. Installer shall coordinate the installation of the window with associated trades to maintain proper compatibility of material.
- B. Installation shall be in accordance with referencing specifications.
- C. Install all perimeters flashing as detailed to create a sealed and watertight condition which includes the installation of the intermediate bead of sealant and backer rod prior to the installation of the membrane.
- D. Once window and flashing has been installed, Contractor shall notify Architect, Owner and Consultants for review for conformance and shall provide a water test of all wall flashing. Contractor shall notify Architect, Owner and Consultants to observe the testing. All tests shall be in accordance with referencing specifications.

3.4 INSTALLATION OF FLASHING AT THROUGH-WALL LOCATION

- A. Installer shall coordinate the installation of the wall flashing with associated trades to maintain proper compatibility of material.
- B. Installation shall be in accordance with referencing specifications.
- C. Once flashing has been installed, Contractor shall notify Architect, Owner and Consultants for review for conformance and shall provide a water test of all wall flashing. Contractor shall notify Architect, Owner and Consultants to observe the testing. All tests shall be in accordance with referencing specifications.
- D. Maintain a photo manifest of all installed locations throughout the construction.

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3.5 CONSTRUCTION SCHEDULE

- A. Once installation sequences have been determined and mock-up wall construction has been approved, modify the Construction Schedule to reflect the established sequencing of material installations and testing requirements. Distribute revised schedule.

END OF SECTION 01 43 39

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SECTION 014519
FIELD TESTING FOR AIR AND WATER LEAKAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Field testing of cladding systems in accordance with performance requirements indicated, including joints in adjacent construction designed to remain permanently closed and watertight.
 - 1. Resistance to water leakage.
 - 2. Resistance to air leakage.
- B. Owner will engage a qualified testing agency and pay costs of initial testing.
- C. Contractor shall engage a qualified testing agency and pay cost of testing.
- D. Contractor shall be responsible for and pay costs of remedial work and subsequent re-testing.
- E. Contractor shall perform out of sequence work as required to allow testing to occur at normal intervals.
- F. Related Requirements:
 - 1. Refer to Division 01 Building Enclosure Commissioning for field observations and performance testing activities.

1.2 DEFINITIONS

- A. Water Leakage: Uncontrolled water penetrating assemblies or water appearing on assemblies' normally exposed interior surfaces, or water that is not contained and drained to the exterior, or water that may damage adjacent materials or finishes. Water leakage does not include water controlled by flashing and gutters that is drained to exterior.
 - 1. Uncontrolled: Infiltrated water that is not captured, controlled or managed by flashings, gutters, and sills to drain to exterior, or water that wets perimeter containment system, wall insulation or exposed interior surfaces.
 - a. Water present within the adjacent wall system or adjacent construction assembly is considered water leakage.
 - 2. Controlled: Infiltrated water that is captured, controlled or managed by flashings, gutters, and sills to drain to exterior, or water that does not wet perimeter containment system, wall insulation or exposed interior surfaces

1.3 SUBMITTALS

- A. Contractor Testing Agency Qualifications:
 - 1. Submit qualifications for proposed Independent Testing Agency.
 - 2. Include qualifications statement for personnel conducting and signing test reports.
 - 3. Test Procedures: Submit testing documentation including but not limited to following:
 - a. Testing schedule.
 - b. Testing sequence including procedures and protocols.
 - c. Testing instrumentation and types of equipment.
 - 4. Test Locations: Submit drawings indicating proposed test locations and designated test procedure; include plans and elevations.

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- B. Field Quality Control Reports: Written report of testing and inspection required by Field Quality Control.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.

1.5 CONTRACTOR RESPONSIBILITIES

- A. Coordinate with Testing Agency. Provide labor, materials and equipment used for testing by testing agency personnel.
 - 1. Contractor shall be responsible for coordinating and scheduling tests.
 - 2. Provide powered scaffold, hose, water supply, communication system and manpower to perform tests. Schedule any work necessary, such as out of sequence sealant work, so that testing can be performed.
- B. Satisfactory results of testing do not relieve Contractor from conforming to requirements of Contract Documents, shop drawings, and project specifications. Installation work on remainder of building shall match area checked, unless otherwise instructed in writing.
- C. Pending actual performance, extent of or absence of water leakage in initial water penetration test, and measures adopted by the Contractor to eliminate leakage, Architect will determine need and scope of additional tests and test methods. Remedial measures are subject to approval by Architect and shall maintain standards of quality and durability.
- D. Remedial measures found necessary and effective in eliminating leakage in area checked shall be used in fabricating and installing remainder of the work.
- E. Notify Architect and testing agency when wall construction is ready for testing. Provide safe access for Architect and Testing Agency to interior and exterior of test locations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Refer to Technical Sections for performance requirements of each system or product to be tested.
- B. Water Spray Test: Selective field testing will be conducted in accordance with AAMA Standard 501.2 Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtainwalls, and Sloped Glazing Systems.
 - 1. Water Spray Test without Air Pressure Difference: Designated areas shall be tested in accordance with AAMA 501.2 and shall not evidence water penetration.
- C. Field Chamber Water Penetration Test: Selective field testing will be conducted in accordance with ASTM E 1105 Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Curtain Walls, and Doors by Uniform or Cyclic Static Air Pressure Difference - Procedure A.
 - 1. Water Penetration Test with Static Air Pressure Difference: Designated areas shall be tested in accordance with ASTM E 1105 at a minimum static air pressure differential specified for laboratory testing in Performance Requirements and shall not evidence water penetration.

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- D. Field Chamber Air Leakage Test: Selective field testing will be conducted in accordance with ASTM E 783 Standard Test Method for Field measurement of Air leakage Through Installed Exterior Window and Doors.
1. Air Leakage Test with Static Air Pressure Difference: Designated areas shall be tested according to ASTM E 783 at 1.5 times the rate specified for laboratory testing in Performance Requirements Article but not more than 0.09 cfm/sq. ft. (0.45 L/s per sq. m) at a minimum static air pressure differential specified for laboratory testing in Performance Requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

3.2 INSTALLATION, GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
1. Respective manufacturer's written installation instructions.
 2. Accepted submittals.
 3. Contract Documents.

3.3 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.
- B. Exterior wall construction shall be completed and shall be fully glazed to provide complete wall installation. Work shall be done in accordance with approved shop drawings and specifications.
1. Sealants shall be fully cured as recommended by manufacturer.

3.4 FIELD QUALITY CONTROL

- A. Owner Testing Agency: Owner will employ and pay a qualified independent testing agency to perform field quality control.
- B. Contractor Testing Agency: Contractor shall employ and pay a qualified independent testing agency to perform field quality control.
- C. Testing and Inspections, General: Testing and inspections shall take place as installation proceeds to determine compliance with specified performance requirements.
1. Performance Requirements: Systems shall be tested in accordance with definitions and at performance requirements, without reduction for field installation, as indicated in Technical Sections.
 2. Interior Finishes: Indoor side of wall in this area shall be unfinished and left open and unobstructed, permitting full length of joints to be examined from indoor side.

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- a. Do not install framing system trim and sealants prior to testing.
 - b. Where testing is performed with interior construction in place, Contractor shall remove interior construction as needed to allow inspections.
 - 3. All joints or other conditions within designated areas where leakage may occur will be tested.
 - a. If operable joints such as those around doors and operable parts of windows occur within wall area involved, appropriate modifications both of procedure and performance requirements will be made in respect to such joints.
 - 4. Correction of Deficiencies:
 - a. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.
 - b. Materials and installation failing to meet specified requirements shall be replaced at Contractor's expense.
 - c. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 - 5. Prepare test and inspection reports.
- D. Architect Designated Test Procedures and Locations:
- 1. Field Testing shall be performed at intervals and locations including but not limited to the following:
 - a. Water Spray Test per AAMA 501.2: Test at intervals and locations as directed by Architect; however, not less than the following:
 - 1) Four locations at 5% completion, four locations at 50% completion, and four locations at 90% completion.
 - b. Field Chamber Water Penetration Test per ASTM E 1105: Test at intervals and locations as directed by Architect; however, not less than the following:
 - 1) Two locations at 5% completion, two locations at 50% completion, and two locations at 90% completion.
 - c. Field Chamber Air Leakage Test per ASTM E 783: Test at intervals and locations as directed by Architect; however, not less than the following:
 - 1) Two locations at 10% completion, two locations at 50% completion, and two locations at 90% completion, in conjunction with Field Chamber Water Penetration Testing.
 - d. Perform one on more tests at locations with a re-glazed lite.

3.5 TEST REPORTS

- A. Testing laboratory shall be responsible for conducting and reporting tests, state in report whether test specimen conforms to requirements of Contract Documents and approved drawings, and specifically note any deviations.
 - 1. Include written documentation describing remedial work, including repairs and modifications required.
 - 2. Required corrections shall be performed in presence of Architect.
- B. Testing shall be witnessed by the Architect; acceptance of test assembly and test results shall be determined by the Architect.

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- C. Test reports shall be prepared according to testing standard indicated. Testing laboratory shall submit reports directly to Owner and Architect.

3.6 REMEDIAL WORK BY CONTRACTOR

- A. In event of failure to meet test requirements, Contractor and subcontractors shall redesign, rework, and/or re-fabricate, reship and re-erect assemblies as required until test requirements are met, at no additional cost to Owner.
 - 1. For each failed test, Contractor shall provide three additional consecutively successful test on like specimens at locations selected by the Architect.
- B. Wherever leakage has occurred, joints shall be made watertight in manner acceptable to Architect.
- C. Remedial work involving use of curing-type compounds shall be allowed to cure for one week minimum, but not less than manufacturer's written recommendation, before re-checking for leakage.
- D. After required remedial work and curing time are completed, repaired joints shall be retested.
- E. If leakage continues, additional remedial measures shall be performed; checking shall be repeated until joints in designated area are found to be acceptable.
 - 1. Re-checking, when required, shall be performed at the Contractor's expense by testing laboratory originally employed.

END OF SECTION

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SECTION 014541
PRECONSTRUCTION LABORATORY MOCKUP TESTING FOR BUILDING ENCLOSURE SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Construction of mock-up of Building Enclosure Systems for testing and coordination with testing laboratory services employed by Owner.
 - 1. Including but not limited to Delegated Engineering, labor, materials, and accessories indicated, specified, or required to complete installation and performance testing of exterior wall specimen (mock-up) in a laboratory.
- B. Related Requirements:
 - 1. Refer to Division 01 Section Field Test for Air and Water Leakage.

1.2 DEFINITIONS

- A. Water Leakage: Uncontrolled water penetrating assemblies or water appearing on assemblies' normally exposed interior surfaces, or water that is not contained and drained to the exterior, or water that may damage adjacent materials or finishes. Water leakage does not include water controlled by flashing and gutters that is drained to exterior.
 - 1. Uncontrolled: Infiltrated water that is not captured, controlled or managed by flashings, gutters, and sills to drain to exterior, or water that wets perimeter containment system, wall insulation or exposed interior surfaces.
 - 2. Controlled: Infiltrated water that is captured, controlled or managed by flashings, gutters, and sills to drain to exterior, or water that does not wet perimeter containment system, wall insulation or exposed interior surfaces

1.3 DELEGATED ENGINEERING REQUIREMENTS

- A. Delegated Engineering Responsibility: Contractor shall engage a qualified professional engineer to provide engineering for products and systems required to comply with the design intent of Contract Documents.
 - 1. Contract Documents Design Intent: Drawings and Specifications indicate design intent for products and systems and do not necessarily indicate or specify total Work required. Contract Documents shall not be construed as an engineered design; furnish and install Work required for a complete installation.
 - 2. Delegated Engineer Professional Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated with a record of successful in-service performance. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.
 - 3. Submittals: Preparation of structural analysis data including engineering calculations, shop drawings and other submittals signed and sealed by the qualified professional engineer.
 - 4. Coordination of Work:
 - a. Product Variations: In the event of minor differences between products and systems of acceptable or available manufacturers, Contractor shall notify Architect of such differences and resolve conflicts in a timely manner. Failure of Contractor to provide notification shall be construed as acceptance of conditions indicated,

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and changes caused by minor differences between products and Contract Documents shall be included in the Work at no additional cost to Owner.

- b. Allowable Adjustments: Minor dimension and profile adjustments may be made in interest of fabrication or erection methods or techniques or ability to satisfy design intent, provided design intent is maintained as determined by Architect. Proposed deviations shall include a detailed analysis of impact to adjacent substrates or other building systems, including related design or construction cost impacts. If accepted by Architect, deviations causing changes in materials, constructability, substrates, or conditions shall be included in the Work at no additional cost to Owner.

1.4 ACTION SUBMITTALS

- A. Shop Drawings: Show details of fabrication and installation. Submit mock-up Shop Drawings prior to fabrication and testing of mock-up unit.
 - 1. Include plans, elevations, and details, including thickness of metals and glass, methods of glazing, methods of anchoring, fastening and jointing, finishes of materials, perimeter sealants and other pertinent data and information.
 - a. Include project specific building maintenance unit tie-back retention mechanisms.
 - 2. Shop drawings shall contain seal of a Structural Engineer currently registered in licensing jurisdiction of the project and a written statement that the framing system conforms to project requirements, applicable codes, and specified conditions.
 - 3. Final acceptance of Shop Drawings will be determined after mock-up testing and compliance with aesthetic and performance requirements.
- B. As Built Mock-Up Drawings: Upon completion of testing, Contractor shall immediately provide "as built" mock-up drawings showing any modifications or additions required to meet performance requirements.
- C. Test Procedures: Laboratory shall submit testing documentation including but not limited to, following:
 - 1. Testing schedule.
 - 2. Testing sequence including procedures and protocols.
 - 3. Testing instrumentation and types of equipment.
 - 4. Statement of qualifications for personnel conducting and signing test reports.
- D. Test Reports.

1.5 INFORMATION SUBMITTALS

- A. Delegated Engineering Submittal: For products and systems indicating compliance with performance requirements. Include structural analysis, calculations and other performance data signed and sealed by the qualified professional engineer responsible for their preparation.
- B. Mock-up Construction Schedule: After review and approval by laboratory, contractor shall submit detailed schedule for construction of mock-up

1.6 COSTS OF TESTS

- A. Cost of laboratory testing fees only (excluding set-up charges) for first series of tests shall be paid for by Owner. Cost of set-up charges, including mobilization and travel, shall be paid for by each subcontractor.

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- B. In the event of failures require retesting, Contractor shall pay additional laboratory fees and any fees and expenses incurred by Owner, Architect, and Consultants, as result of retesting.
- C. Subcontractors shall be responsible for failure of their work to meet test requirements without adjustment to Contract Sum or Contract Schedule.

1.7 CONTRACTOR RESPONSIBILITIES

- A. Satisfactory results of testing do not relieve Contractor from conforming to requirements of Contract Documents, shop drawings, and project specifications.
- B. Remedial measures found necessary and effective in eliminating unacceptable test results shall be used to fabricate and install the building enclosure on the project, unless directed otherwise in writing.
- C. Notify Architect and Owners Consultant a minimum of two weeks in advance of when mock-up construction begins and when mock-up will be ready for testing. Architect and Owner Consultant will observe testing.
 - 1. No pre-testing of any kind is allowed without consent of the Architect and Owner.

PART 2 - PRODUCTS

2.1 CONSTRUCTION

- A. Mockup Construction: Contractor shall arrange for erection of test chamber at approved testing laboratory, including simulated structural supports suitable for construction of mock-ups of exterior wall construction of size and configuration indicated.
 - 1. Build preconstruction laboratory mockups at testing agency facility using personnel, products, and methods of construction that will be used at Project site.
- B. Construct full size Mock-up of typical Building Corner Unit, as shown on the Architectural Drawings, two full building stories in height, including inside and outside corners, plus their connections and supporting elements.
 - 1. Details of the mock-up and test procedure shall be formally approved prior to the commencement of testing or the mock-up shall be deemed unacceptable.
- C. Mockups shall be complete with corners, splice joints, sealants, glass and glazing, anchors, and finishes, with details complete and identical to those proposed for use in building. Do not use excessive amounts of sealant, nor other special measures or techniques not representative of those to be used in building. Finish various components to show maximum variation that will exist in actual building construction between adjacent and non-adjacent components.
 - 1. Allow sufficient time for chemically curing sealants to achieve their proper cure as recommended by manufacturer.
- D. Set up and complete installation of mock-ups at testing laboratory. Mock-ups shall be used to demonstrate quality of materials, finishes and workmanship as well as compliance with performance requirements.
 - 1. Upon completion of satisfactory tests, dismantle mock-ups and remove from premises.
- E. Testing will be performed at one of the following facilities:
 - 1. Construction Consulting Laboratory, Carrollton, Texas.

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PART 3 - EXECUTION

3.1 INSTALLATION

- A. Mockup Installation: Install products and materials in accordance with specified requirements. Include flashings, anchors, interior trim and aluminum covers to demonstrate performance and engagement will not be affected by testing.
- B. Simulate building conditions including the arrangement of structural members and anchorages that will exist within the building.
- C. Glass shall be the same type and manufacturer that will be used on the project, unless approved otherwise by substitution. Provide not less than one additional lite for each type and size of glass.
 - 1. Provide additional accessory materials including, but not limited to gaskets, removable covers and similar items so as not to delay testing should these items need to be replaced during testing.
- D. Finish various components to show the maximum variation between adjacent and non-adjacent components that will exist in the actual building construction.

3.2 TESTING PROCEDURES

- A. Performance Requirements:
 - 1. **Building Enclosure Systems shall be tested in accordance with Performance Requirements, without reduction, as indicated in Technical Sections.** Variations in criteria over the surface of the building, such as wind pressure, shall be accounted for in testing mock-up.
 - a. Apparatus used for conducting tests shall meet requirements of each test procedure and shall be calibrated as prescribed therein.
- B. Air Infiltration:
 - 1. In accordance with ASTM E283 Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
- C. Water Penetration:
 - 1. Static Pressure: In accordance with ASTM E331 Standard Test Method for Water penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.
 - 2. Dynamic Pressure: In accordance with AAMA 501.1 Standard Test Method for Water Penetration of Windows, Curtain Walls and Doors using Dynamic Pressure.
- D. Structural:
 - 1. In accordance with ASTM E330/E330M Standard Test Method for Structural performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
- E. Interstory Drift (Horizontal Displacement):
 - 1. In accordance with AAMA 501.4 Recommended Static Test Method for Evaluating Window Wall, Curtain Wall and Storefront Systems Subjected to Seismic and Wind-Induced Inter-Story Drift.

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- F. Vertical Interstory Movement (Vertical Displacement):
 - 1. In accordance with AAMA 501.7 Recommended Static Test Method for Evaluating Windows, Window Wall, Curtain Wall and Storefront Systems Subjected to Vertical Inter-Story Movements.
- G. Thermal Cycling:
 - 1. In accordance with AAMA 501.5 Test Method for Thermal Cycling of Exterior Walls..

3.3 TESTING

- A. Preconstruction Laboratory Mockup Testing: Test preconstruction laboratory mockups according to requirements in "Performance Requirements" Article. Perform the following tests in the following order:
 - 1. Structural: ASTM E330/E330M at 50 percent of positive test load.
 - 2. Air Leakage: ASTM E283.
 - 3. Water Penetration under Static Pressure: ASTM E331.
 - 4. Water Penetration under Dynamic Pressure: AAMA 501.1.
 - 5. Structural: ASTM E330/E330M at 100 percent of positive and negative test loads. Repeat the following:
 - a. Air Leakage: ASTM E283.
 - b. Water Penetration under Static Pressure: ASTM E331.
 - c. Water Penetration under Dynamic Pressure: AAMA 501.1.
 - 6. Interstory Drift (Horizontal Displacement): AAMA 501.4 at 100 percent of design displacement. Repeat the following:
 - a. Air Leakage: ASTM E283.
 - b. Water Penetration under Static Pressure: ASTM E331.
 - c. Water Penetration under Dynamic Pressure: AAMA 501.1.
 - 7. Vertical Interstory Movement (Vertical Displacement): AAMA 501.7. Repeat the following:
 - a. Air Leakage: ASTM E283.
 - b. Water Penetration under Static Pressure: ASTM E331.
 - c. Water Penetration under Dynamic Pressure: AAMA 501.1.
 - 8. Thermal Cycling: In accordance with AAMA 501.5. Repeat the following:
 - a. Air Leakage: ASTM E283.
 - b. Water Penetration under Static Pressure: ASTM E331.
 - 9. Structural: ASTM E330/E330M at 100 and 150 percent of positive and negative test loads. Repeat the following:
 - a. Air Leakage: ASTM E283.
 - b. Water Penetration under Static Pressure: ASTM E331.
 - 10. Concentrated Load on Building Maintenance Unit Tieback.
- B. If mock-up fails to achieve acceptable performance, repair defects and deficiencies on mock-up, repeat testing and inspection until acceptable performance is achieved, and then restart test sequence beginning with test prior to failed test.
- C. Re-glazing Procedure: Contractor shall demonstrate re-glazing procedure at conclusion of testing.

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3.4 TEST REPORTS

- A. Report for tests shall include date of test and date of report, identification of specimen (manufacturer, source or supply, dimensions, model, type, materials, and other pertinent information).
- B. Testing agency shall inspect specimen and report noted deviations to mock-up shop drawings.
- C. For Air Infiltration under Uniform Static Air Pressure, include:
 - 1. Statement or tabulation of pressure difference exerted across specimen during test and corresponding rate of air leakage for each specimen tested, calculated in accordance with ASTM E 283.
- D. For Water Penetration under Uniform Static Air Pressure and Dynamic Air Pressure, include:
 - 1. Statement or tabulation of pressure difference or differences exerted across specimen and water application rates during test. For dynamic test statement of engine speed (rpm) and air stream velocity (mph).
 - 2. Record of points of water penetration on indoor face of test specimen, and of water leakage.
- E. For Structural Performance Under Uniform Static Air Pressure Difference, include:
 - 1. Tabulation of pressure differences exerted across specimen during test and deflections and permanent deformations at locations specified for each specimen tested.
 - 2. Duration of test loads.
 - 3. Record of visual observations of performance.
 - 4. When tests are made to check conformity of specimen to particular specification, identification or description of that specification.
 - 5. Statement that tests were conducted in accordance with this method, or full description of any deviations from this method.
 - 6. Statement as to whether or not tape or film, or both, were used to seal against air leakage, and whether in judgment of test agency, tape or film influenced results of test.
 - 7. If several essentially identical specimens of component are tested, results for specimens shall be reported, each specimen being properly identified, particularly with respect to distinguishing features or differing adjustments. Separate drawing for each specimen will not be required if differences between them are noted on drawings provided.
- F. For Structural Performance Under Vertical Displacement Resistance, include:
 - 1. Statement or tabulation of vertical displacements applied to the specimen
 - 2. Statement that tests were conducted in accordance with this method, or full description of any deviations from this method
 - 3. Record of visual observations of performance documenting failures and non-compliant performance
- G. For Structural Performance Under Horizontal Displacement Resistance, include:
 - 1. Statement or tabulation of service level and design level horizontal displacements applied to the specimen
 - 2. Statement that tests were conducted in accordance with this method, or full description of any deviations from this method
 - 3. Record of visual observations of performance documenting failures and non-compliant performance

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H. Testing laboratory shall be responsible for conducting and reporting tests, shall state in report whether test specimen conforms to requirements of Contract Documents' approved drawings, and shall specifically note any deviations therefrom.

1. Include written documentation describing remedial work, including repairs and modifications required.

I. Test reports shall be prepared according to testing standard indicated. Testing laboratory shall submit reports directly to Owner and Architect

3.5 CORRECTION OF WORK BY CONTRACTOR

A. In event of failure to initially meet test requirements called for hereinabove, Contractor and respective subcontractors shall, as required, redesign, rework, and/or refabricate, reship and re-erect and retest mock-up assemblies until said requirements are met, at no additional cost to Owner.

END OF SECTION

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SECTION 015000

TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

1.2 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, occupants of Project, testing agencies, and authorities having jurisdiction.
- B. Sewer Service: Pay sewer-service use charges for sewer usage, indicated by utility company meter readings, by all entities for construction operations.
- C. Water Service: Pay water-service use charges for water used, indicated by utility company meter readings, by all entities for construction operations.
- D. Electric Power Service: Pay electric-power-service use charges for electricity used, indicated by utility company meter readings, by all entities for construction operations.

1.3 INFORMATIONAL SUBMITTALS

- A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.
- B. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage.
 - 1. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.
 - 2. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
 - 3. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
- C. Dust- and HVAC-Control Plan at Renovation Work: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Identify further options if proposed measures are later determined to be inadequate. Include the following:
 - 1. Locations of dust-control partitions at each phase of work.
 - 2. HVAC system isolation schematic drawing.
 - 3. Location of proposed air-filtration system discharge.
 - 4. Waste handling procedures.
 - 5. Other dust-control measures.
- D. Temporary Utility Reports: Make available on request, reports of tests, inspections, meter readings, and similar procedures performed on temporary utilities.

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- E. Implementation and Termination Schedule: Make available on request a schedule indicating implementation and termination of each temporary utility.

1.4 QUALITY ASSURANCE

- A. Standards: Comply with ANSI A10.6 "Requirements for Demolition Operations", NECA's "Temporary Electrical Facilities," and NFPA 241 "Standard for Safeguarding Construction, Alteration, and Demolition Operations".
 - 1. Trade Jurisdictions: Assigned responsibilities for installation and operation of temporary utilities are not intended to interfere with trade regulations and union jurisdictions.
- B. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- C. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.
- D. Accessible Temporary Egress at Renovation Work: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.
- E. Regulations: Comply with industry standards and applicable laws and regulations of authorities having jurisdiction, including but not limited to, the following:
 - 1. Building Code requirements.
 - 2. Health and safety regulations.
 - 3. Utility company regulations.
 - 4. Police, Fire Department and Rescue Squad rules.
 - 5. Environmental protection regulations.
 - 6. City ordinances and regulations.

1.5 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Provide new materials. Undamaged, previously used materials in serviceable condition may be used if approved by Architect. Provide materials suitable for use intended.
- B. Materials and equipment may be new or used, but must be adequate in capacity for the required usage, must not create unsafe conditions, and must not violate requirements of applicable codes and standards.
- C. Chain-Link Fencing: Minimum 2 inch (50 mm), 0.148 inch (3.8 mm) thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet (1.8 m) high with galvanized-steel pipe posts; minimum 2-3/8 inch (60 mm) OD line posts and 2-7/8 inch (73 mm) OD corner and pull posts, with 1-5/8 inch (42 mm) OD top rails.
- D. Portable Chain-Link Fencing: Minimum 2 inch (50 mm), 0.148 inch (3.8 mm) thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet (1.8 m) high with galvanized-steel pipe posts; minimum 2-3/8 inch (60 mm) OD line posts and 2-7/8 inch (73 mm) OD corner and

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pull posts, with 1-5/8 inch (40 mm) OD top and bottom rails. Provide concrete or galvanized-steel bases for supporting posts.

- E. Wood Enclosure Fence: Plywood, 8 feet (2.4 m) high, framed with four 2 by 4 inch (50 by 100 mm) rails, with preservative-treated wood posts spaced not more than 8 feet (2.4 m) apart.
- F. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10 mil (0.25 mm) minimum thickness, with flame-spread rating of 15 or less per ASTM E 84 and passing NFPA 701 Test Method 2.
- G. Polyethylene Sheet: Reinforced, fire-resistive sheet, 6 mil (0.14 mm) minimum thickness, with Class A flame-spread rating per ASTM E 84 and passing NFPA 701 Test Method 2.
 - 1. Basis of Design (Product Standard): Abatement Technologies, Inc.; SAFE-FLEX ICRA Awareness Barrier.
- H. Dust Containment Barrier for Doors: reinforced, fire-resistive polyethylene sheet, 10 mil (0.25 mm) minimum thickness with Class B flame-spread rating per ASTM E 84 and designed to be used for securing temporary construction doors so as to minimize and mitigate particle control during construction.
 - 1. Basis of Design (Product Standard): Abatement Technologies, Inc.; Aire Guardian Door Guard Reusable Barrier.
- I. Dust-Control Adhesive-Surface Walk-off Mats: Provide mats minimum 36 by 60 inches (900 by 1500 mm).
- J. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

2.2 TEMPORARY FACILITIES

- A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:
 - 1. Furniture required for Project-site.
 - 2. Conference room of sufficient size to accommodate. Provide electrical power service and 120-V ac duplex receptacles. Furnish room with conference table, chairs, and tack and marker boards.
 - 3. Drinking water and private toilet.
 - 4. Heating and cooling equipment necessary to maintain a uniform indoor.
 - 5. Lighting fixtures capable of maintaining average illumination at desk height.
- C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
 - 1. Store combustible materials apart from building.

2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
 - 1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

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- B. Self-Contained Toilet Units: Single-occupant units of chemical, aerated recirculation, or combustion type; vented; fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.
- C. Drinking-Water Fixtures: Containerized, tap-dispenser, bottled-water drinking-water units, including paper cup supply.
- D. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
 - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
 - 2. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
- E. Air-Filtration Units for Renovation Work: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

- A. Locate temporary utilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify utilities as required.
- B. Provide each utility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until utilities are no longer needed or are replaced by authorized use of completed permanent utilities.
- C. Engage appropriate local utility company to install temporary service or connect to existing service. Where utility company provides only part of the service, provide the remainder with matching, compatible materials and equipment. Comply with utility company recommendations.
 - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
 - 2. Provide adequate capacity at each stage of construction. Before temporary utility is available, provide trucked-in services.
 - 3. Obtain easements to bring temporary utilities to Project site where Owner's easements cannot be used for that purpose.
- D. Storm Sewers and Drainage: If sewers are available, provide temporary connections to remove effluent that can be discharged lawfully. If sewers are not available or cannot be used, provide drainage ditches, dry wells, stabilization ponds, and similar facilities. If neither sewers nor drainage facilities can be lawfully used for discharge of effluent, provide containers to remove and dispose of effluent off-site in a lawful manner.

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1. Filter out excessive soil, construction debris, chemicals, oils, and similar contaminants that might clog sewers or pollute waterways before discharge.
 2. Connect temporary sewers to municipal system as directed by sewer department officials.
 3. Maintain temporary sewers and drainage facilities in a clean, sanitary condition. After heavy use, restore normal conditions promptly.
 4. Provide temporary filter beds, settlement tanks, separators, and similar devices to purify effluent to levels acceptable to authorities having jurisdiction.
- E. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction. Sterilize temporary water piping before use in accordance with requirements of authorities having jurisdiction.
- F. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
1. Existing Toilets in Occupied Facilities: Use of Owner's existing toilet facilities will not be permitted or allowed.
- G. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- H. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.
1. Prior to commencing work, isolate the HVAC system in area where work is to be performed according to coordination drawings.
 - a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
 - b. Maintain negative air pressure within work area using HEPA-equipped air-filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.
 2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust-containment devices.
 3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.
- I. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
1. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.
- J. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
- K. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

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- L. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Provide telephone line(s) for each field office.
- M. Electronic Communication Service: Provide internet access of not less than 15-Mbps download and 5-Mbps upload speed for use by Architect and Owner to access Project electronic documents and maintain electronic communications

3.3 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
 - 1. Locate field offices, storage sheds, sanitary facilities, and other temporary construction and support facilities for easy access.
 - 2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate to support loads and to withstand exposure to traffic during construction period. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.
 - 1. Provide dust-control that is nonpolluting and nontracking. Reapply as required to minimize dust.
- C. Traffic Controls: Provide temporary traffic controls at junction of temporary roads with public roads. Include warning signs for public traffic and "STOP" signs for entrance onto public roads. Comply with requirements of authorities having jurisdiction.
 - 1. Protect existing site improvements to remain including curbs, pavement, and utilities.
 - 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- D. Parking: Coordinated parking with Owner's requirements.
- E. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
 - 1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
 - 2. Before connection and operation of permanent drainage piping system, provide temporary drainage where roofing or similar construction is completed.
 - 3. Remove snow and ice as required to minimize accumulations.
- F. Project Signs: Coordinated signs with Owner's requirements and requirements of authorities having jurisdiction.
- G. Waste Disposal Facilities: Comply with requirements specified in Division 01 Section "Construction Waste Management and Disposal."
- H. Comply with progress cleaning requirements in Division 01 Section "Execution."
- I. Existing Elevator Use in Occupied Facilities: Use of Owner's existing elevators will be permitted, provided elevators are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore elevators to condition existing before initial use, including replacing worn cables, guide shoes, and similar items of limited life.
 - 1. Do not load elevators beyond their rated weight capacity.
 - 2. Provide protective coverings, barriers, devices, signs, or other procedures to protect elevator car and entrance doors and frame. If, despite such protection, elevators

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become damaged, engage elevator Installer to restore damaged work so no evidence remains of correction work. Return items that cannot be refinished in field to the shop, make required repairs and refinish entire unit, or provide new units as required.

- J. Existing Stair Usage in Occupied Facilities: Use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.
 - 1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas so no evidence remains of correction work.

- K. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
 - 1. Comply with work restrictions specified in Division 01 Section "Summary."
- C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to requirements of 2003 EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
- D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- E. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- F. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.
- G. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.
 - 1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
- H. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- I. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.

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- J. Covered Walkway: Erect protective, covered walkway for passage of individuals through or adjacent to Project site. Coordinate with entrance gates, other facilities, and obstructions. Comply with regulations of authorities having jurisdiction and requirements indicated on Drawings.
- K. Temporary Enclosures: Provide temporary, weathertight, enclosures for protection of construction, in progress and completed, including, but not limited to, vertical and horizontal openings, from exposure, foul weather, other construction operations, and similar activities.
- L. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas from fumes and noise.
 - 1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire-retardant-treated plywood on construction operations side.
 - 2. Construct dustproof partitions with two layers of 6 mil (0.14 mm) polyethylene sheet on each side. Cover floor with two layers of 6 mil (0.14 mm) polyethylene sheet, extending sheets 18 inches (450 mm) up the sidewalls. Overlap and tape full length of joints. Cover floor with fire-retardant-treated plywood.
 - a. Construct vestibule and airlock at each entrance through temporary partition with not less than 48 inches (1200 mm) between doors. Maintain walk-off mats in vestibule, for dust control.
 - 3. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
 - 4. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
 - 5. Protect air-handling equipment.
 - 6. Provide walk-off mats at each entrance through temporary partition.
- M. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241 and authorities having jurisdiction; manage fire-prevention program.

3.5 MOISTURE CONTROL

- A. Contractor's Moisture-Protection Plan: Avoid trapping water in finished work. Document visible signs of discoloration that may appear during construction.
- B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure, protect as follows:
 - 1. Protect porous materials from water damage.
 - 2. Protect stored and installed material from flowing or standing water.
 - 3. Keep porous and organic materials from coming into prolonged contact with concrete.
 - 4. Remove standing water from decks.
 - 5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture, protect as follows:
 - 1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
 - 2. Keep interior spaces reasonably clean and protected from water damage.
 - 3. Periodically collect and remove waste containing cellulose or other organic matter.
 - 4. Discard or replace water-damaged material.
 - 5. Do not install material that is wet.

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6. Discard, replace, or clean stored or installed material that begins to show discoloration.
 7. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.
- D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
 2. Use permanent HVAC system to control humidity.
 3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits. Refer to technical specification sections for additional and more stringent criteria.
- 3.6 OPERATION, TERMINATION, AND REMOVAL
- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
 2. Maintain markers for underground lines. Protect from damage during excavation operations.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
1. Materials and facilities that constitute temporary facilities are property of Contractor.
 2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
 3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 01 Section "Closeout Procedures."

END OF SECTION

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SECTION 01 5639

TREE PROTECTION, REMOVAL, AND PRUNING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Furnish all work and materials, appliances, tools, equipment, facilities, transportation, and services necessary for and incidental to performing all operations in connection with the protection, pruning, care, and removal of trees.
- B. The Contractor shall provide protection and care of existing trees or other designated plant material in order to maintain a healthy, vigorous condition.
- C. The Contractor shall perform tree removal, stump grinding and pruning as specified, utilizing acceptable horticultural standards as adopted by the Texas Association of Landscape Contractors (TALC) or Texas Nurseryman Association.
- D. Such work shall include, but is not limited to, the following:
 - 1. Protection of existing trees and landscape to remain from the following types of damage:
 - a. Compaction of root zone by foot, vehicular traffic or material storage.
 - b. Trunk and branch damage from equipment operations, material storage, or from nailing or bolting.
 - c. Root poisoning from spilled solvents, gasoline, paint, and other noxious materials.
 - d. Branch damage due to improper pruning or trimming.
 - e. Damage from lack of water due to:
 - 1) Cutting or altering natural water migration patterns near root zones.
 - 2) Failure to provide adequate watering.
 - f. Damage from alteration of soil pH factor caused by depositing lime, concrete, plaster or other base materials near roots.
 - g. Damage to root zone by coverage of soil.
 - 2. Pruning roots where indicated or specified.
 - 3. Removal and grinding of stump.
 - 4. Removal of understory vegetation.
 - 5. Removal and pruning of tree branches and roots adjacent to new construction and excavation or where construction access route is to occur to reduce damage to tree canopy and roots.
 - 6. Application of wound treatment to Quercus species branch cuts.
 - 7. Removal of existing gravel drives, asphalt roads, road bedding and existing concrete curbs and/or sidewalk within root zone areas of existing trees to remain. NO excavating procedures shall take place under or around the trees.
 - 8. Removal of abandoned existing utilities to prevent damage to root systems above.
 - 9. Removal of dead wood and broken or hanging branches from the existing trees.
 - 10. Application of mulch product and root stimulant at trees to be root pruned and trees to be protected.
 - 11. Placement of plywood over mulch in areas between tree protection fencing and face of vertical features or retaining walls to prevent compaction of soils.
 - 12. Watering and maintenance of root pruned trees.
 - 13. Supplemental hand watering as needed to existing trees.
 - 14. Documentation of tree removal, damage and treatment shall be recorded and submitted.

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- E. All work of this section is to be performed and supervised by ISA Certified Arborist with minimum of ten (10) years of experience.

1.2 PROJECT CONDITIONS AND DOCUMENTATION SUBMITTAL

- A. Verify and examine site conditions with the Owner's Representative. Proceed when official notice is given to the Contractor that the work site is ready. Proceed with tree protection prior to any site work, demolition or grading.
- B. Document the condition of every tree to remain and every tree to be protected by dated photograph submitted to the Owner. Submit six (6) photographs per tree showing the tree, branching, and roots at various angles. Photograph existing trees to remain with Owner's representative present to verify and record tree designation and health at time of commencing site work. Provide one (1) copy of photos to Owner. Contractor to maintain one (1) copy of tree photos and record of tree health in notebook (or pdf file) for entire construction period.
- C. TREE STATUS REPORTS - Submit quarterly (4) reports issued by Arborist regarding the status of tree health, for the remaining trees within the area of construction contract, and care along with recommendations to preserve tree health. Existing trees have not been regularly irrigated and are susceptible to stress due to the site construction conditions and duration. The report shall include a narrative from the Arborist and a minimum of two (2) photos per tree to document the tree's health or any damage. Additional reports shall be required should tree damage (e.g. loss of large branches or limbs) occur due to construction or act of God (snow, ice, wind) which are due within one week of the event.
1. Submit a written inventory in Excel spreadsheet format of all trees on the site. The report must be prepared and submitted by Contractor's Arborist. The Arborist shall record the tree identification number and size in caliper inches (as shown on the drawings). The spread sheet shall record all trees on site including type of protection, care, and the type of damage received (e.g. part of root zone removed due to excavation, compaction of root zone due to vehicular access or construction, etc.). The inventory shall document the type of treatment that damaged trees received. A sample inventory follows which is not meant to be comprehensive.

XYZ Project – TREE INVENTORY of Health, Damage, Repair and Removal					
Prepared by XYZ Arborist, License/Certification No.; Date					
Tree No.	Tree ID	Caliper Inches Remain Removed		Status	Treatment*
01	Post Oak	26		Protected; no change	M
02	Live Oak		10	Removed per plans	-
03	Red Oak	12		Damage - 20% of root zone removed	RP, CT, M
04	Cedar Elm	14		Damage – 30% of root zone removed	RP, CT, M
05	Hackberry		15	Removed due to ice storm damage	--
06	Pecan	24		Removed 2 limbs for construction access	M, W
07	Post Oak	12		Damage – root zone compaction	Aeration, M
08	Live Oak	18		Damage – canopy loss, large branch broken by concrete truck	M, WP, RP
ETC.					
TOTAL INCHES REMOVED			25		

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**A* Aeration – Performed hydraulic aeration of root zone, 24" on center.*

**CT – Performed canopy trimming to remove branches proportional to root loss*

**M – Mulch applied to root zone*

**RP – Root pruning and root stimulant applied*

**W, WP – Branch trimmed and Wound paint applied for Quercus*

Describe other treatments

2. The inventory shall include photos of damaged and trees to show status of health, damage, and signs of insect, disease, mite, pests, mistletoe, mosses, lichen or stress/decline. Submit at least four (4) photos per tree from various angles/viewpoints arranged on 8-1/2 x 11 format with trees labeled corresponding to "Tree Inventory" and site plan. Use a digital camera with at least 5.0 megapixels of resolution to document observations.
3. Submit inventory with corresponding photos in digital format (pdf) and with one copy printed on 8-1/2 x 11 paper and organized into three-hole binder. The four (4) photos per tree shall be organized onto one (1) sheet of paper.
4. Tree photographs must be accompanied by assessment of tree health and existing damage by the Contractor's ISA Certified Arborist.
5. The photo documentation and assessment will serve as a benchmark for future comparisons when a tree is damaged or in decline after any on-site clearing, grubbing, grading, or other work activity.
6. Receive approval of tree photo documentation prior to starting tree protection and site work.
7. Proceeding with site work without approval on pre-construction tree assessment from the Owner's Authorized Representative will make the Contractor responsible for existing damage.
8. The inventory shall include photos of tree protection fencing in place prior to site work at all locations. Include at least four (4) photos of fencing in place prior to construction activities at each location.
9. Monthly Tree Assessments shall be performed by the Contractor's arborist throughout the duration of construction and landscape establishment period. Monthly Tree Assessments shall be submitted in accordance with submittal requirements.
10. Submit inventory as work progresses and at end of project as part of Final Acceptance.
11. Prior to Closeout and with approval of the Owner's Representative a final Post-Construction Tree Assessment shall be performed. The Post Construction Tree Assessment shall be performed no more than two (2) months prior to Project Closeout.

1.3 ARBORIST INVOLVEMENT AND QUALIFICATIONS

- A. Submit resume and relevant tree preservation experience of ISA Certified Arborist prior to commencing work. Arborist shall have a minimum of ten (10) years of experience in tree preservation and care. The Arborist shall submit ten (10) example tree preservation projects along with the project site address and project representative's name and phone number.
- B. Submit manufacturer's product information for root sealant, limb sealant, root stimulant, or other item recommended by the Arborist.
- C. The Contractor is required to his Arborist prior to any construction activity near the protected trees. The Contractor Arborist's report shall be the guide for any construction activity within the vicinity of trees identified for preservation.
- D. The Arborist shall be required to regularly monitor the health of the trees being preserved. The Arborist shall inspect trees monthly and issue monthly assessment reports documenting tree health and tree care measures employed to preserve or enhance the tree's health.

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1.4 SEQUENCING

- A. Coordinate installation of protection devices and other related units of Work specified in other Sections to ensure that protection of existing trees is complete prior to any site work, demolition or grading.
- B. Trees designated for root or branch pruning must be pruned prior to commencing site work or demolition.

1.5 DAMAGES

- A. Trees that are designated to remain but, during the course of construction, are removed, severely damaged, in significant decline or have died due to Contractor's work or neglect shall be replaced and/or damages paid by the Contractor to the Owner per the schedule below at the Contractor's expense.
- B. For trees four (4) inch caliper or greater, the Owner's Authorized Representative will assess the following damages for damaged, dead or dying, or removed trees to be paid by the Contractor to the Owner.

Tree size – Diameter/Caliper in Inches	Replacement Tree or Value Each tree
Equal to 4 and up to 6	\$ 1,500.00
Equal to 6 and up to 8	\$ 3,000.00
Greater than 8 and up to 12	\$ 6,000.00
Greater than 12 inches	\$ 1,000 per caliper inch

Size will be determined by measuring caliper at twelve (12) inches above grade for trees from four (4) to twelve (12) inch caliper and at six (6) inches above grade for trees from zero (0) to four (4) inch in caliper.

Trees that are larger than twelve (12) inch in caliper shall be measured at four (4) feet above natural ground elevation, or from top of stump, if removed.

Multi-trunk trees shall be measured at twelve (12) inches above grade of each trunk. The largest trunk's diameter shall be counted as 100% caliper; the remaining trunks shall be counted at 50% caliper.

- C. For Damaged trees twelve (12) inch caliper and greater – If a major branch is damaged, the cost will be assessed by the percentage of the tree canopy that is lost. For example, if the loss of a branch results in one-fifth of the canopy loss, then the penalty on a twenty (20) inch tree would be one-fifth or \$4,000.00.
- D. Slight Damage: shall be defined as damage that may heal.
 - 1. Examples include but are not limited to: scaring of the trunk into the cambial layer one-half ($\frac{1}{2}$) inch to two (2) inches in width but less than one-third ($\frac{1}{3}$) trunk circumference or breaking of limbs less than two (2) inches in diameter or limbs less than one-third ($\frac{1}{3}$) trunk caliper, whichever is less.
 - 2. Slight damage shall also include removal or lying down of protective tree fencing prior to end of construction, storing equipment or supplies within the critical root zone (CRZ), or disposing of paint or concrete within the CRZ but not closer to the trunk than 50% radius of the CRZ. Slight damage to trees shall be assessed at a rate of \$100.00 for each instance. Each day tree fencing is not properly placed, equipment or supplies are stored within CRZ or fill is stored within the CRZ shall be considered one instance.

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- E. Moderate Damage: shall be defined as damage that contributes to the poor health and reduced longevity of the tree.
 - 1. Examples include but are not limited to: scaring of the trunk into the cambial layer greater than two (2) inches but less than one-third (1/3) the trunk circumference or breaking of limbs more than two (2) inches in diameter but less than one-third (1/3) trunk caliper.
 - 2. Moderate damage shall also include compaction of soil, grading or filling in 20% of the CRZ on one of four sides but outside the 50% radius of the CRZ, disposing of paint or concrete within 50% radius of the CRZ. Moderate damages shall be calculated at a rate of one-half (½) the assessed value of the tree per each instance of damage.
- F. Severe Damage: shall include removal or damage no defined as slight or moderate.
 - 1. Examples include but are not limited to: scaring of the trunk to the cambial layer greater than one-third (1/3) the trunk circumference, uprooting or causing a tree to lean, damage to a scaffolding branch or branch greater than one-third (1/3) of trunk caliper.
 - 2. Severe damage shall also include compaction of soil, grading or filling more than 20% of the CRZ, or within 50% radius of the CRZ or on more than one (1) of four (4) sides. Cutting one-third (1/3) of the buttress roots within three (3) times the distance of the DBH of the trunk, or cutting four (4) roots four (4) inches or greater in diameter within four (4) foot of the trunk shall also be considered severe damage.
 - 3. Severely damaged trees shall be designated by the Owner's Authorized Representative and shall be scheduled for removal. The Contractor shall pay the Owner penalty as described in the table above.
- G. Assessment of Tree Mitigation: The Owner's Authorized Representative opinion is final regarding tree damage penalties. The Owner's Authorized Representative may exercise the right to stop any work if any level of tree damages are being incurred due to the execution of the work until the Contractor and develop a work plan which prevents further damage to the existing trees.
- H. Trees that must be removed due to damage caused by the Contractor shall be removed at the Contractor's expense.
- I. All damages shall be paid to the Owner. Failure to replace or pay for damaged trees shall result in a breach of contract and the Contractor will be automatically assessed damages. Damages as described herein shall be deducted from payments otherwise due to the Contractor.

1.6 WATER

Potable water is available on site.

PART 2 - PRODUCTS

2.1 WOUND PAINT

For trees within protection fencing area that may need limb pruning/removal, use petroleum or latex base tree wound paint, dark gray, brown or black in color. Spray type paints are acceptable for use on genus Quercus only.

2.2 TREE PROTECTION FENCING

- A. Refer to the drawings for the location of proposed tree protection fencing.
- B. Fencing: Non-movable chain link fencing.
 - 1. All elements hot dip galvanized and unless otherwise shown.
 - 2. All elements consist of the following:
 - a. Chain link fencing: Nine (9) gauge, two (2) inch mesh, four (4) foot height.

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- b. Posts: two and three-eighths (2 3/8) inches outside diameter, minimum, steel driven and set a minimum of two (2) feet into ground. Posts are set maximum eight (8) feet on center.
 - c. Brace rails: one and five-eighths (1 5/8) inch outside diameter, minimum.
 - d. Stretcher bars: one-quarter (1/4) inch by three-quarter (3/4) inch, minimum.
- C. Orange Safety Fencing for trees (as shown on plans):
 - 1. Orange safety fencing: polyvinyl mesh, four (4) foot height.
 - 2. Posts: Metal T-posts, minimum of four (4) foot above finished grade and two (2) feet below grade.
- D. Refer to drawings for additional fencing requirements.
- E. Temporary enclosures and wrapping
 - 1. The Contractor shall protect tree trunks and root zones from damage. If fencing is not possible due to proximity of construction, then the Contractor is obligated to wrap the trunk with material sufficient to protect the trunk from any damage. The Contractor is obligated to protect the root zone from compaction and damage. The Contractor may use 2x4 pieces wired together to protect the trunk to a minimum height of eight (8) feet above grade. Mulch, gravel and plywood boards should be used to cover 100% of the root zone.
 - 2. Miscellaneous materials: burlap, coarsely shredded hardwood mulch, septic (rounded) gravel.
 - 3. The Contractor shall be aware and flag, if necessary, existing overhead canopies of trees to remain. Equipment shall operate with lowered boom or cranes to protect the existing tree canopies from damage.

2.3 MULCH AND COMPOST

- A. Mulch – Commercially available decomposed coarsely shredded hardwood mulch at three (3) inch depth. Mulch shall have been decomposing for a minimum of sixty (60) days.

Shredded tree mulch – Undecomposed, twice shredded hardwood mulch from on-site trees that do not include invasive tree species. This mulch must be utilized with a compost bottom layer that shall be one-half (1/2) to one (1) inch and the undecomposed hardwood added for a minimum three (3) inch combined thickness.
- B. Compost - commercially available, mature, fully decomposed compost that complies with Section 32 9200 Turf and Grasses.

2.4 MISCELLANEOUS PRODUCTS

- A. Tree Fertilizer: Fertilize all trees with a combination of PHC for trees 27-9-9 and Mycor Tree Injectable. Mix 8 pounds of PHC for trees and A and B packets of Mycor Tree Injectable per one hundred (100) gallons of water.
- B. Herbicides, Insecticides, Miticides and Fungicides: Legal commercial quality non-staining materials with original manufacturers' containers, properly labeled with guaranteed analysis, least toxic required.
- C. Water: Clean fresh, free of substances toxic to plant growth.
- D. Sterilant: Use a horticulturally accepted sterilant for sterilizing pruning equipment.
- E. Root Sealant: Use a horticulturally accepted sealant appropriate for each species of tree.
- F. Erosion Control Net (Jute Mesh): Shall be heavy, twisted jute mesh, weighing approximately 1.22 pounds per linear yard and four (4) feet wide with mesh openings of approximately one (1) inch square.
- G. Plywood: three-quarter (3/4) inch non-treated.

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2.5 MACHINERY AND EQUIPMENT

- A. Machinery or tools requirements listed under this Section are NOT intended to be restrictive of specific manufacturers or models, unless so stated. Specific mention of the manufacturers is intended as a guide to illustrate the final product of the maintenance operations desired.
- B. All equipment and pruning tools shall be maintained in a safe working condition, and cutting edges shall be sharp at all times.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Verify trees to remain and trees to remove with Owner's Authorized Representative. Verify health of trees to remain and provide photo documentation prior to commencing demolition or site work.
- B. Verify locations of existing utilities in area of tree removal and root grinding. Contractor shall protect all utility lines to remain.
- C. Verify locations of existing utilities and old pavements to be removed in areas of trees to remain. Contractor shall protect tree's root systems.
- D. Verify staging of access into site for removal or trees, and protection of trees and areas to be preserved. Utilize existing pavement surfaces to be demolished to prevent compaction of soils into protected areas.
- E. By beginning Work, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the Owner.

3.2 TREE PRESERVATION

- A. Protect and preserve trees, understory trees, shrubs, native grasses, and plants not to be removed by the use of fencing, temporary enclosures, wrapping or other means. TREE PROTECTION MUST OCCUR PRIOR TO ANY SITE WORK, DEMOLITION, EXISTING ABANDONED UTILITY REMOVAL, OR GRADING.
- B. Abandoned Utilities to be Removed: Determine locations of underground utilities and perform work in a manner which is intended to avoid possible damage to trees and protected vegetation. Hand excavate or use air-spade technology where required.
- C. Tree protection must receive approval of the Owner's Authorized Representative prior to starting any site work.
- D. Protected trees shown to remain must maintain a full 75% existing undisturbed root zone minimum to be counted as a protected site tree per the local city code or ordinance.
- E. Protect trees shown with approved fencing as indicated on the drawings and as needed to protect from construction activities.
- F. Per assessment report, protect existing understory trees and shrubs to remain under and adjacent to existing trees to remain.
- G. Repair injuries, abrasions and other damage to plants by cleanly removing broken members, loose and torn bark, and shape edges in order to permit drainage of rainwater from wounds. Paint wounds with an approved tree wound paint. Provide photo documentation of all tree injuries and repairs.
- H. Where depth of soil over root system of existing plantings is to be modified by final grading, provide the following:
 - 1. Where increase of one (1) foot or more in elevation is shown, spread continuous layer of rock aggregate, graded one quarter (1/4) inch to two (2) inches, six (6) inches deep from trunk to drip line of branches prior to installation of fill.

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2. Provide proper aeration by installing within perimeter of spread, a system of four (4) inch clay drain tile. Install vertically flush with soil surface and penetrating into layer of aggregate fill.
- I. Install tree guard fencing at a minimum of three (3) feet past the tree drip line or as noted on the drawings.
- J. Do not install gates in tree guard fencing. Do not stack or store any equipment inside the tree fence.
- K. Do not clean construction equipment, dump liquids, nor perform field maintenance on vehicles in the vicinity of the trees to be preserved.
- L. Apply three (3) inches of coarsely shredded hardwood mulch over tree root zone within fencing, unless shown otherwise.
- M. Install plywood over mulch in areas reflected on plans for access between the tree protection fencing and the face of building or edge of retaining wall construction.
- N. Trees inside fencing with native turf areas to remain: DO NOT install mulch or disturb soils in areas shown without mulch due to in-situ soils ability to percolate and drain.

3.3 TREE, LIMB, AND VEGETATION REMOVAL

- A. Receive approval from the Owner's Authorized Representative in the field for trees and vegetation to be removed. Trees that have died or have been approved for removal shall be removed by felling with chain saws. Fell trees to avoid injuring protected trees and vegetation or damaging utilities and existing pavement or structures. Use felling methods that comply with OSHA and American Association of Nurserymen.
- B. Undergrowth identified and designated for removal within existing tree stands to be preserved shall be removed by hand with machinery and tools that do not harm the root systems, trunks, limbs, or any other part of the trees, understory trees, understory shrubs or native grasses designated to be preserved.
- C. Grind stumps to a depth of eighteen (18) inches within a three (3) foot diameter of the trunk in areas where rough grading does not exceed two (2) feet of cut. Remove ground mulch from area and fill hole with select fill or site stockpiled topsoil compacted to 90% proctor density. Trees will not need to have stumps ground that are removed within area of building construction and excavation or where rough grading exceeds two (2) feet of cut.
- D. Trees within heavily rooted zones of other trees will have stumps ground to same depth as above, but grind main root laterals out three (3) feet from tree. DO NOT grind over or into other tree's root systems.
- E. Arborist shall prune trees to remove limbs and branches that hinder Contractor's work. Owner's Authorized Representative shall approve any pruning that removes more than ten (10) percent of the tree's canopy.
- F. Prune branches of trees per approved horticultural practices, for balanced overall canopy appearance, and to prevent one-sided canopy pruning to provide for:
 1. Construction equipment access clearance to fourteen (14) feet height from finished grades.
 2. Building vertical face clearance to allow scaffolding, lifts and equipment access.
 3. Building projected finished roof or parapet elevation clearance of five (5) feet.
 4. Fire truck access lanes and drives clearance of fourteen (14) feet above finished pavement elevation.
- G. Prune trees to remove dead wood, broken branched, mistletoe and suckers from canopies as needed. Thin prune by removing no more than twenty (20) percent of growth. Sterilize pruning tools between individual plants to keep down spread of disease.
- H. Neatly cut limbs and branches to be trimmed or removed close to the bole of the tree or main branches. Paint cuts more than one and one-quarter (1 1/4) inches in diameter with an approved tree wound paint. Use 3-cut process to remove branches.

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- I. Limb up trees to provide seven (7) foot minimum clearance over adjacent pedestrian walks, plazas, or accessible pavements to be constructed. Tree shall be limbed up by Arborist to provide balanced shape and to allow for interior branch development.
- J. Remove poison ivy and other vines from tree trunks, treat and remove roots of ivy to prevent reestablishment (If applicable).
- K. Hand grub to remove small seedling trees, excessive surface vegetative debris, seeds, nuts and trash. Retain a minimum layer or naturally decomposed surface litter over top of existing grade below tree canopy. Grubbing shall not extend into the surface roots of the tree to remain to prevent damage to the surface roots. Apply coarsely shredded hardwood mulch over root zone if area previously had excessive debris depth to help retain surface moisture over root zone.
- L. Remove all branches and debris. Legally dispose of vegetation, branches and debris off site.
- M. Leave site in a clean and orderly manner.

3.4 ROOT PRUNING

- A. Root pruning as indicated on the drawings must occur prior grading or excavation in the root zone.
- B. Arborist – Major root pruning (one (1) inch caliper and larger) should be supervised by an ISA Certified Arborist where indicated on the plan or if roots are exposed due to grading or excavation. Use sharp instruments that leave a clean cut, with no ragged edges.
- C. Root pruning guidelines:
 - 1. Do not mechanically trench under trees, Trench using Air Spade Technology offered by Root Flare Services, Dallas, TX (or approved equal), hand dig or bore underneath. If roots greater than one (1) inch are encountered and severed, dig back along the root and find solid root wood, then cut flush and treat with an acceptable root sealant immediately. If the roots cannot be treated immediately, cover with moist burlap to prevent desiccation until they can be treated.
 - 2. Any roots broken and disturbed during construction trenching operations shall be immediately cleanly cut and sprayed with root sealant. Do not leave uncut, frayed roots without immediate treatment. Owner is to inspect any trench before filling occurs.
 - 3. Temporarily cover exposed roots with wet burlap to prevent roots from drying out.
 - 4. Do not remove more than 25 % of the tree's roots, with no more than 20% from one side.
 - 5. For trees twelve (12) inches in diameter and less, roots should not be removed within four (4) feet of the outer edge of the tree trunk base. Trees other than Post Oaks with diameter more than twelve (12) inches should be allowed an additional twelve (12) inches for every three (3) inches of trunk diameter measured at a point three (3) feet above the ground. Root prune all trees adjacent to proposed pavement locations.
 - 6. Oak trees with diameter more than twelve (12) inches should be allowed an additional twelve (12) inches for every one (1) inch of trunk diameter measured at a point three (3) feet above the ground.
 - 7. Root prune all trees adjacent to proposed pavement and excavation locations with proper pruning technique to provide clean cuts at roots with no ragged edges. Do not cut within five (5) feet of trunk.
- D. Arborist will review root pruning prior to backfilling.
- E. Backfill the excavation as soon as possible after sealing cuts with root sealant and water the soil around the roots to avoid leaving air pockets.
- F. Backfill with five (5) parts native topsoil and one (1) part compost.
- G. Apply root fertilizer / stimulator to root zone of trees where root pruning has occurred. Apply fertilizer at rates recommended by manufacturer. Inject fertilizer at depths prescribed by manufacturer.
- H. The Arborist must receive field approval from Owner's Authorized Representative or the Landscape Architect for tree and root pruning not shown in the drawings.

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3.5 BORING NEAR TREES

- A. Bores within the root zone of large trees shall be horizontal directional bores. For pipe installation, mechanically bore the tunnel under the roots with a horizontal directional drill and hydraulic or pneumatic air excavation technology. In all cases, install the utility pipe immediately, backfill with soil and soak within the same day.
- B. Installation shall be tunnel bored beneath the tree and roots per the following chart:

Trenching Distance	
When the Tree Diameter (at 4.5' height) is	Trenching will be Replaced with Boring at this Min. Distance (10x tree diameter) from the Face of the Tree in any Direction
6-9" measured at 6"	5- 8'
10-14" measured at 54"	10 - 13'
15-19" measured at 54"	14- 16'
19-24" measured at 54"	17-19'
Over 25" measured at 54"	20'+
Depth of Tunneling	
9" or less measured at 6"	2.0'
10-14" measured at 54"	2.5'
15-19" measured at 54"	3.0'
More than 19" measured at 54" depth of tunnel	3.5'

Bore pits shall be located at a minimum distance as specified by trenching distance table above.

3.6 WATERING

- A. The Contractor shall provide watering as needed to keep existing trees to remain in vigorous condition.
- B. The Contractor shall water protected trees during construction by deep root watering trees once every two weeks during the months of June, July, August, and September. Should drought of more than three (3) weeks occur from October through May, the Contractor shall provide additional deep root watering of protected trees as needed to keep trees in healthy, growing condition. A dripping hose or gator bag or other means may be used to deep root water the trees. Soil should be saturated within the drip line after deep root watering.
- C. For large masses of protected trees, water trees that are located along the outside edge of protected area as described above.

3.7 MAINTENANCE OF EXISTING TREES

- A. Trees shall be continuously and routinely inspected for distress caused by construction activities. Notify Owner's Authorized Representative at first sign of distress.
- B. Maintain fence taut, stable and secure until soil preparation and seeding activity is needed within the fenced area.
- C. The Contractor shall maintain a three (3) inch cover of mulch on the tree root zone though out construction on individual trees. After initial mulch application re-apply mulch twice per year. Mulch shall be refreshed to specified depth within seven (7) calendar days of January 1 and July 1. Use erosion control net (jute mesh) as needed to secure mulch in place from potential heavy erosion adjacent to drainage.
- D. Remove mulch when sodding commences within tree root zone.

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- E. For masses of protected trees, unmown grass should be left within fifteen (15) feet of the trunk line along the outside edge of the trees.
- F. Native and existing turf grasses are to be retained and maintained, if necessary, during project construction period. If grass stops growing within tree protective fencing, or if the tree shows signs of stress such as leaf drop, sucker growth, wilting, or if tree shows signs of insects or disease, the Contractor shall notify the Owner immediately. It is the Contractor's responsibility to maintain the health of the trees during the construction period.
- G. Any Fire Ant mounds around or on top of a tree root zone of a specimen tree shall be treated immediately and the mound removed physically. Do not allow the mound to build on the tree trunk as this will cover the tree root flare and possibly cause injury or death. Ensure that any chemical application to the Fire Ant mound is safe for application atop tree root zones. Ant mounds do not need to be treated in tree masses.

3.8 DISPOSAL

- A. Haul off and legally dispose of any debris from the work of this section.
- B. Dispose of debris off the Site only with permission of property owner where such debris is to be deposited and in accordance with codes and regulations of the jurisdictional authorities.
- C. Burning and burying debris on the Worksite is prohibited.

3.9 CLEAN-UP

Remove and dispose of any debris, trash, protective materials, enclosures and fencing upon completion of the Work.

3.10 FINAL ACCEPTANCE

- A. The trees designated for protection will be examined as part of final acceptance when all site work has reached final acceptance.
- B. The Arborist shall issue a final Post Construction Tree Assessment regarding the status of the tree health for each specimen tree and for the large tree groupings. The report should identify if future care is required to maintain the health of the specimen trees. The report should identify what specific treatment the trees should receive coordinated with a time schedule to the treatment to promote tree health.
- C. If grading impacts the critical root zone, the Contractor's Arborist will be required to report specifically on the impacted tree. The Arborist shall recommend tree treatment and maintenance after final acceptance.
- D. Request inspection for final acceptance at least thirty (30) calendar days from project close out.
- E. Receive approval from the Owner's Authorized Representative for the work of this section completed.

END OF SECTION

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SECTION 016000

PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

1.2 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Substitutions: Changes in products, materials, and equipment from those required by the Contract Documents and proposed by Contractor. Refer to Division 01 Section "Substitution Procedures".
- C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "Product Standard," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other manufacturers
- D. Hazardous Substances Prohibited by Law: Including, but not limited to, any product, material, element, constituent, chemical, substance, compound, or mixture, which is defined in, included under, or regulated by any environmental laws.
- E. Environmental Laws: Applicable local, state, and federal laws, rules, ordinances, codes, regulations, and requirements in effect at the time Contractor's services are rendered, any amendments for Contractor's services rendered after the effective date of any such amendments.

1.3 SUBMITTALS

- A. Comparable Products: Comply with requirements in Division 01 Section "Submittal Procedures." Show compliance with requirements. Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 01 Section "Submittal Procedures." Show compliance with requirements.

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- C. Contractor Affidavit: Submit an affidavit on construction company letterhead signed by an officer of the company, notarized by a notary public, which certifies compliance with the environmental laws controlling hazardous substances for the construction of this Project.

1.4 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
- B. Compliance: Contractor shall take whatever measures deemed necessary to insure that all employees, suppliers, vendors, fabricators, subcontractors, or their assigns, to comply with hazardous substance requirements.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
 - 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 - 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 - 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 - 4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
- C. Storage:
 - 1. Store products to allow for inspection and measurement of quantity or counting of units.
 - 2. Store materials in a manner that will not endanger Project structure.
 - 3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
 - 4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
 - 5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
 - 6. Protect stored products from damage and liquids from freezing.

1.6 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 - 1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product, required by the Contract Documents to provide specific rights for Owner, and specifically endorsed by manufacturer to Owner.
 - 2. Warranties: Prepare a written document, on manufacturer's standard form, modified to include Project-specific information, that contains appropriate terms and identification, properly executed.

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- B. Submittal Time: Comply with requirements in Division 01 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
 4. Where products are accompanied by the term "as selected," Architect will make selection.
 5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
 6. Products and materials brought onto the Project Site, and products and materials incorporated into the Work, shall comply with environmental laws.
- B. Product Selection Procedures:
1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 3. Products:
 - a. Restricted List (Acceptable Manufacturers/Fabricators and Products): Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered unless otherwise indicated.
 - b. Nonrestricted List (Available Manufacturers/Fabricators and Products): Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.
 4. Manufacturers:
 - a. Restricted List (Acceptable Manufacturers/Fabricators): Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered unless otherwise indicated.
 - b. Nonrestricted List (Available Manufacturers/Fabricators): Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies

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with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.

5. Basis-of-Design Product (Product Standard): Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers, or unnamed manufacturer's product.
 - C. Descriptive Specification Requirements: Where Specifications describe a product, or assembly, listing exact characteristics required, without use of a brand or trade name, provide a product, material or assembly that provides the characteristics and otherwise complies with Contract requirements.
 - D. Performance Specification Requirements: Where Specifications require compliance with performance requirements, provide products that comply with these requirements, and are recommended by the manufacturer for the application indicated. General overall performance of a product is implied where the product or material is specified for a specific application.
 1. Manufacturer's recommendations may be contained in published product literature, or by the manufacturer's certification of performance.
 - E. Compliance with Standards, Codes and Regulations: Where Specifications only require compliance with imposed code, standard or regulation, select product that complies with standards, codes or regulations specified.
 - F. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
 1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Division 01 Section "Substitution Procedures" for proposal of product.
 - G. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's color, gloss, pattern, density, or texture" or similar phrase, select a product (and manufacturer) that complies with other specified requirements.
 1. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, or texture from manufacturer's product line that does not include premium items.
 2. Custom Range: Where Specifications include the phrase "custom range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, or texture from manufacturer's product line that includes both standard and premium items.
 3. Special Custom Range: Where Specifications include the phrase "special custom range of colors patterns, textures" or similar phrase, Architect will select a new color, pattern, or texture different from those normally produced by the manufacturer.
 - H. Allowances (If Applicable): Refer to provisions of individual Specification Sections and of Division 01 Section "Allowance" for allowances that control product selection and for procedures required for processing such selections.
- 2.2 COMPARABLE PRODUCTS
- A. Conditions for Consideration: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied,

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Architect may return requests without action, except to record noncompliance with these requirements:

1. Evidence that the proposed product does not require revisions to the Contract Documents; that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

PART 3 - EXECUTION

3.1 RESTRICTION OF HAZARDOUS SUBSTANCES

- A. Contractor agrees that it shall not knowingly after reasonable diligence and effort, incorporate into the Work any hazardous substance other than as may be lawfully contained within products, except in accordance with applicable environmental laws. Further, in performing any of its obligations hereunder, Contractor shall not cause any release of hazardous substances into, or contamination of, the environment, including soil, the atmosphere, any watercourse or ground water, except in accordance with applicable environmental laws. In the event that Contractor engages in any of the activities prohibited in this paragraph, to the fullest extent permitted by law, Contractor hereby indemnifies and holds harmless Owner and its partners, members, officers, directors, agents, employees and consultants from and against any and all claims, damages, losses, causes of action, suits and liabilities of every kind, including, but not limited to, expenses of litigation, court costs, punitive damages and attorney's fees, arising out of, incidental to or resulting from the activities prohibited.
- B. In the event Contractor observes on the Project Site any substance which Contractor reasonably believes to be a hazardous substance, and which is being introduced into the Work, or exists on the Project Site, in a manner violative of any applicable environmental laws, Contractor shall immediately notify Owner and report the condition to Owner in writing. The Work in the affected area shall not thereafter be resumed except by written authorization of Owner if in fact a hazardous substance has been encountered and has not been rendered harmless. In the event that Contractor fails to give Owner proper notification hereunder, upon knowingly observing a hazardous substance at the Project Site, to the fullest extent permitted by the law, Contractor hereby indemnifies and holds harmless Owner, and all of its partners, members, officers, directors, agents, employees and consultants from and against all claims, damages, losses, causes of action, suits and liabilities of every kind, including, but not limited to, expenses of litigation, court costs, punitive damages and attorneys' fees, arising out of, incidental to, or resulting from Contractor's failure to stop the Work.
- C. If Owner believes that hazardous substances may have been located, generated, manufactured, used or disposed of on or about the Project Site by Contractor or any of its employees, agents, subcontractors, suppliers, or invitees, Owner may have environmental studies of the Project Site conducted as it deems appropriate, and Contractor shall be responsible for the cost of such studies to the extent that Contractor or any of its employees, agents, subcontractors, suppliers or invitees are responsible for the presence of any hazardous substances.

END OF SECTION

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SECTION 017300
EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. Installation of the Work.
 - 4. Cutting and patching.
 - 5. Coordination of Owner-installed products.
 - 6. Progress cleaning.
 - 7. Starting and adjusting.
 - 8. Protection of installed construction.
 - 9. Correction of the Work.

1.2 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

1.3 SUBMITTALS

- A. Land Surveyor Qualification Data: For land surveyor or professional engineer.
- B. Land Surveyor Certificates: Submit certificate signed by land surveyor or professional engineer certifying that location and elevation of improvements comply with requirements.
- C. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed, requesting approval to proceed. Include the following information:
 - 1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
 - 2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
 - 3. Products: List products to be used for patching and firms or entities that will perform patching work.
 - 4. Dates: Indicate when cutting and patching will be performed.
 - 5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.
 - a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.
 - 6. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.

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7. Architect's Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.
- D. Certified Surveys: Submit two copies signed by land surveyor or professional engineer.
- E. Final Property Survey: Submit 6 copies showing the Work performed and record survey data.
- F. Retention System Certification: Submit a statement certified by the Contractor's registered structural engineer that the design of components of the excavation support system is in compliance with provisions of the Contract Documents and the local building code, and is in keeping with generally accepted engineering practice.
 1. Submit, if requested, design calculations, specifications and erection drawings, bearing the Contractor's registered structural engineer's stamp, to the local building code official.
 2. Submit complete excavation support system shop drawings for information coordination purposes only.
 3. Architect/Engineer will neither review nor approve excavation support system shop drawings.

1.4 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor or engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. Retention System Engineering: Each component of the excavation support system shall be designed by a registered structural engineer, in accordance with the local building code, and registered structural engineer shall be engaged by the Contractor.
- C. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
 1. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection
 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
 3. Miscellaneous Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
 4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
 - a. If possible, retain original Installer or fabricator to cut and patch exposed Work listed below. If it is impossible to engage original Installer or fabricator, engage another recognized, experienced, and specialized firm.
- D. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

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- E. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

1.5 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
 - 1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with requirements in Division 01 sustainable construction requirements Section.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.
 - 1. Before construction, verify the location and points of connection of utility services.
- B. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, and other construction affecting the Work.
 - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.
 - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- C. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions. Record observations.
 - 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.

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2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

3.2 INSTALLATION, GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
 1. Respective manufacturer/fabricator's written installation instructions.
 2. Accepted submittals.
 3. Contract Documents.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by isolating metals and other materials from direct contact with incompatible materials.

3.3 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.
- B. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- C. Existing Utility Interruptions at Renovation Work: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 1. Notify Owner not less than 72 hours in advance of proposed utility interruptions.
 2. Do not proceed with utility interruptions without Owner's written permission.
- D. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- E. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- F. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Division 01 Section "Project Management and Coordination."

3.4 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.
- B. General: Engage a land surveyor or professional engineer to lay out the Work using accepted surveying practices.

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1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
 2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 3. Inform installers of lines and levels to which they must comply.
 4. Check the location, level and plumb, of every major element as the Work progresses.
 5. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
 6. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.5 FIELD ENGINEERING

- A. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
1. Do not change or relocate existing benchmarks or control points. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- B. Benchmarks: Establish and maintain a minimum of 2 permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
- C. Certified Survey: 30 days after completion of each work component/activity, including, but not limited to, foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.
- D. Final Property Survey: Engage a land surveyor or professional engineer to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor or professional engineer, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.

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1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.6 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 1. Make vertical work plumb and make horizontal work level.
 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated, unless indicated otherwise in the Contract Documents.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located, aligned, and coordinated with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 2. Allow for building movement, including thermal expansion and contraction.
 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.7 CUTTING AND PATCHING

- A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

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1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Division 01 Section "Summary."
- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 4. Excavating and Backfilling: Comply with requirements in applicable Division 31 Sections where required by cutting and patching operations.
 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 6. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.

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3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
 - b. Patch fire rated assemblies with materials to match existing and maintain assembly fire rating.
 4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
 - I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.
- 3.8 OWNER-INSTALLED PRODUCTS
- A. Site Access: As applicable, provide access to Project site for Owner's construction personnel.
 - B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.
 1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
 2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.
- 3.9 PROGRESS CLEANING
- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 2. Do not hold waste materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F (27 deg C).
 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
 - a. Use containers specifically intended for holding types of waste materials identified where applicable, e.g. blue colored containers with labeling and symbols for bio-waste.
 - B. Site: Maintain Project site free of waste materials and debris.
 - C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
 1. Remove liquid spills immediately.

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2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
 - D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
 - E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
 - F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
 - G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Division 01 Section "Temporary Facilities and Controls." and Division 01 Section "Construction Waste Management and Disposal", whichever is the more restrictive.
 - H. Remove construction markings not required and graffiti immediately, repairing or replacing damaged material.
 - I. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
 - J. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
 - K. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.
- 3.10 STARTING AND ADJUSTING
- A. As applicable, coordinate startup and adjusting of equipment and operating components with commissioning requirements in Division 01 specification sections.
 - B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
 - C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
 - D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - E. Manufacturer's Field Service: Comply with qualification requirements in Division 01 Section "Quality Requirements."
- 3.11 PROTECTION OF INSTALLED CONSTRUCTION
- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
 - B. Comply with manufacturer's written instructions for temperature and relative humidity.

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END OF SECTION

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SECTION 017419.13
CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Salvaging nonhazardous demolition and construction waste.
 - 2. Recycling nonhazardous demolition and construction waste.
 - 3. Disposing of nonhazardous demolition and construction waste.

1.2 DEFINITIONS

- A. Construction Waste: Building, structure, and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building, structure, and site improvement materials resulting from demolition operations.
- C. Disposal: Removal of demolition or construction waste and subsequent salvage, sale, recycling, or deposit in landfill, incinerator acceptable to authorities having jurisdiction, or designated spoil areas on Owner's property.
- D. Diversion: Avoidance of demolition and construction waste sent to landfill or incineration. Diversion does not include using materials for landfill, alternate daily cover on landfills, or materials used as fuel in waste energy processes.
- E. Material Stream: A flow of materials coming from a job site into markets for building materials. Examples of material streams include deconstructed materials sent to reuse markets, commingled waste sent to mixed-waste recycling facility, source separation where each material is sent to a specific facility, manufacturers' or suppliers' take-back of materials, and reuse of deconstructed materials on-site.
- F. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- G. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- H. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.
- I. Source Separation: The act of keeping different types of waste materials separated starting at the first instance a material is considered waste.

1.3 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition and construction waste becomes property of Contractor.

1.4 SUBMITTALS

- A. Waste Management Plan: Submit plan within 14 days of date established for commencement of the Work.
- B. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Include the following information:

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1. Material category.
2. Generation point of waste.
3. Total quantity of waste in **tons (tonnes)**.
4. Quantity of waste salvaged, both estimated and actual in **tons (tonnes)**.
5. Quantity of waste recycled, both estimated and actual in **tons (tonnes)**.
6. Total quantity of waste recovered (salvaged plus recycled) in **tons (tonnes)**.
7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.

C. Qualification Data: For waste management coordinator and refrigerant recovery technician.

1.5 QUALITY ASSURANCE

- A. Waste Management Coordinator Qualifications: Experienced firm, with a record of successful waste management coordination of projects with similar requirements.
- B. Waste Management Conference(s): Conduct conference(s) at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:
1. Review and discuss waste management plan including responsibilities of each contractor and waste management coordinator.
 2. Review requirements for documenting quantities of each type of waste and its disposition.
 3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
 4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
 5. Review waste management requirements for each trade.

1.6 WASTE MANAGEMENT PLAN

- A. General: Develop and implement a Construction Waste Management Plan (CWMP) consisting of waste identification, waste reduction work plan, waste diversion goal, whether separated or comingled and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate quantities by weight or volume but use the same units of measure throughout the CWMP.
- B. Waste Identification: Indicate anticipated types and quantities of waste generated by the Work. Include estimated quantities and assumptions for estimates.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General: Achieve end-of-Project rates for salvage/recycling nonhazardous solid waste generated by the Work. Practice efficient waste management in the use of materials in the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials for the following.
1. Demolition Waste:
 - a. Landscape Debris and Soil: Do not include as part of demolition waste quantities.
 2. Construction Waste:
 - a. Divert 50% by weight or higher when mandated by local ordinance.

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PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

- A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
 - 1. Comply with operation, termination, and removal requirements in Division 1 Section "Temporary Facilities and Controls."
- B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan.
 - 1. Periodic Observations: Contractor's qualified waste management coordinator shall periodically inspect waste collection bins to ensure collection is proceeding in accordance with requirements.
- C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.
 - 1. Distribute waste management plan to everyone concerned.
 - 2. Distribute waste management plan to entities when they begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.
- D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, or sold.
 - 2. Comply with Division 1 Section "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

- A. Salvaged Items for Reuse in the Work: Salvage items for reuse and handle as follows:
 - 1. Not allowed unless noted otherwise.
 - 2. Clean, repair, service, and refinish salvaged items, unless noted otherwise.
 - 3. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
 - 4. Store items in a secure area until installation.
 - 5. Protect items from damage during transport and storage.
 - 6. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.
- B. Salvaged Items for Sale and Donation: Not permitted on Project site.
- C. Salvaged Items for Owner's Use: Salvage items for Owner's use and handle as follows:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
 - 3. Store items in a secure area until delivery to Owner.
 - 4. Transport items to Owner's storage area designated by Owner.
 - 5. Protect items from damage during transport and storage.

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3.3 RECYCLING WASTE, GENERAL

- A. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.
- B. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.
- C. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.
 - 1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
 - a. Inspect containers and bins for contamination and remove contaminated materials if found.
 - 2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
 - 4. Store components off the ground and protect from the weather.
 - 5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor as often as required to prevent overfilling bins.

3.4 RECYCLING DEMOLITION WASTE

- A. General: Grind, chip, separate, sort, stack and store as necessary to process waste material.

3.5 RECYCLING CONSTRUCTION WASTE

- A. General: Grind, crush, remove reinforcing and metals, separate, sort, stack and store as necessary to process waste materials
- B. Packaging:
 - 1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
 - 2. Polystyrene Packaging: Separate and bag materials.
 - 3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
 - 4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.
- C. Wood Materials:
 - 1. Lumber Treated with Heavy-Metal Preservatives: Do not grind, chip, or incinerate; must be reused or landfilled.

3.6 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged or recycled, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

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1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. General: Except for items or materials to be salvaged or recycled, remove waste materials and legally dispose of at designated spoil areas on Owner's property.
- C. Burning: Do not burn waste materials.
- D. Disposal: Remove waste materials from Owner's property and legally dispose of them.

END OF SECTION

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SECTION 017700
CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
 - 5. Repair of the Work.

1.2 SUBMITTALS

- A. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- B. Certified List of Incomplete Items: Final submittal at Final Completion.
- C. Certificates of Release: From authorities having jurisdiction.
- D. Certificate of Insurance: For continuing coverage.
- E. Field Report: For pest control inspection.
- F. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.3 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
 - 3. Submit closeout submittals specified in individual Divisions 02 through 33 Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 4. Submit maintenance material submittals specified in individual Divisions 02 through 33 Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number where applicable.
 - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item

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and name and number of related Specification Section. Obtain Owner's signature for receipt of submittals.

5. Submit test/adjust/balance records.
- C. Procedures Prior to Substantial Completion: Complete the following prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Advise Owner of pending insurance changeover requirements.
 2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 3. Complete startup and testing of systems and equipment.
 4. Perform preventive maintenance on equipment used prior to Substantial Completion.
 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Division 01 Section "Demonstration and Training."
 6. Advise Owner of changeover in heat and other utilities.
 7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
 8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 9. Complete final cleaning requirements, including touchup painting.
 10. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
1. Reinspection: Request, in writing, reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 2. Results of completed inspection will form the basis of requirements for final completion.
- E. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.
- 1.4 FINAL COMPLETION PROCEDURES
- A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:
1. Submit a final Application for Payment according to Division 01 Section "Payment Procedures."
 2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list). Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 4. Submit pest-control final inspection report.
- B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements.

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Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.5 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction
 1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
 2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
 3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Page number.
 4. Submit list of incomplete items in the format agreed upon by the Owner and Architect.

1.6 PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Partial Occupancy: Submit properly executed warranties within minimum number days, as required by the Contract, of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
 1. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
- D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

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PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 - 1. Complete the following cleaning operations, as applicable, before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Remove snow and ice to provide safe access to building.
 - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - h. Sweep concrete floors broom clean in unoccupied spaces.
 - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
 - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - k. Remove labels that are not permanent.
 - l. Remove all graffiti and construction writing.
 - m. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - o. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - p. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
 - q. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
 - r. Leave Project clean and ready for occupancy.
- C. Pest Control: Comply with pest control requirements in Division 01 Section "Temporary Facilities and Controls." Prepare written report.

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- D. Construction Waste Disposal: Comply with waste disposal requirements in Division 01 Section "Temporary Facilities and Controls." and Division 01 Section "Construction Waste Management and Disposal", whichever is the more restrictive and as follows:

1. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.
- B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
 2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.
 - a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
 3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
 4. Replace all lamps and starters to comply with requirements for new fixtures.
- C. All Warranties remain in effect.

END OF SECTION

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SECTION 017823
OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory.
 - 2. Emergency manuals.
 - 3. Operation manuals for systems, subsystems, and equipment.
 - 4. Product maintenance manuals.
 - 5. Systems and equipment maintenance manuals.

1.2 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

1.3 CLOSEOUT SUBMITTALS

- A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
- B. Format: Submit operations and maintenance manuals in the following format:
 - 1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Owner.
 - a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
 - b. Enable inserted reviewer comments on draft submittals.
- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and before commencing demonstration and training. Architect will return copy with comments.
 - 1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual prior to commencing demonstration and training.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

- A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:
 - 1. List of documents.

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2. List of systems.
 3. List of equipment.
 4. Table of contents.
- B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
- C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
- D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."
- 2.2 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS
- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
1. Title page.
 2. Table of contents.
 3. Manual contents.
- B. Title Page: Include the following information:
1. Subject matter included in manual.
 2. Name and address of Project.
 3. Name and address of Owner.
 4. Date of submittal.
 5. Name and contact information for Contractor.
 6. Name and contact information for Architect.
 7. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 8. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.

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2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

2.3 EMERGENCY MANUALS

- A. Content: Organize manual into a separate section for each of the following:
 1. Type of emergency.
 2. Emergency instructions.
 3. Emergency procedures.
- B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
 1. Fire.
 2. Flood.
 3. Gas leak.
 4. Water leak.
 5. Power failure.
 6. Water outage.
 7. System, subsystem, or equipment failure.
 8. Chemical release or spill.
- C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- D. Emergency Procedures: Include the following, as applicable:
 1. Instructions on stopping.
 2. Shutdown instructions for each type of emergency.
 3. Operating instructions for conditions outside normal operating limits.
 4. Required sequences for electric or electronic systems.
 5. Special operating instructions and procedures.

2.4 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
 1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 2. Performance and design criteria if Contractor has delegated design responsibility.
 3. Operating standards.
 4. Operating procedures.
 5. Operating logs.
 6. Wiring diagrams.
 7. Control diagrams.
 8. Piped system diagrams.
 9. Precautions against improper use.
 10. License requirements including inspection and renewal dates.
- B. Descriptions: Include the following:

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1. Product name and model number. Use designations for products indicated on Contract Documents.
 2. Manufacturer's name.
 3. Equipment identification with serial number of each component.
 4. Equipment function.
 5. Operating characteristics.
 6. Limiting conditions.
 7. Performance curves.
 8. Engineering data and tests.
 9. Complete nomenclature and number of replacement parts.
- C. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
 2. Equipment or system break-in procedures.
 3. Routine and normal operating instructions.
 4. Regulation and control procedures.
 5. Instructions on stopping.
 6. Normal shutdown instructions.
 7. Seasonal and weekend operating instructions.
 8. Required sequences for electric or electronic systems.
 9. Special operating instructions and procedures.
- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.5 PRODUCT MAINTENANCE MANUALS

- A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- C. Product Information: Include the following, as applicable:
1. Product name and model number.
 2. Manufacturer's name.
 3. Color, pattern, and texture.
 4. Material and chemical composition.
 5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
1. Inspection procedures.
 2. Types of cleaning agents to be used and methods of cleaning.
 3. List of cleaning agents and methods of cleaning detrimental to product.
 4. Schedule for routine cleaning and maintenance.
 5. Repair instructions.

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- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.

2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
 - 1. Standard maintenance instructions and bulletins.
 - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 - 3. Identification and nomenclature of parts and components.
 - 4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
 - 1. Test and inspection instructions.
 - 2. Troubleshooting guide.
 - 3. Precautions against improper maintenance.
 - 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - 5. Aligning, adjusting, and checking instructions.
 - 6. Demonstration and training video recording, if available.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
 - 1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 - 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

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1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

- A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- B. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- C. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- D. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
- E. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
 1. Do not use original project record documents as part of operation and maintenance manuals.
 2. Comply with requirements of newly prepared record Drawings in Division 01 Section "Project Record Documents."
- F. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION

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SECTION 017839
PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for project as constructed record documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
 - 4. Miscellaneous record submittals.

1.2 SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit copies of record Drawings as follows:
 - a. Initial Submittal:
 - 1) Submit PDF electronic files of scanned record.
 - 2) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final Submittal:
 - 1) Submit PDF electronic files of scanned record.
- B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.
- D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit-annotated PDF electronic files and directories of each submittal.

PART 2 - PRODUCTS

2.1 ELECTRONIC PROJECT MANAGEMENT SOFTWARE

- A. Electronic File of Project Record Documents: Provide Architect with an independent electronic archive of accepted project record documents using electronic project management software as defined in Division 01 Section "Project Management and Coordination", in addition to the printed documents described elsewhere in this Section.

2.2 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
 - 1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.

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- a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding archive photographic documentation.
2. Content: Types of items requiring marking include, but are not limited to, the following:
- a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations below first floor.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or Construction Change Directive.
 - k. Changes made following Architect's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

2.3 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 4. Note related Change Orders, record Product Data, and record Drawings where applicable.
- B. Format: Submit record Specifications as scanned PDF electronic file(s) of marked-up paper copy of Specifications.

2.4 RECORD PRODUCT DATA

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

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1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 3. Note related Change Orders, record Specifications, and record Drawings where applicable.
- B. Format: Submit record Product Data as scanned PDF electronic file(s) of marked-up paper copy of Product Data.
1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

2.5 MISCELLANEOUS RECORDS

- A. Assemble miscellaneous records submittals required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.
- B. Format: Submit miscellaneous record submittals as scanned PDF electronic file(s) of marked-up miscellaneous record submittals.
1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.
- B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

END OF SECTION

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SECTION 017846.13
EXTRA STOCK AND MAINTENANCE MATERIALS - ARCHITECTURAL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Extra stock and maintenance material requirements for contract closeout.

1.2 SUBMITTALS

- A. Extra Stock and Maintenance Materials: Furnish maintenance materials, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Owner. Label with manufacturer's name and model number.
1. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Owner's signature for receipt of submittals.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Store materials in containers and packaging as recommended by manufacturer.

PART 2 - PRODUCTS

2.1 SCHEDULE OF EXTRA STOCK AND MAINTENANCE MATERIALS

- A. A Schedule of Materials is attached to this Section.

2.2 SCHEDULE OF EXTRA STOCK AND MAINTENANCE MATERIALS

- A. 04 4200 - Exterior Stone Cladding:
1. Stone Cladding Units: 2%; amount installed, full-size units, each shape and thickness.
- B. 07 2400 - EIFS:
1. Maintenance Kit: Consisting of the following items:
- a. Printed Maintenance Instructions.
 - b. Adhesive: 1 gallon (3.8 L).
 - c. Base Coat Material: 1 gallon (3.8 L).
 - d. Finish Coat Material: 1 gallon (3.8 L), each color, from same batch as installed finish coat.
 - e. Reinforcing Mesh: 20 sf (1.8 sq m).
 - f. Insulation Board: 20 sf (1.8 sq m).
- C. 07 3113 - Asphalt Shingles:
1. Asphalt Shingles: 100 sq. ft. (9.3 sq. m), unbroken bundles, each type, composition, color, pattern, and size.
- D. 07 3127 - Simulated Slate Roofing:
1. Simulated Slate Roofing: 100 sq. ft. (9.3 sq. m), unbroken bundles, each type. Components from same production run as materials installed.
- E. 07 3200 - Roof Tiles:

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1. Roof Tiles and Accessories: 2%; amount installed, each type, composition, color, pattern, and size. Components from same production run as materials installed.
- F. 07 4646 - Fiber Cement Siding:
 1. Fiber Cement Materials and Accessories: 2%; amount installed, full size units, each type.
- G. 07 7600 - Roof Pavers and Pedestals:
 1. Roof Pavers and Pedestals: 2%; amount installed, each type, composition, color, pattern, and size. Components from same production run as materials installed.
- H. 08 4400 - Glazed Aluminum Framing Systems:
 1. Glass: 1%; total square footage installed, each glass type in sizes determined by the Architect.
 2. Entrance Door Hardware: 3 sets; operating hardware.
 3. Glazing Gaskets: 500 LF; typical glazing gaskets.
 4. Finish Coating: 2 gallons; each architectural metal finish coating system and color.
- I. 08 7100 - Door Hardware:
 1. Locksets: To be determined.
 2. Closers: To be determined.
 3. Exit Devices: To be determined.
 4. Electrical Parts: To be determined.
 5. Guestroom Locksets: 3 per 100; guestroom locksets only.
 6. Maintenance Tools and Instructions: 1 complete set, specialized tools and maintenance instructions.
- J. 09 3000 - Tiling:
 1. Tile and Trim: 2%, amount installed, each type, composition, color, pattern, and size.
 2. Grout: 2%, amount installed, each type, composition, and color.
- K. 09 5113 - Acoustical Panel Ceilings:
 1. Ceiling Panels: 2%; amount installed, full size units.
 2. Suspension System Components: 2%, amount installed, each grid, exposed molding and trim component.
 3. Hold Down Clips: 2%; amount installed.
 4. Impact Clips: 2%; amount installed.
- L. 09 5135 - Snap-In Metal Pan Ceilings:
 1. Metal Pans: 1%, amount installed, full-size units.
 2. Suspension System Components: 1%, amount installed, each grid and exposed molding and trim component.
- M. 09 5423 - Linear Metal Ceilings:
 1. Ceiling Components: 1%, amount installed, each pan, carrier, accessory, and exposed molding and trim.
- N. 09 5436 - Suspended Decorative Grids:
 1. Suspension System Components: 1%, amount installed, each component.
- O. 09 6340 - Stone Flooring:

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1. Stone Flooring and Trim: 2%, amount installed, each type, composition, color, pattern, and size.
 2. Grout: 2%, amount installed, each type, composition, and color.
- P. 09 6400 - Wood Flooring:
1. Wood Flooring: 1%, amount installed, each type, color, and finish.
- Q. 09 6500 - Resilient Flooring:
1. Resilient Tile Flooring: 1 box for each 50 boxes of amount installed, each type, color, pattern, class, wearing surface, and size.
 2. Resilient Sheet Flooring: 10 linear ft (3 linear m) in roll form and full roll width for each 500 linear ft (150 linear m) of amount installed, each color, pattern, and type.
- R. 09 6513 - Resilient Base and Accessories:
1. Resilient Base: 10 linear ft (3 linear m) for each 500 linear ft (150 linear m) of amount installed, each type, color, pattern, and size.
- S. 09 6520 - Interlocking Rubber Tile Flooring:
1. Rubber Tile: 5%, amount installed, each type, color, pattern, and size.
- T. 09 6566 - Resilient Athletic Flooring:
1. Resilient Athletic Flooring: 2%; amount installed, each type, color, pattern, class, wearing surface, and size.
- U. 09 6800 - Carpeting:
1. Tile Carpeting: 5%, amount installed but not less than 10 SY; amount installed, full-size units, each color and type.
 2. Sheet Carpeting: 10 linear ft (3 linear m) in roll form and full roll width, for each 500 linear ft (150 linear m) amount installed, each color, pattern, and type.
 3. Carpet Cushion: 10 linear ft (3 linear m) in roll form and full roll width, for each 500 linear ft (150 linear m) amount installed, each type.
- V. 09 6900 - Access Flooring:
1. Access Flooring Panel Type 1 - Typical Areas: 25 panels.
 2. Access Flooring Panel Type 2 - Data Areas: 10 panels.
 3. Access Flooring Panel Type 3 - MRI-related Areas: 10 panels.
 4. Pedestals: 10 units.
 5. Stringers: 10 units.
 6. Grommets: 10 units
 7. Fasteners: As required for each extra component.
 8. Adhesive: One case.
- W. 09 7200 - Wall Covering:
1. Wall Covering: 5%; amount installed, full-size units, each type.
- X. 09 7723 - Fabric Wrapped Panels:
1. Fabric: 10%, amount installed but not less than 10 yds, each fabric, color, and pattern.
 2. Attachment Devices: 5%, amount installed but not less than five full-size units.
- Y. 09 8433 - Acoustical Wall Panels:

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1. Wall Panels: 2%; amount installed, full-size units, each type.
- Z. 09 9100 - Painting:
 1. Painting: 5%, amount installed but not less than 1 gallon; each material and color.
- AA. 09 9413 - Textured Interior Coatings:
 1. Textured Interior Coatings: 5%, amount installed but not less than 1 gallon; each material and color.
- BB. 09 9600 - High Performance Coatings:
 1. Refer to Division 9 section High Performance Coatings for requirements.
- CC. 09 9613 - Multi-Colored Interior Coatings:
 1. Coatings: 5%, amount installed but not less than 1 gallon; each material, color and pattern.
- DD. 09 9623 - Graffiti Resistant Coatings:
 1. Graffiti Resistant Coatings: 5%, amount installed but not less than 5 gallons; each material and color.
- EE. 09 9653 - Elastomeric Coatings:
 1. Elastomeric Coatings: 5%, amount installed but not less than 1 gallon, each color
- FF. 09 9663 - Textured Acrylic Coatings:
 1. Textured Acrylic Coatings: 5%, amount installed but not less than 1 gallon, each color.
- GG. 09 8433 - Acoustical Wall Panels:
 1. Wall Panels: 2%, amount installed, full size units.
- HH. 10 2115 - Cubicle Specialties:
 1. Curtain Carriers and Track End Caps: 3%, amount installed but not less than 10 units, full-size units, each size.
 2. Curtains: 10%, amount installed but not less than 2 units, full-size units.
- II. 10 2238 - Operable Panel Partitions:
 1. Refer to Division 10 section Operable Panel Partitions for requirements.
- JJ. 10 2613 - Wall and Corner Guards:
 1. Wall and Corner Guards: 2%, amount installed but not less than 2 units, full-size units of maximum length, including plastic cover and aluminum retainer, each type and color. Components from same production run as materials installed.
- KK. 10 5116 - Wood Lockers:
 1. Locker Doors: 2 doors, full-size units, each type and color, complete with door hardware.
 2. Locker Hardware: 5%, amount installed but not less 2 each of hinges, pulls, hooks, and locks, each type and finish.
- LL. 10 5503 - USPS-Delivery Postal Specialties
 1. Key Blanks: 25 for each type of compartment-door lock.

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MM. 12 2113 - Horizontal Louvered Blinds:

1. Horizontal Louvered Blinds: 5%, amount installed but not less than 2 units, each size, color, texture, pattern, and gloss.

NN. 12 2413 - Roller Window Shades:

1. Roller Window Shades: 5%, amount installed but not less than 2 units; full-size units, each size, color, texture, and pattern.

OO. 12 6300 - Stadium Seating:

1. Refer to Division 12 section Stadium Seating for requirements.

PP. 32 1813 - Synthetic Grass Field Turf:

1. Refer to Division 32 section Synthetic Grass Field Turf for requirements.

QQ. 32 1826 - Synthetic Grass Turf:

1. Refer to Division 32 section Synthetic Grass Turf for requirements.

RR. FF&E:

1. FF&E: All remaining decorative, FF&E unused material.

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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SECTION 017910

DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Demonstration of operation of systems, subsystems, and equipment.
 - 2. Training in operation and maintenance of systems, subsystems, and equipment.
 - 3. Demonstration and training video recordings.

1.2 SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
 - 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.
- B. Qualification Data: For facilitator instructor videographer.
- C. Attendance Record: For each training module, submit list of participants and length of instruction time.
- D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.
- E. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.
 - 1. Identification: On each copy, provide an applied label with the following information:
 - a. Name of Project.
 - b. Name and address of videographer.
 - c. Name of Architect.
 - d. Name of Construction Manager.
 - e. Name of Contractor.
 - f. Date of video recording.
 - 2. Transcript: Prepared in PDF electronic format. Include a cover sheet with same label information as the corresponding video recording and a table of contents with links to corresponding training components. Include name of Project and date of video recording on each page.
 - 3. At completion of training, submit complete training manual(s) for Owner's use in PDF electronic file format on compact disc or digital video disk.

1.3 QUALITY ASSURANCE

- A. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 01 Section "Quality Requirements," experienced in operation and maintenance procedures and training.

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- B. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- C. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required.
- D. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:
 - 1. Inspect and discuss locations and other facilities required for instruction.
 - 2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
 - 3. Review required content of instruction.
 - 4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.4 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
 - 2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Operations manuals.
 - c. Maintenance manuals.

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- d. Project record documents.
 - e. Identification systems.
 - f. Warranties and bonds.
 - g. Maintenance service agreements and similar continuing commitments.
3. Emergencies: Include the following, as applicable:
- a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
4. Operations: Include the following, as applicable:
- a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
5. Adjustments: Include the following:
- a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
- a. Diagnostic instructions.
 - b. Test and inspection procedures.
7. Maintenance: Include the following:
- a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
8. Repairs: Include the following:
- a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.

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- e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Division 01 Section "Operations and Maintenance Data."
- B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - 1. Owner will furnish Contractor with names and positions of participants.
- C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 - 1. Schedule training with Owner with at least seven days' advance notice.
- D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.
- F. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

3.3 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
 - 1. At beginning of each training module, record each chart containing learning objective and lesson outline.
- B. Video: Provide video resolution as requested by Owner converted to .mp4 format file type, on electronic media.
 - 1. Electronic Media: Read-only format compact disc acceptable to Owner, with commercial-grade graphic label.
 - 2. File Hierarchy: Organize folder structure and file locations according to project manual table of contents. Provide complete screen-based menu.
 - 3. File Names: Utilize file names based upon name of equipment generally described in video segment, as identified in Project specifications.
 - 4. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the Equipment Demonstration and Training DVD that describes the following

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for each Contractor involved on the Project, arranged according to Project table of contents:

- a. Name of Contractor/Installer.
 - b. Business address.
 - c. Business phone number.
 - d. Point of contact.
 - e. E-mail address.
- C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.
1. Film training session(s) in segments not to exceed 15 minutes.
 - a. Produce segments to present a single significant piece of equipment per segment.
 - b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.
 - c. Where a training session on a particular piece of equipment exceeds 15 minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.
- D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.
1. Furnish additional portable lighting as required.
- E. Narration: Describe scenes on video recording by audio narration by microphone while video recording is recorded. Include description of items being viewed.
- F. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.
- G. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

END OF SECTION

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SECTION 018112.13
HEALTH AND ENVIRONMENTAL PERFORMANCE REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general requirements and procedures for health and environmental performance requirements.

1.2 DEFINITIONS

- A. Bio-based Materials: Bio-based products and materials other than wood must be tested using ASTM Test Method D6866 or equivalent method ISO 16620-2, or be certified to the USDA BioPreferred Voluntary Labeling Initiative that includes verification via ASTM 6866 testing. Exclude hide products, such as leather and other animal skin material.
- B. CDPH Standard Method: California Department of Public Health (CDPH) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers, v. 1.1-2010 or newer, for the emissions testing and requirements of products and materials
- C. Composite Wood and Agrifiber: Products such as particleboard, medium density fiberboard (MDF), plywood, wheatboard, strawboard, panel substrates, and door cores that are a composite of wood and/or plant material pressed and adhered together.
- D. Cradle to Gate Assessment: Analysis of a product's partial life cycle, from resource extraction (cradle) to the factory gate (before it is transported for distribution and sale). It omits the use and the disposal phases of the product.
- E. Cradle to Grave: Analysis of a product's full life cycle, from resource extraction (cradle) to the disposal phase (grave).
- F. Cradle to Cradle Certification: End use product has been certified by the Cradle to Cradle Product Innovation Institute
- G. Declare Label: International Living Future Institute, Declare Product Label indicating all ingredients have been evaluated and disclosed down to 1000 ppm.
- H. Environmental Product Declaration (EPD): An independently verified report based on life-cycle assessment studies that have been conducted according to a set of common rules for each product category and peer-reviewed.
 - 1. Product-Specific Declarations: A product with a publicly available, critically reviewed life-cycled assessment conforming to ISO 14044 that has at least a cradle to gate scope.
 - 2. Industry-Wide (Generic) EPD: Provide products with third-party certification (Type III), including external verification, in which the manufacturer is explicitly recognized as a participant by the program operator. EPD must conform to ISO 14025 and EN 15804 or ISO 21930 and have at least a cradle to gate scope.
 - 3. Product Specific Type III EPD: A product with a third-party certification, including external verification, in which the manufacturer is explicitly recognized by the program operator. EPD must conform to ISO 14025 and EN 15804 or ISO 21930 and have at least a cradle to gate scope.
- I. GBCI: Green Business Certification Institute; the Certification body that oversees LEED and WELL Certifications.

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- J. GWP: Global Warming Potential; the heat absorbed by any greenhouse gas in the atmosphere typically reported in carbon dioxide equivalent.
 - K. Health Product Declaration (HPD): End use product has published a complete Health Product Declaration in compliance with the Health Product Declaration Open Standard and with a chemical inventory of the product to at least 1000 ppm or to at least 100 ppm with no known GreenScreen v1.2 Benchmark Level 1 Chemicals.
 - L. Indoor Air Quality (IAQ) Management Plan: Plan developed by the Contractor to provide a healthy indoor environment for workers and building occupants during construction. Plan must meet or exceed the recommendations of the Sheet Metal and Air Conditioning Contractors National Association (SMACNA) IAQ Guidelines for Occupied Buildings Under Construction, 2nd edition, 2007, ANSI/SMACNA 008"2008, Chapter 3.
 - M. Inside the Building: Defined as inside the weatherproofing system.
 - N. Life Cycle Assessment: An evaluation of the environmental effects of a product from cradle to grave, as defined by ISO 14040-2006 and ISO 14044-2006.
 - O. Mindful Materials: a design industry initiative that provides a common platform for manufacturers to clearly communicate transparency and optimization information for their building products. www.mindfulmaterials.com
 - P. Product: A permanently installed building product is an item that arrives on the project site either as a finished element ready for installation or as a component to another item assembled on-site. The product unit is defined by the functional requirement for use in the project; this includes the physical components and services needed to serve the intended function of the permanently installed building product. In addition, similar product within a specification, each contributes as a separate product.
 - Q. Product Category Rules: A set of rules, requirements, and guidelines for developing Environmental Product Declarations.
 - R. Program Operator: An organization that ensures EPDs meet the product category rules (PCRs) for the associated product category. The program operator doesn't do the actual life-cycle assessments. UL Environment is the leading program operator in the United States.
 - S. Volatile Organic Compound (VOC): Carbon compounds considered indoor air contaminants that are odorous, irritating, and/or harmful to the comfort and wellbeing of installers and occupants. VOC content measurements are available for wet-applied products.
 - T. Volatile Organic Compounds (VOC) Emissions Test: Refer to CDPH Standard Method definition.
 - U. Wet Applied Products: Materials and products installed in wet form that have South Coast Air Quality Management District (SCAQMD) rules relating to VOC associated with them. These include the following:
 - 1. SCAQMD Rule 1113: Architectural Coatings
 - 2. SCAQMD Rule 1168: Adhesive and Sealant Applications
- 1.3 PRECONSTRUCTION AND COORDINATION MEETINGS
- A. Preconstruction Conference: Conduct conference with Owner and Architect at a mutually agreed upon time within 21 days prior to commencement of the Work.
 - 1. Participants:

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- a. Owner.
 - b. Owner's Commissioning Agent.
 - c. Architect.
 - d. Architect's Consultants.
 - e. Contractor, including superintendent.
 - f. Contractor's Major Subcontractors
 - g. If requested, other concerned parties needed to conduct the conference.
 2. Minimum Agenda: Include, but not be limited to, following topics:
 - a. Review Health and Environmental Performance requirements and Contractor's Action Plans for meeting requirements.
 - b. Submittal requirements and approval sequence.
 - c. Review Contract Document requirements.
 - d. Review inspection and testing requirements.
 3. Record discussions, including decisions and agreements, and prepare report.
- B. Coordination Meetings: Conduct meetings with Owner and Architect at a mutually agreed upon times.
1. Requirements: Participants, minimum agenda and meeting minutes similar to preconstruction conference.
- 1.4 GENERAL ADMINISTRATIVE REQUIREMENTS
- A. Work Includes: Provide materials and procedures necessary to obtain health and environmental performance goals required in this Section.
1. Refer to other sections for additional materials and procedures necessary to obtain sustainable design goals.
- 1.5 SUBMITTALS
- A. Health and Environment Performance Requirements Documentation:
1. Construction and Demolition Waste Management: Comply with plan requirements of Division 1 Section "Construction Waste Management and Disposal."
 2. Construction Indoor-Air-Quality (IAQ) Management Plan:
 - a. Construction IAQ Management Plan developed in accordance with Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guidelines for Occupied Buildings under Construction, Version indicated.
 - b. Product data for temporary filtration media.
 - 1) Provide minimum MERV 8 filtration when mechanical system is used during construction.
 - c. Product data for filtration media used during occupancy.
 - d. Construction Documentation: Six photographs at three different times during the construction period, along with a brief description of the SMACNA approach employed, documenting implementation of the IAQ management measures, such as protection of ducts and on-site stored or installed absorptive materials.
 - e. Prohibit smoking inside the building and within 25 feet of the building openings during construction. Smoking includes tobacco smoke, as well as smoke produced from the combustion of cannabis and controlled substances and the emissions produced by electronic smoking devices.
 3. Mindful Materials Plan:

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- a. Identify at least 25 products that will be used in this project that meet the identified Mindful Materials transparency or optimization documentation.
 - b. Include certifications and optimization data by manufacturer that products supplied comply with the identified Mindful Material transparency or optimization documentation.
- B. Product Data: Manufacturer's technical literature for interior applied adhesives, sealants, paints and coatings indicating VOC content in grams/Liter (g/L).
 - 1. Include Certifications by manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs) and General Emissions Requirements indicated in this Section
- C. Health and Environmental Performance Requirements Progress Reports: Concurrent with each Application for Payment, submit reports comparing actual construction and purchasing activities with Health and Environmental Performance action plans.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Provide products and procedures necessary. The Contractor shall provide additional materials and procedures necessary to obtain performance requirements indicated.
 - 1. Exclusions: Special equipment, such as elevators, escalators, process equipment, and fire suppression systems, is excluded from the credit calculations. Also excluded are products purchased for temporary use on the project, e.g. formwork for concrete.

2.2 BUILDING PRODUCT DISCLOSURE AND OPTIMIZATION

- A. Provide submittals that ensure 25 different products that comply with Mindful Materials Material Ingredient Disclosure or Environmental Profile requirements.
- B. Material Ingredient Disclosure
 - 1. Comply with any of the following programs to demonstrate the chemical inventory of the product to at least 0.1% (1000 ppm), which meet one of the following disclosure criteria
 - a. Cradle to Cradle (C2C) certifications, version 3 bronze or above
 - b. Cradle to Cradle Material Health Certificate
 - c. Declare Product Labels
 - d. HPD
 - e. Living Product Challenge
- C. Environmental Profile
 - 1. Environmental Product Declaration
 - a. Product specific Type III EPD, must meet the following standards
 - b. ISO 14025
 - c. ISO 21930 or EN 15804
 - d. EPD must be at least Cradle-to-Gate Scope

2.3 TOXIC MATERIAL REDUCTION

- A. General: the following limitations apply to materials installed within the weather-proofing membrane of the Project.
- B. Antimicrobials

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1. No antimicrobials are present that make a health claim.
 - C. Bisphenol A (BPA).
 1. No product that contains Bisphenol A.
 - D. Cadmium
 1. Use no interior or exterior paints containing intentionally added cadmium.
 2. Cadmium is limited in the following components to 0.01% (100 ppm):
 - a. Fire alarms
 - b. Electrical meters
 - c. Electrical sensors
 - d. Thermostats
 - e. Load breaker switches
 - E. Perfluorinated Compound Limitation
 1. No perfluorinated compounds (PFCs) are present in the following condition:
 - a. At levels equal to or greater than 100 ppm in components that constitute at least 5% by weight of a furniture or furnishing (drapes/curtains) assembly.
 - F. Flame Retardant Limitation
 1. Halogenated flame retardants are limited in the following components to 0.01% (100 ppm) to the extent allowable by local code:
 - a. Window and waterproofing membranes, door and window frames and siding.
 - b. Flooring, ceiling tiles and wall coverings.
 - c. Piping and electrical cables, conduits and junction boxes.
 - d. Sound and thermal insulation.
 - e. Upholstered furniture and furnishings, textiles and fabrics.
 - G. Phthalate (Plasticizers) Limitation
 1. DEHP, DBP, BBP, DINP, DIDP or DNOP (often found in polyvinyl chloride [PVC]) are limited in the following components to 0.01% (100 ppm):
 - a. Flooring, including resilient and hard surface flooring and carpet.
 - b. Wall coverings, window blinds and shades, shower curtains, furniture and upholstery.
 - c. Plumbing pipes and moisture barriers.
 - H. Isocyanate-Based Polyurethane Limitation
 1. Isocyanate-based polyurethane products are not used in:
 - a. Interior finishes.
 - I. Urea-Formaldehyde Restriction
 1. Urea-formaldehyde is limited in the following components to 100 ppm:
 - a. Furniture or any composite wood products.
 - b. Laminating adhesives and resins.
 - c. Thermal insulation.
- 2.4 LOW-EMITTING MATERIALS
- A. Refer to Division 01 Section Construction Requirements for VOCs.

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2.5 VOLATILE ORGANIC COMPOUND (VOCs) LIMITS

- A. General Emissions Requirements: Products must demonstrate they have been tested and determined compliant in accordance with California Department of Public Health, (CDHP), Standard Method, version indicated, using the applicable exposure scenario. Manufacturers documentation demonstrating compliance must state the range of Total VOCs (TVOC) after 14 days measured as specified in the CDHP Standard Method CATEGORIES as follows:
1. 0.5mg/m³ or less,
 2. Between 0.5 and 5.0 mg/m³ or,
 3. 5.0 mg/m³ or more.

2.6 PAINTS AND COATINGS

- A. Paints and Coatings: For field applications that are inside the weatherproofing system, paints and coatings shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits.
1. South Coast Air Quality Management District (SCAQMD): Use only paints and coatings that comply with the limits for VOC content when calculated according to the California Air Resources Board (CARB) 2007, Suggested Control Measure (SCM) for Architectural Coatings, or the South Coast Air Quality Management District (SCAQMD) Rule 1113, effective June 5, 2016.
 2. California Department of Public Health (CDPH): Compliance with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers", version indicated.
 - a. At least 75 percent of paints and coatings.

2.7 ADHESIVES AND SEALANTS

- A. Adhesives and Sealants: For field applications that are inside the weatherproofing system, adhesives and sealants shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits.
1. South Coast Air Quality Management District (SCAQMD): For field applications that are inside the weatherproofing system, use adhesives and sealants that comply with the limits for VOC content when calculated according to South Coast Air Quality Management District (SCAQMD) Rule #1168, requirements in effect on October 6, 2017.
 - a. Exception: The provisions of SCAQMD Rule 1168 do not apply to adhesives and sealants subject to state or federal consumer product VOC regulations.
 2. California Department of Public Health (CDPH): For field applications that are inside the weatherproofing system, compliance with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers", version indicated.
 - a. At least 75 percent of adhesives and sealants (by volume or surface area).
- B. Flooring: Flooring shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
1. At least 75 percent of flooring (by cost or surface area).

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- C. Composite Wood: Composite wood, agrifiber products, and adhesives shall be made using ultra-low-emitting formaldehyde (ULEF) resins as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products" or shall be made with no added formaldehyde (NAF).
 - 1. At least 75 percent of composite wood (by cost or surface area).
- D. Insulation: Insulation inside the weatherproofing membrane shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The insulation material category includes all thermal and acoustic boards, batts, rolls, blankets, sound attention fire blankets, foamed-in place, loose-fill, blown, and sprayed insulation.

PART 3 - EXECUTION

3.1 NONSMOKING BUILDING

- A. Smoking of any kind is not permitted within the building or within 25 feet (8 m) of entrances, operable windows, outdoor-air intakes, decks, patios, balconies, rooftops and other regularly occupied exterior building spaces. Applicable during construction.

3.2 CONSTRUCTION WASTE MANAGEMENT

- A. Comply with Division 1 Section "Construction Waste Management and Disposal."

3.3 CONSTRUCTION IAQ MANAGEMENT

- A. Comply with SMACNA's "SMACNA IAQ Guideline for Occupied Buildings under Construction."

3.4 COMBUSTION MINIMIZATION

- A. Engine Exhaust Reduction:
 - 1. Signage, visible from pick-up, drop-off and parking areas indicates:
 - a. Idling with vehicle engines on for more than 30 seconds is prohibited.
- B. Construction Equipment:
 - 1. To reduce particulate matter emissions from both on-road and non-road diesel fueled vehicles and construction equipment, the following requirements are met:
 - a. All non-road diesel engine vehicles comply with the U.S. EPA Tier 4 PM emissions standards or local equivalent when applicable. Engines may be retrofitted with verified technology (required to be U.S. EPA or California Air Resources Board approved) at the time the equipment is first placed on the job site.
 - b. All on-road diesel engine vehicles meet the requirements set forth in the U.S. EPA model year 2007 on-road standards for PM, or local equivalent when applicable. Engines may be retrofitted with verified technology (required to be U.S. EPA or California Air Resources Board approved) at the time the equipment is first placed on the job site.
 - c. All equipment, vehicles and loading/unloading are located at least 25 ft. (7.5 m) away from air intakes and operable openings.

END OF SECTION

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SECTION 018116.16
CONSTRUCTION REQUIREMENTS FOR VOCs

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Volatile Organic Compound (VOC) limits for adhesives, sealants, paints and coatings.
- B. Related Sections:
 - 1. Refer to Division 01 Section for Health and Environmental Performance Requirements.

1.2 DEFINITIONS

- A. CDPH Standard Method: California Department of Public Health (CDPH) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers, v. 1.1-2010 or current version, for the emissions testing and requirements of products and materials.
- B. Volatile Organic Compounds (VOC) Emissions Test: Refer to CDPH Standard Method v1.1 definition.

1.3 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for interior applied adhesives, sealants, paints and coatings indicating VOC content in grams/Liter (g/L).
 - 1. Include Certifications by manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs) and General Emissions Requirements indicated in this Section.

PART 2 - PRODUCTS

2.1 VOLATILE ORGANIC COMPOUND (VOCs) LIMITS

- A. General Emissions Requirements: Products must demonstrate they have been tested and determined compliant in accordance with California Department of Public Health, (CDHP), Standard Method, version indicated, using the applicable exposure scenario. Manufacturer's documentation demonstrating compliance must state the range of Total VOCs (TVOC) after 14 days measured as specified in the CDPH Standard Method CATEGORIES as follows:
 - 1. 0.5mg/m³ or less,
 - 2. Between 0.5 and 5.0 mg/m³ or,
 - 3. 5.0 mg/m³ or more.

2.2 PAINTS AND COATINGS

- A. Paints and Coatings: For field applications that are inside the weatherproofing system, paints and coatings shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits
 - 1. Air Quality Resources and Management: Use only paints and coatings that comply with the limits for VOC content when calculated according to the California Air Resources Board (CARB) 2007, Suggested Control Measure (SCM) for Architectural Coatings, or the South Coast Air Quality Management District (SCAQMD) Rule 1113, effective February 5, 2016.
 - 2.

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Product Type	Allowable VOC Content (g/L)
Bond Breaker	350
Clear wood finishes - Varnish	275
Clear wood finishes - Sanding Sealer	275
Clear wood finishes - Lacquer	275
Colorant - Architectural Coatings, excluding IM coatings	50
Colorant - Solvent Based IM	600
Colorant - Waterborne IM	50
Concrete - Curing compounds	100
Concrete - Curing compounds for roadways & bridges	350
Concrete surface retarder	50
Driveway Sealer	50
Dry-fog coatings	50
Faux finishing coatings - Clear topcoat	100
Faux finishing coatings - Decorative Coatings	350
Faux finishing coatings - Glazes	350
Faux finishing coatings - Japan	350
Faux finishing coatings - Trowel applied coatings	50
Fire-proof coatings	150
Flats	50
Floor coatings	50
Form release compounds	100
Graphic arts (sign) coatings	150
Industrial maintenance coatings	100
Industrial maintenance coatings - High temperature IM coatings	420
Industrial maintenance coatings - Non-sacrificial anti-graffiti coatings	100
Industrial maintenance coatings - Zinc rich IM primers	100
Magnesite cement coatings	450
Mastic coatings	100
Metallic pigmented coatings	150
Multi-color coatings	250
Non-flat coatings	50
Pre-treatment wash primers	420
Primers, sealers and undercoaters	100
Reactive penetrating sealers	350
Recycled coatings	150
Roof coatings	50
Roof coatings, aluminum	100
Roof primers, bituminous	350
Rust preventative coatings	100
Stone consolidant	450
Sacrificial anti-graffiti coatings	50
Shellac- Clear	730
Shellac - Pigmented	550

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Specialty primers	100
Stains	100
Stains, interior	250
Swimming pool coatings - repair	340
Swimming pool coatings - other	340
Traffic Coatings	100
Waterproofing sealers	100
Waterproofing concrete/masonry sealers	100
Wood preservatives	350
Low solids coatings	120

2.3 ADHESIVES AND SEALANTS

- A. Adhesives and Sealants: For field applications that are inside the weatherproofing system, adhesives and sealants shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:

1. Air Quality and Resources Management: For field applications that are inside the weatherproofing system, use adhesives and sealants that comply with the limits for VOC content when calculated according to South Coast Air Quality Management District (SCAQMD) Rule #1168, requirements in effect on October 6, 2017:
- 2.

Architectural Applications	Allowable VOC Content (g/L)
Indoor carpet adhesives	50
Carpet pad adhesives	50
Outdoor carpet adhesives	150
Wood flooring adhesives	100
Rubber floor adhesives	60
Subfloor adhesives	50
Ceramic tile adhesives	65
VCT and asphalt tile adhesives	50
Dry wall and panel adhesives	50
Cove base adhesives	50
Multipurpose construction adhesives	70
Structural glazing adhesives	100
Single ply roof membrane adhesives	250
Specialty Applications:	
PVC welding	510
CPVC welding	490
ABS welding	325
Plastic cement welding	250
Adhesive primer for plastic	550
Computer diskette manufacturing	350
Contact adhesive	80
Special purpose contact adhesive	250
Tire retread	100
Adhesive primer for traffic marking tape	150
Structural wood member adhesive	140
Sheet applied rubber lining operations specialty	250

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Top and Trim adhesive	250
Substrate Specific Applications:	
Metal to metal substrate specific adhesives	30
Plastic foam substrate specific adhesives	50
Porous material (except wood) substrate specific adhesives	50
Wood substrate specific adhesives	30
Fiberglass substrate specific adhesives	80
Sealants:	
Architectural sealant	250
Marine deck sealant	760
Nonmember roof sealant	300
Roadway sealant	250
Single-ply roof membrane sealant	450
Other sealant	420
Sealant Primers:	
Architectural non-porous sealant primer	250
Architectural porous sealant primer	775
Modified bituminous sealant primer	500
Marine deck sealant primer	760
Other sealant primer	750
Other:	
Other adhesives, adhesive bonding primers, adhesive primers or any other primers	250

- a. Exception: The provisions of SCAQMD Rule 1168 do not apply to adhesives and sealants subject to state or federal consumer product VOC regulations.

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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SECTION 019113

GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. OPR and BoD documentation are included by reference for information only.

1.2 SUMMARY

- A. Section includes general requirements that apply to implementation of commissioning without regard to specific systems, assemblies, or components.
- B. Related Documents:
 - 1. OPR and BoD documentation are included by reference for information only.

1.3 DEFINITIONS

- A. BoD: Basis of Design. A document that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.
- B. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
- C. CxA: Commissioning Authority.
- D. OPR: Owner's Project Requirements. A document that details the functional requirements of a project and the expectations of how it will be used and operated. These include Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.
- E. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.4 COMMISSIONING TEAM

- A. Members Appointed by Contractor(s): Individuals, each having the authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated action. The commissioning team shall consist of, but not be limited to, representatives of Contractor, including Project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA.
- B. Members Appointed by Owner:
 - 1. CxA: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process. Owner will engage the CxA under a separate contract.
 - 2. Representatives of the facility user and operation and maintenance personnel.
 - 3. Architect and engineering design professionals.

1.5 OWNER'S RESPONSIBILITIES

- A. Provide the OPR documentation to the CxA and Contractor for information and use.

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- B. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities.
- C. Provide the BoD documentation, prepared by Architect and approved by Owner, to the CxA and Contractor for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.

1.6 CONTRACTOR'S RESPONSIBILITIES

- A. Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:
 - 1. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
 - 2. Cooperate with the CxA for resolution of issues recorded in the Issues Log.
 - 3. Attend commissioning team meetings held as follows:
 - a. Weekly.
 - b. Biweekly.
 - c. Monthly.
 - d. Variable.
 - 4. Integrate and coordinate commissioning process activities with construction schedule.
 - 5. Review and accept construction checklists provided by the CxA.
 - 6. Complete construction checklists as Work is completed and provide to the Commissioning Authority as follows:
 - a. Format:
 - 1) Paper.
 - 2) Electronic.
 - b. Submit:
 - 1) Daily.
 - 2) Weekly.
 - 7. Review and accept commissioning process test procedures provided by the Commissioning Authority.
 - 8. Complete commissioning process test procedures.

1.7 CxA'S RESPONSIBILITIES

- A. Organize and lead the commissioning team.
- B. Provide commissioning plan.
- C. Convene commissioning team meetings.
- D. Provide Project-specific construction checklists and commissioning process test procedures.
- E. Verify the execution of commissioning process activities using random sampling. The sampling rate may vary from 1 to 100 percent. Verification will include, but is not limited to, equipment submittals, construction checklists, training, operating and maintenance data, tests, and test reports to verify compliance with the OPR. When a random sample does not meet the requirement, the CxA will report the failure in the Issues Log.
- F. Prepare and maintain the Issues Log.
- G. Prepare and maintain completed construction checklist log.

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- H. Witness systems, assemblies, equipment, and component startup.
- I. Compile test data, inspection reports, and certificates; include them in the systems manual and commissioning process report.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 024100

DEMOLITION

PART 1 -GENERAL

1.01 WORK INCLUDED

- A. Furnish labor, materials, equipment, and incidentals necessary for every type of required demolition.
- B. Furnish equipment of every type required to demolish and transport construction debris away from the site.

1.02 QUALITY ASSURANCE [Not Used]

1.03 SUBMITTALS

Submittals shall be in accordance with Section 013323 – Shop Drawings, Product Data, and Samples.

1.04 STANDARDS

Work shall be performed in accordance with the codes and ordinances of the agency having jurisdiction over the Place of Record.

1.05 DELIVERY AND STORAGE

Stockpile construction debris at the site only as long as necessary to arrange hauling to a disposal site. Stack materials neatly and handle in an orderly manner until removed from site. Construction debris shall be placed in trash containers. Do not allow trash to blow around the construction site.

1.06 JOB CONDITIONS

- A. Contractor shall visit the site and determine the extent of demolition required and the site conditions that might affect his proposal. Include costs of covering all aspects of the demolition as part of the proposal.
- B. The drawings shall be carefully reviewed to determine the extent of necessary demolition. Property lines and limits of demolition shall be accurately located prior to beginning site demolition. Demolition outside the limits indicated on the plans, or outside the property lines shall not be performed.
- C. Material removed from the construction site during demolition, and any equipment not otherwise designated to remain the property of the Owner shall become the property of the Contractor and shall be promptly removed from the construction site.
- D. Remove and dispose of off-site all drilled pier spoils.

PART 2 - PRODUCTS [Not Used]

PART 3 - EXECUTION

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3.01 PREPARATION

- A. Mark areas to be cleared and grubbed prior to commencing clearing additional requirements. Program Manager shall approve clearing and grubbing limits prior to commencement of clearing operations.
- B. The clearing limits shall not extend beyond the project limits, plus adequate distance as approved by the Program Manager to allow for construction procedures.

3.02 BACKFILLING

- A. Backfill cavities resulting from demolition. Fill cavities occurring within the limits of building, structures, or pavements in accordance with the requirements of other sections of the specifications. Backfill and compact cavities outside the construction limits to the same density as the surrounding earth.
- B. Except where further excavation extends beyond the cavities resulting from work performed under this section, fill holes with appropriate backfill material and compact to the density of the surrounding undisturbed soil. Finish the site by blading or other methods to smooth the area, remove ditches, mounds, or other natural or manmade irregular features. Blend grades together in a smooth uniform manner.

3.03 EXISTING LANDSCAPING

- A. Remove trees and brush of all sizes and description within the limits of construction. Cut trees approximately 12" above ground line and grub out and remove the remaining stumps and roots. Remove root systems larger than one (1) inch to 12" below the lowest foundation line.
- B. Protect trees and landscaping not designated to be removed from damage. Contractor and Program Manager shall visit the site and mark trees that are to remain. In the event that these trees are in close proximity to the construction, wrap trunks with 2" x 4" timber and take precautions to prevent damage to limbs and root systems.
- C. Scrape the entire site within the limits of construction, including structures, building, streets, parking lots or other pavements clear of brush, under-growth, or other vegetation.
- D. Felled trees, brush, lumber, concrete, and other debris shall become the property of the Contractor and shall be promptly removed from the site.
- E. Areas that have gravel parking or areas that are HMAC surfaces shown to be removed will be excavated down to natural soil. All gravel will be stockpiled on site as per Engineer. Gravel may be used in other areas requiring gravel if approved by Engineer. All HMAC surfaces shall be disposed of legally off site.

3.04 EXISTING STRUCTURES

Remove any concrete or masonry structures within the limits of the construction, or as otherwise indicated, including concrete slabs, foundations, brick or other masonry work, concrete steps, septic tanks, sidewalks, pavements, curbs and gutters or other components.

3.05 BURIED STRUCTURES

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Remove underground structures such as abandoned manholes, vaults, septic tanks and distribution field piping, inlets, buried trash, or debris.

3.06 UNDERGROUND UTILITIES

Take precautions during excavation procedures to guard against damage to active underground piping. In the event that inactive or abandoned pipelines are uncovered, determine that the lines are inactive, then remove buried piping within the limits of construction, or 4'-0" beyond the limits of buildings or other structures, or as needed to clear excavations. Plug both ends of such abandoned piping with concrete plugs.

3.07 FIELD QUALITY CONTROL

No burning will be permitted on the site.

3.08 CLEAN AND ADJUST

At conclusion of demolition, remove all remaining trash and debris from the construction site. Clean site to remove wind-blown paper, trash, or other debris.

END OF SECTION

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SECTION 02 4119

SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes selective removal and subsequent offsite disposal of portions of existing building indicated on drawings and as required to accommodate new construction.

1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Detach items from existing construction and deliver them to Owner's designated storage area.
- C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
- D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.3 MATERIALS OWNERSHIP

- A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, demolished materials shall become Contractor's property and shall be removed from Project site.

1.4 SUBMITTALS

- A. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- B. Proposed Dust-Control and Noise-Control Measures: Submit statement or drawing that indicates the measures proposed for use, proposed locations, and proposed time frame for their operation. Identify options if proposed measures are later determined to be inadequate.
- C. Schedule of Selective Demolition Activities: Indicate the following:
 - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
 - 2. Interruption of utility services.
 - 3. Coordination for shutoff, capping, and continuation of utility services.
 - 4. Use of elevator and stairs.
 - 5. Locations of temporary partitions and means of egress.

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6. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

- D. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged.
- E. Predemolition Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by selective demolition operations. Submit before Work begins.

1.5 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.
- B. Professional Engineer Qualifications: Comply with Division 01 Section "Quality Requirements."
- C. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction. Comply with applicable regulations, codes and ordinances.
- D. Standards: Comply with ANSI A10.6 and NFPA 241.
- E. Predemolition Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to selective demolition including, but not limited to, the following:
 - 1. Inspect and discuss condition of construction to be selectively demolished.
 - 2. Review structural load limitations of existing structure.
 - 3. Review and finalize selective demolition schedule.
 - 4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
- F. Do not disable or disrupt building fire or life safety systems without 3 days prior written notice to Owner.
- G. Building survey for ACM is the responsibility of the contractor. A copy of this survey must be submitted to the Asbestos Designated person in maintenance.
- H. Notification of demolition and associated fees will be handled by the contractor and a copy sent to the asbestos designated person in maintenance. This is for all demolitions with or without asbestos as required by DSHS.

1.6 PROJECT CONDITIONS

- A. Occupied Buildings:
 - 1. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.
 - 2. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.

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- B. Owner assumes no responsibility for condition of areas to be selectively demolished. Conditions existing at time of inspection for bidding will be maintained by Owner as far as practical.
- C. Hazardous Materials: If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- D. Storage or sale of removed items or materials on-site will not be permitted.
- E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

1.7 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 REPAIR MATERIALS

- A. Use repair materials identical to existing materials.
 - 1. If identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
 - 2. Use materials whose installed performance equals or surpasses that of existing materials.
- B. Comply with material and installation requirements specified in individual Specification Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

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- E. Engage a professional engineer to survey condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective demolition operations.
- F. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES

- A. Existing Utilities: Maintain services indicated to remain and protect them against damage during selective demolition operations.
- B. Occupied Buildings: Do not interrupt existing utilities serving occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and to authorities having jurisdiction.
 - 1. Provide at least 72 hours' notice to Owner if shutdown of service is required during changeover.
- C. Utility Requirements: Locate, identify, disconnect, and seal or cap off indicated utilities serving areas to be selectively demolished.
 - 1. Arrange with Owner to shut off indicated utilities.
 - 2. If utility services are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary utilities that bypass area of selective demolition and that maintain continuity of service to other parts of building.
 - 3. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.

3.3 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.
 - 2. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction.
 - 3. Protect existing site improvements, appurtenances, and landscaping to remain.
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.

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3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 4. Cover and protect furnishings, and equipment that have not been removed.
- C. Temporary Enclosures: Provide temporary enclosures for protection of existing building and construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
1. Where heating or cooling is needed and permanent enclosure is not complete, provide insulated temporary enclosures. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.
- D. Temporary Partitions: Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise.
- E. Temporary Shoring: Provide and maintain shoring, bracing, or structural support to preserve stability and prevent movement, settlement, or collapse of construction to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished. Strengthen or add new supports when required during progress of selective demolition.

3.4 POLLUTION CONTROLS

- A. Dust Control: Use water mist, temporary enclosures, and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations.
1. Do not use water when it may damage existing construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.
 2. Wet mop floors to eliminate trackable dirt and wipe down walls and doors of demolition enclosure. Vacuum carpeted areas.
- B. Disposal: Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
1. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- C. Cleaning: Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

3.5 SELECTIVE DEMOLITION

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction.

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3. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
 4. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 5. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, verify condition and contents before starting flame-cutting operations.
 6. Maintain portable fire-suppression devices during flame-cutting operations.
 7. Maintain adequate ventilation when using cutting torches.
 8. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 9. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 10. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 11. Dispose of demolished items and materials promptly.
 12. Return elements of construction and surfaces that are to remain to condition existing before selective demolition operations began.
- B. Existing Facilities: Comply with building manager's requirements for using and protecting elevators, stairs, walkways, loading docks, building entries, and other building facilities during selective demolition operations.
- C. Removed and Salvaged Items: Comply with the following:
1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers.
 3. Store items in a secure area until delivery to Owner.
 4. Transport items to Owner's storage area designated by Owner.
 5. Protect items from damage during transport and storage.
- D. Removed and Reinstalled Items: Comply with the following:
1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 3. Protect items from damage during transport and storage.
 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and reinstalled in their original locations after selective demolition operations are complete.
- 3.6 PATCHING AND REPAIRS
- A. General: Promptly repair damage to adjacent construction caused by selective demolition operations.

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- B. Repairs: Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.

- 1. Completely fill holes and depressions in existing concrete or masonry that are to remain with an approved masonry patching material applied according to manufacturer's written recommendations.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.8 SELECTIVE DEMOLITION SCHEDULE

- A. Refer to the drawings.

END OF SECTION

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SECTION 030150
CONCRETE PATCHING

PART 1 - GENERAL

1.1 SUMMARY

- A. Work required for this section includes non-structural concrete patching and supplementary items necessary to complete their installation.

1.2 ACTION SUBMITTALS

- A. Product Data: Submit copies of manufacturers' technical literature for specified products. Submittal(s) shall identify location(s) of Contractor's intended application of product(s).
 - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.

1.3 INFORMATIONAL SUBMITTALS

- A. Manufacturer(s) Project Acceptance Document: Certification by the manufacturer that its product(s) are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required, and that a warranty will be issued.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Experience: Installer's personnel with not less than 5 years of experience in the successful performance of Work similar to scope of this Project.
 - 2. Supervision: Installer shall maintain a competent supervisor at Project while the Work is in progress, and who has not less than 5 years of experience installing products and systems similar to scope of this Project.
- B. Fire Rated Assemblies: Perform patching of fire rated assemblies using materials and procedures to maintain fire rating of existing assembly.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply patching and repair material when air and substrate temperatures are outside limits permitted by manufacturer.
- B. Hot-Weather Requirements: Protect repair work when temperature and humidity conditions produce excessive evaporation of water from patching materials. Provide artificial shade and wind breaks, and use cooled materials as recommended by manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND PRODUCTS

- A. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".

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2.2 MATERIALS, GENERAL

- A. Source Limitations: Obtain each type of cement of the same brand from the same manufacturer's plant, each aggregate from one source, and each admixture from the same manufacturer.

2.3 MATERIAL

- A. Epoxy-Resin Bonding Adhesives: ASTM C 881, Type II.
1. Suitable for use on dry or damp surfaces.
 2. Epoxy Adhesive for Bonding Plastic Concrete to Hardened Concrete: Conform to requirements of ACI 503.2-92 (R97), unless modified herein.
 3. Epoxy Adhesive for Bonding Hardened Concrete, Steel, Wood, Brick, and other Materials to Hardened Concrete: Conform to requirements of ACI 503.1-92 (R97), unless modified herein.
 4. Manufacturers:
 - a. BASF
 - b. Euclid Chemical Company
 - c. Sika Corporation
 - d. W.R. Meadows
- B. Latex Bonding Agents, Admixtures, and Adhesives: ASTM C 1059, Type II.
1. Acceptable at non-structural and structural bonding applications, interior or exterior, unless noted otherwise in Contract Documents.
 2. Use only acrylic or styrene butadiene latex based adhesives.
 3. Manufacturers and Products:
 - a. Euclid Chemical Company; SBR Latex
 - b. L & M Construction Chemicals; Everbond
 - c. W.R. Meadows, Inc.; ACRY-LOK
- C. Polyvinyl Acetate Bonding Agents: ASTM C 1059, Type I.
1. Acceptable at non-structural and structural bonding applications, interior surfaces not subject to water exposure or high humidity during construction or in-service.
 2. Manufacturers and Products:
 - a. Euclid Chemical Company; Euco Weld.
 - b. L & M Construction Chemicals; Everweld.
 - c. W.R. Meadows, Inc.; Intralok.
- D. Patching Mortar: Packaged, dry mix polymer-modified, cementitious patching mortar complying with ASTM C 928 that contains a non-redispersible latex additive as either a dry powder or a separate liquid that is added during mixing.
- E. Coarse Aggregate: Washed aggregate complying with ASTM C 33, Size No. 8, Class 5S. Add only as permitted by patching mortar manufacturer.
- F. Epoxy Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Shore A hardness of 80 per ASTM D 2240.
- G. Self-Leveling Concrete Underlayment - Non-traffic-bearing:
1. Description: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 in (3 mm) to 1 in (25 mm) and that can be feathered at edges to match adjacent floor elevations. Interior use only, unless exterior application recommended by manufacturer within written literature.

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2. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
3. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
4. Aggregate: Well-graded, washed sand as recommended by underlayment manufacturer.
5. Compressive Strength: 4,000 psi minimum at 28 days when tested according to ASTM C 109.
6. Substrate Preparation: As recommended by product manufacturer.
7. Basis of Design (Product Standard): Ardex, Inc.; "Ardex K-15".
8. Manufacturers: (Consult manufacturer for specific product and compatibility with substrate conditions. Subject to Architect's and Engineer's review and approval.)
 - a. Ardex, Inc.
 - b. BASF
 - c. Euclid Chemical Co.

H. Self-Leveling Concrete Topping - Traffic-bearing:

1. Description: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/2 in (12 mm) to 2 in (50 mm). Consult manufacturer for thickness exceeding 2 in (50 mm). Interior use only, unless exterior application recommended by manufacturer within written literature.
2. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
3. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
4. Aggregate: Well-graded, washed gravel, 1/8 in (3 mm) to 3/8 in (10 mm) or coarse sand as recommended by topping manufacturer for specific application thickness. No coarse aggregate permitted for thicknesses of 1 in (25 mm) or less.
5. Compressive Strength: 5,000 psi minimum at 28 days when tested according to ASTM C 109.
6. Substrate Preparation: As recommended by product manufacturer.
7. Basis of Design (Product Standard): Ardex Inc.; "Ardex SD-T".
8. Manufacturers: (Consult manufacturer for specific product and compatibility with substrate conditions. Subject to Architect's and Engineer's review and approval.)
 - a. Ardex, Inc.
 - b. BASF
 - c. Euclid Chemical Co.
 - d. Sika Corp.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

3.2 INSTALLATION, GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:

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1. Respective manufacturer/fabricator's written installation instructions.
2. Accepted submittals.
3. Contract Documents.

3.3 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.
- B. Concrete Removal: Saw-cut perimeter of areas indicated for removal to a depth of at least **1/2 in (12 mm)**. Make cuts perpendicular to concrete surfaces and no deeper than cover on reinforcing. Remove loose and deteriorated concrete.
- C. Preparation of Floor Joints: Saw-cut joints full width to edges of spalls and to a depth of at least **3/4 in (19 mm)**. Clean out debris and loose concrete; vacuum or blow clear with compressed air.
- D. Surface Preparation for Patching Mortar: Clean concrete by scarifying or sand blasting to remove dirt, oils, films, and other materials detrimental to patching application. Allow surface to dry before applying mortar.
- E. Surface Preparation for Toppings: Remove delaminated material and deteriorated concrete surface material. Roughen surface of concrete by shot blasting, to produce a surface profile recommended by manufacturer. Sweep and vacuum roughened surface to remove debris followed by low-pressure water cleaning.

3.4 APPLICATION

- A. Epoxy Bonding Agent: Apply to reinforcing bars and concrete by brush, roller, or spray according to manufacturer's written instructions, leaving no pinholes or other uncoated areas. Apply to reinforcing bars in at least two coats, allowing first coat to dry before applying second coat. Apply patching mortar or concrete while epoxy is still tacky. If bonding agent dries, recoat before placing patching mortar or concrete.
- B. Latex Bonding Agent, Type II: Mix with Portland cement and scrub into concrete surface according to manufacturer's written instructions. If bonding agent dries, recoat before placing patching mortar or concrete.
- C. Latex Bonding Agent, Type I: Apply to concrete by brush roller or spray. Allow to dry before placing patching mortar or concrete.
- D. Patching Mortar: Unless otherwise recommended by manufacturer, apply as follows:
 1. Wet substrate thoroughly and then remove standing water. Scrub slurry of neat patching mortar into substrate, filling pores and voids.
 2. Place patching mortar by troweling toward edges of patch to force intimate contact with edge surfaces. For large patches, fill edges first and then work toward center, always troweling toward edges of patch. At fully exposed reinforcing bars, force patching mortar to fill space behind bars by compacting with trowel from sides of bars.
 3. For vertical patching, place material in lifts of not more than **1 in (25 mm)** or less than **1/4 in (6 mm)**. Do not feather edge.
 4. For overhead patching, place material in lifts of not more than **1/2 in (12 mm)** or less than **1/8 in (3 mm)**. Do not feather edge.
 5. After each lift is placed, consolidate material and screed surface.

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6. Where multiple lifts are used, score surface of lifts to provide a rough surface for application of subsequent lifts. Allow each lift to reach final set before placing subsequent lifts.
 7. Allow surfaces of lifts that are to remain exposed to become firm and then finish to match adjacent surface.
 8. Wet-cure cementitious patching materials, including polymer-modified, cementitious patching materials, for not less than seven days by water-fog spray or water-saturated absorptive cover.
- E. Epoxy Joint Filler: Install in nonmoving floor joints where indicated.
1. Install filler to a depth of at least 1 in (25 mm). Use fine silica sand no more than 1/4 in (6 mm) deep to close base of joint. Do not use sealant backer rods or compressible fillers below joint filler.
 2. Install filler so that when cured, it is flush at top surface of adjacent concrete. If necessary, overfill joint and remove excess when filler has cured.
- F. Topping or Underlayment: Mix and apply self leveling components according to manufacturer's written instructions.
1. Apply primer over prepared substrate at manufacturer's recommended spreading rate.
 2. Apply to produce uniform, level surface.
 3. Add aggregate for thicker areas as recommended by manufacturer.
 4. Apply a final layer without aggregate if required to produce smooth surface.
 5. Feather edges to match adjacent floor elevations.
 6. Cure according to manufacturer's written instructions.
 7. Prevent contamination during application and curing processes.
 8. For areas which are to have finish flooring, use self-leveling concrete underlayment.
 9. For areas which will be exposed as wearing surface, use self-leveling concrete topping.

END OF SECTION

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SECTION 031100

CONCRETE FORMING

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish material and labor to form, tie, brace and support wet concrete, reinforcing steel and embedded items until the concrete has developed sufficient strength to remove forms.

1.02 QUALITY ASSURANCE

A. DESIGN CRITERIA

Forms shall be designed for the pressure exerted by a liquid weighing 150 pounds per cubic foot. The rate of placing the concrete, the temperature of the concrete, and all other pertinent factors shall be taken into consideration when determining the depth of the equivalent liquid. An additional design live load of 50 pounds per square foot shall be used on horizontal surfaces.

B. ALIGNMENT CONTROL

True alignment of walls and other vertical surfaces having straight lines or rectangular shapes shall be controlled and checked by the following procedures:

1. Forming shall be arranged with provisions for adjusting the horizontal alignment of a form, after the form has been filled with concrete to grade, using wedges, turn-buckles, or other adjustment methods. Establish a transit line or other reference so that adjustments can be made to an established line while the concrete in the top of the form is still plastic.
2. Adjusting facilities shall be at intervals which permit adjustments to a straight line. Concrete shall not be placed until adequate adjusting facilities are in place.

1.03.1 SUBMITTALS

- A. Submittals shall be in accordance with Section 013300, SUBMITTAL PROCEDURES and shall include drawings or descriptions of construction joint locations.

1.04 STANDARDS

The applicable provisions of the following standards shall apply as if written here in their entirety:

- A. American Concrete Institute (ACI) specifications:
ACI 361 Specifications for Structural Concrete for Buildings
ACI 318 Building Code Requirements for Reinforced Concrete
- B. American Institute of Steel Construction (AISC) publication: AISC Manual of Steel Construction
- C. American Iron and Steel Institute (AISI) publication: American Plywood Association (APA) standards

1.05 DELIVERY AND STORAGE

- A. Lumber for forms shall be stacked neatly on platforms raised above ground.

1.06 JOB CONDITIONS

- A. The Contractor shall notify the Engineer upon completion of various portions of the work required for placing concrete so that compliance with the plans and specifications may be monitored. The Engineer will authorize the Contractor to proceed with the placement after this has been completed and corrections, if required, have been made.
- B. In hot weather, both sides of the face forms may be required to be treated with oil to prevent warping and to secure tight joints.

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PART 2 - PRODUCTS

2.01 MATERIALS

- A. LUMBER: Properly seasoned and of good quality; free from loose or unsound knots, knot holes, twists, shakes, decay, splits, and other imperfections which would affect its strength or impair the finished surface of the concrete.
- B. FIBER BOARD FORM LINING: Hardboard finished smooth on one (1) side; minimum thickness of 3/16"; thoroughly wet with water at least 12 hours before using.
- C. PLYWOOD FORM LINING: Conforming to APA HDO; exterior exposure waterproof adhesive, 3/8" thick.
- D. FORM OIL: Light, clear oil; shall not discolor or injuriously affect the concrete surface, subsequent coatings, or delay or impair curing operations

2.02 FABRICATIONS

- A. LUMBER: Lumber for facing or sheathing shall be surfaced on at least one (1) side and two (2) edges and sized to uniform thickness. Lumber of nominal 1" thickness or plywood of 3/4" thickness shall be permitted for general use on structures, if backed by a sufficient number of studs and wales.
- B. SPECIAL FORM LUMBER
 - 1. Molding for chamfer strips or other uses shall be made of redwood, cypress, or pine materials of a grade that will not split when nailed, and which can be maintained to a true line without warping. The form shall be mill cut and dressed on all faces. Fillet forms at sharp corners, both inside and outside and at edges, with triangular chamfer strips at all non-contiguous edges exposed to view. Thoroughly oil chamfer strips before installation on forms.
 - 2. Construct forms for railings and ornamental work to standards equivalent to first class mill work.
 - 3. All moldings, panel work, and bevel strips shall be straight and true with neatly mitered joints and designed so that the finished work shall be true, sharp, and clean-cut.
- C. FORMS
 - 1. Forms shall be built mortar-tight and of material sufficient in strength to prevent bulging between supports.
 - 2. Reused forms or form lumber shall be maintained clean and in good condition as to accuracy, shape, strength, rigidity, tightness, and smoothness of surface.
 - 3. All forms shall be so constructed as to permit removal without damage to the concrete. Exercise special care in framing forms for copings, offsets, railing and ornamental work, so that there will be no damage to the concrete when the forms are removed.
- D. METAL FORMS
 - 1. The specifications for "Forms" regarding design, mortar tightness, filleted corners, beveled projections, bracing, alignment, removal, re-use, oiling, and wetting shall apply equally to metal forms.
 - 2. The metal used for forms shall be of such thickness that the forms will remain true to shape. Bolt and rivet heads on the facing sides shall be countersunk. Clamps, pins, or

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other connecting devices shall be designed to hold the forms rigidly together and to allow removal without injury to the concrete.

3. Metal forms which do not present a smooth surface or line up properly shall not be used. Exercise special care to keep metal free from rust, grease, or other foreign material that discolors the concrete.

E. FORM LININGS

1. Timber forms for exposed concrete surfaces which are to be given a rubbed finish shall be facelined with an approved type of form lining material.
2. If plywood is used for form lining, it shall be made with waterproof adhesive and have a minimum thickness of 3/4". It shall preferably be oiled at the mill and then be oiled or lacquered on the job before using.
3. If fiber board is used, apply water to the screen side on the board. Stack the boards screen side to screen side. Use the smooth hard face as the contact surface of the form. Such surfaces may be formed with 3/4" thick plywood made with waterproof adhesive if backed with adequate studs and wales. The greatest strength of the outer plies should be at right angles to the studding. In this case, form lining will not be required.
4. Carefully align edges and faces of adjacent panels and fill the joints between panels with patching plaster or cold-water putty to prevent leakage. Lightly sand with No.0 sandpaper to make the joints smooth.
5. Forms which are reused shall have all unused form tie holes filled and smoothed as specified above.

F. FORM TIES

1. Metal form ties shall be used to hold forms in place and to provide easy metal removal. The use of wire for ties shall not be permitted.
2. Remove metal appliances which are used inside the forms to hold the forms in correct alignment to a depth of at least 1-1/2" from the surface of the concrete, without undue injury to the surface from chipping or spalling. Such devices, when removed, shall leave a smooth opening in the concrete surface no larger than 1" in diameter.
3. Burning off rods, bolts, or ties shall not be permitted.
4. Metal ties shall be held in place by devices attached to wales. Each device shall be capable of developing the strength of the tie.
5. Metal and wooden spreaders which are separate from the forms shall be wired from the top of form and shall be entirely removed as the concrete is placed.
6. The use of metal form ties which are encased in paper or other material to allow the removal of complete tie, and which leave a hole through the concrete structure, shall not be permitted in the construction of basement or water bearing walls.

G. FALSEWORK

1. Falsework shall be designed and constructed so that no excessive settlement or deformation occurs. Falsework shall provide necessary rigidity.
2. Timber used in falsework centering shall be sound, in good condition and free from defects which impair its strength.
3. Steel members shall be of adequate strength and shape for the intended purpose.

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4. Timber piling used in falsework may be of any wood species which satisfactorily withstands driving and which adequately supports the superimposed load.
5. When sills or timber grillages are used to support falsework Columns, unless founded on solid rock, shale, or other hard materials, place them in excavated pits. Backfill to prevent the softening of the supporting material from form drip or from rains that may occur during the construction process. Sills or grillages shall be of ample size to support the superimposed load without settlement.
6. Falsework not founded on a satisfactory spread footing shall be supported on piling, which shall be driven to a bearing capacity to support the superimposed load without settlement.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Before placing concrete, ensure that embedded items are correctly, firmly, and securely fastened into place. Embedded items shall be thoroughly clean and free of oil and other foreign material. Anchor bolts shall be set to exact locations by the use of suitable anchor bolt templates.

3.02 INSTALLATION

A. Pre-placement

1. During the elapsed time between building the forms and placing the concrete, maintain the forms to eliminate warping and shrinking.
2. Treat the facing of forms with suitable form oil before concrete is placed. Apply oil before the reinforcement is placed. Wet form surfaces which will come in contact with the concrete immediately before the concrete is placed.
3. At the time of placing concrete, the forms shall be clean and entirely free from all chips, dirt, sawdust, and other extraneous matter at the time. Forms for slab, beam and girder construction shall not have tie wire cuttings, nails, matches or any other matter which would mar the appearance of the finished construction. Clean forms and keep them free of foreign matter during concrete placement.

B. PLACEMENT

1. Set and maintain forms to the lines designated, until the concrete is sufficiently hardened to permit form removal. If, at any stage of the work, the forms show signs of bulging or sagging, immediately remove that portion of the concrete causing this condition. If necessary, reset the forms and securely brace against further movement.
2. Provide adequate cleanout openings where access to the bottom of the forms is not otherwise readily attainable.
3. Carefully and accurately place and support reinforcement in concrete structures.

C. REMOVAL

Remove forms so that the underlying concrete surface is not marred or damaged in any way. Forms shall not be removed until the concrete has attained sufficient strength (minimum of 28-day compressive strength) to safely carry the dead load, but in no case less than the number of curing days set forth in the following table.

Forms for concrete paving.

7-day min.
OR
75% design strength

END OF SECTION

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SECTION 031100

CONCRETE FORMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes concrete forming and supplementary items necessary to complete work required for its installation.

1.3 DEFINITIONS

- A. Formwork: Total system of support for freshly placed concrete including mold or sheathing that contacts concrete as well as supporting members, hardware, and necessary bracing.

1.4 PERFORMANCE REQUIREMENTS

- A. Design, engineering and construction of Formwork: Shall be responsibility of Contractor.
- B. Shoring of Concrete Members: Concrete members shall be adequately shored to safely support loads and lateral pressures outlined in "Guide to Formwork for Concrete" (ACI 347) without distortion, excessive deflection or other damage.
- C. Formwork Tolerances: Conform to ACI 301, unless tighter tolerance is specified herein or on drawings, or where stricter tolerance is required to facilitate satisfactory installation requirements of other trades/finishes. Contractor shall be responsible for control of concrete work tolerances to permit satisfactory installation of other trades/finishes.

1.5 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections.
 - 1. Shop drawings shall not be made by using reproductions of Contract Drawings.
 - 2. Any fabrication of material before approval of drawings will be at risk of Contractor.
 - 3. Fabricator alone shall be responsible for errors of detailing and fabrication.
- B. Formwork Design Statement: Submit written statement sealed and signed by Structural Engineer responsible for formwork design and registered in state of project that design of components of formwork, including reshores are in compliance with provisions of Contract Documents and Building Code, and is in keeping with generally accepted engineering practice. Submit prior to placement of concrete requiring formwork.
- C. Sleeve Locations: Submit plan showing proposed sleeve locations, sleeve material and sleeve sizes for review by Architect and Engineer prior to concrete placement. Include dimensions to centerline of sleeves, tied to building grids where feasible.

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- D. Source and field quality-control documentation.
 - 1. Submit test reports as required for indicating compliance with the Quality Control sections below.
- E. Contractor shall submit to the enforcing agency, for acceptance, a quality control or inspection plan that addresses all inspection issues.

1.6 QUALITY ASSURANCE

- A. Codes and Standards: Comply with provisions of following, except as otherwise indicated or where more stringent requirements are shown or specified:
 - 1. International Building Code (IBC) Edition indicated by Drawings, including Special Inspection and Quality Control requirements, chapter 17 of the IBC and any local or State provisions.
 - 2. Following code and standard versions shall be as referenced by IBC chapter 35 or, where not referenced in IBC, the most recent published versions.
 - a. American Concrete Institute (ACI) 301, "Specifications for Structural Concrete".
 - b. ACI 318, "Building Code Requirements for Structural Concrete".

1.7 PROPOSED SUBSTITUTIONS

- A. Substitutions of sections or modifications of details, if proposed by Contractor, shall be submitted for approval prior to submission of shop drawings, and such substitutions shall be made only when approved by Architect, and at no additional cost to Owner. Total amount of credit, if any, shall be stated in writing with submission.
- B. Corrections for inaccuracies that result in change from Structural Drawings or final approved shop drawing details shall be submitted for approval. Such substitutions or corrections shall be made only when approved by Architect.

1.8 HANDLING, STORAGE AND COORDINATION

- A. Storage of materials:
 - 1. Store materials to permit easy access for inspection and identification.
 - 2. Store materials to protect from moisture, sunlight, dirt, oil and contaminants.
- B. Form lumber shall be delivered to job site as far in advance of its use as is practical, and shall be carefully stacked clear of ground in such manner as to facilitate air-drying.
- C. Coordinate installation of formwork. Provide setting diagrams, templates, instructions and directions for installation.
- D. Coordinate openings in formwork, penetrations through formwork and sleeve requirements with final equipment selections and locations by MEP sub-contractors. Verify any changes from approved shop drawings with Engineer of Record prior to the Work.

1.9 FORMWORK LOAD ON EXISTING BUILDINGS

- A. Formwork and formwork loads not permitted on existing buildings unless otherwise indicated on drawings or specified herein.

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- B. Design formwork to be self-supporting without reliance on existing building for support or control of formwork deflection.
- C. Existing building occupancy and activity shall not be disturbed or interrupted due to formwork requirements for project.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Specific product, material or manufacturer listed under each item below is "acceptable" only if manufacturer can evidence product compliance with requirements of Contract Documents.
- B. For manufacturers not listed, submit as substitution according to the Conditions of the Contract and Division 01 Specification Sections.

2.2 ACCEPTABLE MANUFACTURERS

- A. Following manufacturers listed are "acceptable" only if manufacturer can evidence product compliance with requirements of Contract Documents.
 - 1. Form Coating:
 - a. Laticrete; L&M Debond.
 - b. Nox-Crete Chemicals; Chemically active form release agent(s).
 - c. W.R. Meadows, Inc.; Duogard II.
- B. For manufacturers not listed, submit as substitution according to the Conditions of the Contract and Division 01 Specification Sections.

2.3 MATERIALS

- A. Forms
 - 1. General: Refer to Division 03 Section "Concrete Finishing" for description, location and irregularity limits for Classes D, C, B and A surfaces.
 - 2. Class D and C Surfaces: Wood forms for surfaces specified to receive Rough-Formed Finish for Class D and C Surfaces, shall be built of material (subject to approval of Architect), of sufficient thickness to be capable of sustaining loads to be imposed thereon, dressed to uniformly smooth contact surfaces, and so constructed as to be readily removable. Forms for round columns may have one vertical seam.
 - 3. Class B and A Surfaces: Wood forms for surfaces specified to receive Smooth-Formed Finish for Class B and A Surfaces shall be constructed of Commercial Standard, moisture-resistant, concrete form plywood, not less than five (5) ply, and at least nine-sixteenths inch (9/16") thick, with one (1) smooth face. Other form materials or liners may be used provided smoothness and appearance of concrete produced will be equivalent to that produced by noted wood forms. Forms for round columns shall be prefabricated seamless type.
 - 4. Plywood: PS-1, MDO, BB Grade, Class I; II features or B-B High Density Concrete Form Overlay.
 - 5. Steel Forms: Minimum 16 ga. sheet, tight fittings, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.

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- B. Form Ties:
1. Form ties for exposed concrete surfaces shall be manufactured to allow a positive break-back of no less than **1 in (25 mm)** inside concrete surface. Ties shall be equipped with a plastic cone of not less than **5/8 in (15 mm)** diameter and **1 in (25 mm)** long which will completely cover hole and prevent leakage of any mortar.
 2. Form ties for unexposed surfaces shall be bolt rods or patented devices. Ties shall be adjustable in length and free of features which would leave a hole larger than **1 in (25 mm)** in diameter, or depressions back of exposed surface of concrete. Ties shall leave no corrodible metal within **1 in (25 mm)** of finished surface of concrete.
 3. Form ties fabricated on project site and wire ties are not acceptable.
- C. Form Coating: Non-staining, non-residual, free of fuel oils, kerosene, waxes or resins.
- D. Corner Chamfer: Meadow Burke, "CSF" Type, **3/4 in (19 mm)** polyvinyl chloride strip corner chamfer.
- E. Sleeves Through Concrete: Vertical and horizontal sleeves through concrete work shall be minimum size required for application, but, in no case greater than **2 in (50 mm)** nominally larger in cross-section than pipe/element intended to pass through sleeve.
1. It shall be expressly understood that sleeve sizes affect structural concrete capacity and performance.
 2. Over-sizing of sleeves to degree greater than stated above will not be permitted unless otherwise authorized by Architect/Engineer.
 3. Refer to structural drawings for additional maximum sleeve diameters/sizes criteria.
 4. Sleeves shall not be placed in beams and girders, or through two-way flat slabs in the vicinity of columns without Architect/Engineer advance approval, if not shown on structural Drawings.

PART 3 - EXECUTION

3.1 STANDARDS

- A. Formwork Design and Engineering: Responsibility of Contractor. Refer to "Performance Requirements" above.
- B. Formwork Construction: Conform to shapes, lines and dimensions of various components of concrete construction shown or scheduled on Drawings.
1. Sufficiently tight and assembled to prevent bulging or leakage of mortar.
 2. Assembled to facilitate removal without damage to concrete.
 3. Provide temporary openings at bottom of walls, columns and elsewhere as required to facilitate cleaning, drainage and inspection. Close such openings securely in advance of pouring concrete.
 4. Construct formwork at Smooth-Formed Finish surfaces to produce concrete surfaces free of unsightly or objectionable form marks for exposed surfaces.
 5. Cleaning Formwork: Formwork once used shall have contact surfaces thoroughly cleaned before reuse.
- C. Formwork Classes and Irregularity Limits: Refer to Section 03 3500 "Concrete Finishing".
- D. Construction Joints: Refer to Section 03 3000 "Cast-in-Place Concrete".

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3.2 FORMWORK AT CONCRETE MEMBERS

- A. General: Construct formwork for concrete members to heights, thicknesses, depths, profiles, sizes and shapes as shown or scheduled on Drawings.
- B. Openings: Form openings through concrete members where shown and in accordance with structural details.
 - 1. Do not form openings through concrete members, vertically or horizontally, unless shown by structural Drawings.
 - 2. Where openings for horizontal passage of ducts, conduits, etc.....through concrete members are required but not indicated by structural Drawings, advise Architect/Engineer sufficiently in advance of the work to permit review.
 - 3. Form openings vertically through slabs as required for vertical passage of ducts, pipes, etc...in conformance with structural details.
- C. Keys and Haunches:
 - 1. Provide appropriate keys and haunches in walls to receive edges of concrete floors.
 - 2. Provide appropriate keys at slab construction joints in conformance with structural details.
 - 3. Provide appropriate keys at vertical construction joints through beams, girders and joists as occurs in conformance with structural details.

3.3 MISCELLANEOUS FORMWORK ITEMS, ACCESSORIES AND SLEEVES

- A. General: Construct forms for items of concrete work required for or in connection with satisfactory completion of project, whether each such item is specifically shown or referred to or not.
- B. Form Ties: Form ties shall be employed in such places and at such intervals as to securely hold forms in position during placing of concrete, and to withstand weight and pressure of wet concrete.
 - 1. Ties of a type intended to be entirely removed shall be coated with an approved lubricant to safeguard against damaging concrete during such removal.
 - 2. Use of wire ties will not be permitted.
- C. Form Coating: Coat contact surfaces of wood forms, before placing any metal reinforcement, with form coating.
 - 1. Do not apply form release agent where concrete surfaces are scheduled to receive special finishes or applied coverings which may be affected by agent.
 - 2. Soak contact surfaces of untreated forms with clean water. Keep surfaces wet prior to placing concrete.
- D. Chamfers, Wood Strips, Blockings and Moldings: Place in forms wood strips, blocking, moldings, nailers, etc., as required to produce finished profiles and surfaces shown on Drawings and to provide nailing for wood members or other features required to be attached to concrete surfaces in such manner.
 - 1. Coat wood strips, blocking and moldings with form coating.
 - 2. Exposed external angles of concrete members shall have 3/4 in (19 mm) chamfer strips placed in forms to relieve angles.
- E. Inserts and Embedded Items: Install accessories in accordance with manufacturer's instructions, level and plumb.
 - 1. Coordinate work of other sections in forming and setting slots, recesses, bolts, anchors and other inserts.

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2. Ensure items are not disturbed during concrete placement.

F. Sleeves: Coordinate work of other sections in setting sleeves.

1. Do not install sleeves in any concrete member except where shown on structural Drawings or upon written approval of Engineer.
2. Secure sleeves to avoid displacement during concreting.

G. Recesses and Ledges: Coordinate work of other sections in forming recesses in slabs, and ledges in beams and walls.

1. Notify Architect/Engineer in advance of work if recesses or ledges are deemed as required but not shown by structural drawings.
2. Do not recess slabs if not shown by structural Drawings, without advance review of Architect/Engineer.

3.4 REMOVAL OF FORMWORK

A. General:

1. Formwork shall not be removed until concrete has set sufficiently to permit form removal with complete safety and without loss of serviceability of structure.
2. No construction loads shall be supported on, nor shoring removed from, part of structure under construction except when that portion of structure in combination with remaining forming and shoring system has sufficient strength to support safely its weight and loads placed thereon.
3. Construction loads exceeding basis of design loading, consisting of superimposed dead load plus specified live load, shall not be supported on unshored portion of structure under construction.
4. Exercise care when removing formwork and through wall ties from finished concrete surfaces such that surfaces, edges and corners are not damaged.
5. Cutting ties back from face of concrete is not permitted.
6. Remove formwork in manner such that members are not subjected to stress reversal.
7. Do not remove formwork until measurement of slab surface tolerances is complete.

B. Early Formwork Removal (Typical Standards):

1. Formwork for concrete member soffits that support weight of concrete may be removed earlier as indicated by FORMWORK REMOVAL TABLE – EARLY REMOVAL only if it is demonstrated that the concrete has reached 75 percent of its specified 28-day compressive strength. Concrete compressive strength shall be determined by tests on field-cured cylinders.
2. Minimum period of time for Early Removal of concrete member soffit formwork shall not be less than 72 hours.
3. If concrete strength data based on field-cured cylinders is not available, minimum period of time shall be as specified by FORMWORK REMOVAL TABLE – NORMAL REMOVAL.
4. Formwork removal for sides of concrete members shall comply with requirements specified by FORMWORK REMOVAL TABLE.

PART 4 - QUALITY CONTROL

4.1 INSPECTION STANDARDS

A. Quality control, testing, and inspections shall meet the special inspection requirements of the building code and any local or state provisions.

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1. Minimum periodic and continuous inspection requirements are indicated below. Refer to Drawings for supplemental and/or more stringent testing requirements, as required.
2. Provide for more stringent inspection/testing where specified on Drawings or required elsewhere in these Specifications.

4.2 TESTING AGENCY

- A. Owner will employ and pay a qualified independent testing agency to perform the quality control indicated in this section, including special inspections required by the building code.
1. Inspection and testing by Owner's testing agency is for verification and shall not relieve Contractor of his responsibility to furnish materials and workmanship in accordance with Contract Documents.
 2. Retesting of materials or conditions failing to meet specified requirements shall be done at Contractor's expense.
 3. In cases of differences of opinion between Owner's testing agency and the Contractor's inspector regarding conformance, the issue should be brought to the Engineer of Record and the enforcement agency as part of the resolution process.
- B. Scope of Services:
1. Check general arrangement and construction of forms for conformance to shapes, lines and dimensions of members as required by design drawings and specifications.
 2. Check time sequence of form removal and re-shore procedure, considering field measured concrete strength.
 3. Confirm results of field cured concrete test cylinders before stripping of forms.
 4. Verify that forms are properly coated and all debris and ice have been removed from spaces to be occupied by concrete.
- C. Provided Reports: Provide timely written reports which document observations made. Include following information as minimum content:
1. Date of observations.
 2. Conditions observed.
 3. Location of condition(s). Give clear identification of location(s) with reference to floor level and column grids whenever possible.
 4. Acknowledgement of compliant or non-compliant conditions.

4.3 CONTRACTOR

- A. Materials and Workmanship: Owner's employment of a qualified independent testing agency to perform testing/inspection services indicated above shall not operate to relieve Contractor of responsibility to furnish materials and workmanship in accordance with Contract Documents.
- B. Contractor Inspection/Testing: Owner's employment of a qualified independent testing agency to perform testing/inspection services indicated above is for verification and does not prevent Contractor from providing supplemental inspection/testing at Contractor's discretion and expense.
- C. Formwork Installation
1. Verify compliance with shoring and reshoring design.
 2. Check supports of forms for vertical and lateral stability.
 3. Verify positioning of shores to ensure concentric alignment at consecutive levels.
 4. Verify arrangement of forms for conformance to shapes, lines and dimensions of members as specified by design drawings and specifications.

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5. Verify cleanliness of forms prior to concreting.
6. Observe forms during concrete placement to detect abnormal deflections or signs of imminent failure and if detected, halt operations immediately until the deficiencies have been corrected.

D. Early Formwork Removal Time Control and Testing:

1. If early formwork removal is desired by Contractor, additional cylinders and testing performed for this purpose are required and shall be at Contractor's expense.
2. Compressive strength verification shall be made on field cured cylinders during construction work phase.
 - a. Secure composite samples in accordance with ASTM C 172. Each sample shall be obtained from different batch of concrete on random basis, avoiding selection of test batch other than by number selected at random before commencement of concrete placement.
 - b. Mold and field cure 2 specimens (one strength test) from each sample in accordance with ASTM C 31.
 - c. Cure cylinders in accordance with ASTM C 31 procedures for "Curing for Determining Form Removal Time".
 - d. Make at least one strength test (2 specimens) for each 3000 square feet of floor slab or fraction thereof.
 - e. Test cylinders in accordance with ASTM C 39. Early form removal shall be based on average compressive strength of cylinders for concrete under construction where early form removal is desired.

END OF SECTION

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SECTION 031500

CONCRETE ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes concrete accessories and supplementary items necessary to complete work required for their installation.

1.3 DEFINITIONS

- A. Adhesive Anchor: post-installed device (bolt, threaded rod, or reinforcing bar) for transferring load(s) to concrete consisting of a steel element used in conjunction with an adhesive compound and embedded in a drilled round hole in hardened concrete. Adhesive Anchor System includes fastening components and necessary accessories recommended by adhesive manufacturer for appropriate installation.
- B. Anchor Spacing: distance between centerline of adjacent anchors
- C. Cast-in-Place Anchor: headed bolt, headed stud, hooked bolt, or reinforcing bar installed before concrete placement
- D. Cracked Concrete: condition of concrete in which the anchor is installed and/or condition which could occur at or near anchor location over service life of anchor
- E. Edge Distance: dimension from anchor/component centerline to free edge of base material in which component is anchored or installed
- F. Embedment Depth: dimension from surface of base material to tip of anchor/component installed in base material
- G. Mechanical Anchor: post installed device for transferring load(s) to concrete by direct bearing, friction or both. Generally includes expansion type, sleeve type and screw type anchors
- H. Post-Installed Anchor: an anchor or dowel installed into hardened concrete of specified 28-day compressive strength. Includes drilled-in bolts, threaded rods and reinforcing bars/dowels.

1.4 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections.
- B. Product Data (General): Manufacturer's printed literature to evidence compliance with these specifications.

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- C. Product Data (Mechanical and Adhesive Anchors): Manufacturer's product specifications with recommended design values, physical characteristics, installation instructions, ICC-ES Report(s) and necessary calculations to evidence compliance with these specifications.
- D. Samples:
 - 1. Expansion Joint Filler: Two (2) representative samples, 6 inches x 12 inches.
 - 2. Waterstops: Two 6 inch strips, complete with "quick-release" papers.
 - 3. Concrete Inserts: Construction and finish specified.
 - 4. Mechanical and Adhesive Anchors: Two (2) samples of each respective type and size proposed if requested by Architect/Engineer
- E. Source and field quality-control documentation.
 - 1. Test reports as required for indicating compliance with the Quality Control sections below.
- F. Contractor shall submit to the Engineer and the enforcing agency, for acceptance, a quality control or inspection plan that addresses all inspection issues.
- G. Design calculations for Post-Installed Anchors where/if substitution is proposed from requirements shown on Drawings. Include seal/signature of Engineer responsible for design and licensed to practice in jurisdiction of Project.

1.5 QUALITY ASSURANCE

- A. Codes and Standards: Comply with following provisions, except as otherwise indicated:
 - 1. International Building Code (IBC), edition indicated by Drawings including Special Inspection and Quality Control requirements, Chapter 17 of the IBC and any local or State provisions. All following code and standard versions shall be as referenced by IBC Chapter 35 or, where not referenced in IBC, the most recent published versions.
 - 2. ICC-ES approval and related testing to meet ICC-ES Acceptance Criteria required for mechanical and adhesive anchors.
 - 3. ACI 355.2 (for bolted connections to hardened concrete using expansion type and sleeve type anchors)
 - 4. ACI 355.4 (for bolted connections to hardened concrete using adhesive anchors)
- B. Each type product covered under this Section shall be produced by single manufacturer unless otherwise specified.
- C. Manufacturer: Not less than five (5) years successful production of product. Submit evidence if requested by Architect/Engineer.
- D. Mechanical Anchor and Adhesive Anchor Installer Qualifications:
 - 1. Qualification: Post-installed anchors/dowels shall be installed by personnel having minimum of 3 years experience performing similar installations and having applicable certificate or other evidence of previous training from anchor product manufacturer, subject to approval of Architect/Engineer.
 - 2. Training (As Alternate to Above Qualification): Conduct training (with manufacturer or manufacturer's representative) for installer(s) on project. Training to consist of review of complete installation process for drilled-in anchors, to include but not limited to:
 - a. Hole drilling process/bits
 - b. Hole preparation/cleaning
 - c. Adhesive dispenser/injection technique(s)
 - d. Rebar dowel preparation
 - e. Proof loading/torqueing.

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3. Maintain Qualification/Training records on site. Subject to Testing Agency and/or Architect/Engineer review on request.

1.6 PROPOSED SUBSTITUTIONS

- A. Substitution or modifications, if proposed by Contractor, shall be submitted for approval prior to submission of shop drawings, and such substitutions shall be made only when approved by Architect, and at no additional cost to Owner. Total amount of credit, if any, shall be stated in writing with submission.
- B. Substitution of drilled-in anchors for cast-in-place anchors, or alternate type drilled-in anchors, shall not be made without advance proposed substitution and Architect/Engineer's approval.
- C. Corrections for conflicts or inaccuracies that result in change from Structural Drawings or final approved shop drawing details shall be submitted in sketch form for approval. Such substitutions or corrections shall be made only when approved by Architect/Engineer.
- D. Where drilled-in anchors must be substituted for specified anchors due to mis-placement or other reason, Contractor shall be responsible for design/re-design and cost for design/re-design. Assume "cracked" concrete unless otherwise advised in writing by Architect/Engineer. Refer to paragraph 1.4.G above.

1.7 STORAGE AND HANDLING

- A. Storage of materials:
 - 1. Store materials to permit easy access for inspection and identification.
 - 2. Store materials in accordance with manufacturer's recommendations.
 - 3. Note: Adhesive cartridges and capsules have special requirements for temperature/sunlight exposure and shelf life.

1.8 COORDINATION

- A. Coordinate installation of anchorage items to be embedded in or attached to other construction. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.
- B. Coordinate qualifications/training for installers.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Specific product, material or manufacturer listed under each item below is "acceptable" only if manufacturer can evidence product compliance with requirements of Contract Documents.
- B. For manufacturers not listed, submit as substitution according to the Conditions of the Contract and Division 01 Specification Sections.

2.2 MATERIALS

- A. Expansion Joint Filler:
 - 1. Superior-grade, polyethylene, closed cell, expansion joint filler.
 - 2. Strong, ultra-violet stable, resistant to most oils, chemicals, ozone and weathering.

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3. Acceptable manufacturers and product(s):
 - a. ChemRex Inc., Sonneborn Building Products – “Sonoflex F”
 - b. Sealed Air Corporation – “Cellu Joint”
 - c. Williams Products, Inc. – “Everlastic Expand-O-Foam 1380 Series”
 - d. W.R. Meadows, Inc. – “Ceramar”
- B. Waterstops:
 1. Extruded “rope” form, between two protective papers, silicone treated for fast stripping. Bentonite type waterstops not permitted.
 2. In standard cross-section (as extruded) of approximately 1 square inch, 36 inch minimum supplied length.
 3. Primer: As recommended by waterstop manufacturer.
 4. Basis of Design:
 - a. Henry Company – “SF302 Synko-Flex Waterstop”
- C. Concrete Inserts:
 1. Wedge Type Inserts:
 - a. Description: Malleable iron, with 1-1/2 inch stainless steel askew head bolt. Standard or long as required by location.
 - b. Acceptable manufacturers and product(s):
 - 1) Heckmann Building Products, Inc., Cat. No. 425
 - 2) Hohmann & Barnard, Inc., No. HW340 and LW340
 - 3) Dayton/Richmond, Shelf Angle Wedge Inserts – F-7 and F-7-L
 2. Dovetail Anchor Slots: Heckmann Building Products, Inc. No. 100, 1 inch wide back, 1 inch deep, 5/8 inch throat, 20 gage galvanized steel with removable filler.
- D. Mechanical and Adhesive Anchors:
 1. Where specific anchor manufacturer/type is shown on drawings, substitution of alternate anchor is subject to Engineer’s approval.
 2. Size and Embedment: As indicated on Drawings. Where embedment is not indicated, submit proposed embedment prior to installation to Engineer for approval. For adhesive anchorages, use embedment of 12 x anchor/rebar diameter, or, submit proposed embedment prior to installation to Engineer for review.
 3. Material for Bolts, Nuts, and Washers, unless noted otherwise:
 - a. Carbon Steel with Zinc-Plating: ASTM B 633, Type III, Fe/Zn 5. Use at permanent interior environments free of moisture or other potentially corrosive conditions.
 - b. ASTM A 276 or ASTM A 493, Type 316 Stainless Steel: Use at potentially corrosive environments, including but not limited to following:
 - 1) Exterior exposed conditions
 - 2) Potentially wet environments
 - 3) Attachment of exterior cladding materials
 4. Expansion Anchors for Bolted Connections to Concrete (Mechanical Anchor):
 - a. Only expansion anchors with ICC-ES approval and tested to meet the provisions of ACI 355.2 and ICC-ES Acceptance Criteria (AC) 193 are acceptable for use.
 - b. Drawing Reference: Drawing reference to “expansion anchor(s)” shall indicate the use of anchors specified by this paragraph. Sleeve, adhesive, and other type anchors shall only be provided if specifically referenced or otherwise approved in advance of the Work.
 - c. Subject to compliance with requirements, provide one of following:
 - 1) HILTI, Inc. – “Kwik Bolt TZ” (ICC ESR-1917)
 - 2) SIMPSON Strong-Tie Company, Inc. – “Strong Bolt 2” (ICC ESR-3037)
 5. Heavy Duty Sleeve Anchors for Bolted Connections to Concrete (Mechanical Anchor):
 - a. Use ~~Only~~ heavy duty sleeve anchors with ICC-ES approval and tested to meet the provisions of ACI 355.2 and ICC-ES Acceptance Criteria (AC) 193.

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- b. Anchors consist of hex head bolts or threaded studs with hex head nut, along with spacer sleeve, expansion sleeve, expansion cone, and washer.
 - c. Anchors shall be torque controlled expansion type bolts exhibiting follow-up expansion under load, with provision for rotation prevention during installation, and specifically designed for high performance in static and dynamic applications.
 - d. Subject to compliance with requirements, provide following:
 - 1) HILTI, Inc. – “HSL-3 Heavy Duty Expansion Anchor” (ICC ESR-1545)
 - 6. Screw Anchors for Bolted Connections to Concrete (Mechanical Anchor):
 - a. Use screw anchors with ICC-ES approval and tested to meet the provisions of ICC-ES Acceptance Criteria (AC) 193 are acceptable for use.
 - b. Pre-drilling of hole requires standard ANSI drill bit with same diameter as anchor and installing anchor will be done with impact wrench.
 - c. Anchors shall have diameter and length marked on head.
 - d. Materials: Use carbon steel, heat treated with zinc-plating or mechanically galvanized at interior environments free of moisture or other potentially corrosive conditions. Screw anchors shall not be used in potentially corrosive environments, including but not limited to exterior exposed conditions, potentially wet environments, and attachments for exterior cladding materials.
 - e. Screw anchors once tightened may be loosened maximum of one turn and re-tightened with torque wrench. Loosening or removal beyond this limitation will void screw anchor.
 - f. Subject to compliance with requirements, provide following:
 - 1) HILTI, Inc. – “Kwik HUS-EZ” (ICC ESR-3027)
 - 2) SIMPSON Strong-Tie Company, Inc. – “Titen HD” (ICC ESR-2713)
 - 7. Adhesive Anchors for Bolted Connections and Rebar Doweling to Concrete:
 - a. Only adhesive anchor systems with ICC-ES approval and tested to meet the provisions of ACI 355.4 and ICC-ES Acceptance Criteria (AC) 308 are acceptable for use.
 - b. Adhesive anchor system for bolted connections consists of threaded steel rod, nut, washer, two component epoxy or hybrid adhesive injection system and manufacturer’s installation instructions.
 - c. Material for Bolts, Nuts and Washers:
 - 1) Carbon steel conforming to ASTM A36, or better, except as noted below.
 - 2) ASTM F 593, Type 316 Stainless Steel: Use at potentially corrosive environments, as noted above par. D.3.
 - d. Adhesive anchor system for rebar doweling consists of Grade 60 reinforcing bar, two component epoxy injection adhesive injection system and manufacturer’s installation instructions.
 - e. Subject to compliance following products are considered acceptable for use:
 - 1) HILTI, Inc. – “HIT RE 500-SD Adhesive System (ICC ESR-2322)
 - 2) HILTI, Inc. – “HIT HY 200 SAFE SET” Anchoring System (ICC ESR-3187), using one of following techniques: HIT-Z Anchor Rods in drilled holes; Standard threaded rods or rebar dowels in holes drilled with Hilti Hollow Drill Bit and VC 20/40 Vacuum System
 - 3) SIMPSON Strong-Tie Company, Inc. – “SET-XP Epoxy-Tie Adhesive System” (ICC ESR-2508)
 - f. Above epoxy adhesive systems require special attention to ambient conditions and cure time prior to loading. Where ambient or other project conditions require alternate product, such as acrylic based adhesive, other product(s) of listed manufacturers may be considered by Engineer. Consult with product manufacturer and submit proposal for review/approval by Engineer prior to use.
- E. Cast-In Place Internally Threaded Rods:
- 1. Following Product is considered acceptable for use.
 - a. HILTI, Inc. – “HCI-WF” (Wood Form) Cast-in Anchor
 - b. HILTI, Inc. – “HCI-MD” (Metal Deck) Cast-in Anchor
 - c. SIMPSON Strong-Tie Company, Inc. – “Blue Banger Hanger –Wood Form (BBWF)”

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- d. SIMPSON Strong-Tie Company, Inc. – “Blue Banger Hanger – Metal Deck (BBMD)”

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine and verify that receiving substrate surfaces of structure have no defects or errors which would result in poor or potentially defective application, cause latent defects in workmanship and are in compliance with product manufacturer criteria.
- B. Starting installation shall imply acceptable and proper surfaces.

3.2 PREPARATION

- A. Prepare substrate surfaces to insure proper and adequate installation, in accordance with Contract Documents and approved Shop Drawings, and/or manufacturer's requirements.
- B. Field measure and verify dimensions as required.
- C. Protect adjacent areas or surfaces from damage as result of Work of this Section.
- D. Waterstops:
 - 1. Brush clean loose dirt and particles from concrete surfaces.
 - 2. Brush apply 2 to 3 inch wide strip of primer and allow to dry thoroughly (2-3 hours).
- E. Mechanical and Adhesive Anchors:
 - 1. Verify following with anchor manufacturer's printed instructions.
 - a. Drill type and drill bit type/size
 - b. Required clean-out of drilled hole to receive anchor
 - c. Adhesive injection procedure into hole (for adhesive anchor systems)
 - d. Bolt, rod, or dowel insertion procedure into hole
 - e. Adhesive cure time prior to loading (for adhesive anchor systems)
 - f. Nut tightening to proper torque
 - g. Ambient temperature limitations (for adhesive anchor systems)
 - 2. Verify with anchor manufacturer if restrictions exist on type of drilling equipment.
 - 3. Identify position of reinforcing steel and other embedded items prior to drilling/coring holes for anchors. Exercise care in drilling/coring to avoid damaging existing reinforcing or embedded items. Notify Engineer if reinforcing or other embedded items are encountered during drilling.
 - 4. Verify installer qualifications/training.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's latest published requirements, instructions and specifications.
- B. Expansion Joint Filler:
 - 1. Position filler material so it does not protrude above surface of concrete. Provide minimum of ½ inch from surface of concrete to top of filler if sealant is to be used to seal off joint.
 - 2. Interface with Other Products: coordinate and cooperate with adjacent and contiguous materials trades to ensure proper installation.
- C. Waterstops:

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1. Strip protective paper wrapper from one side only of waterstop material.
2. Press waterstop material strip firmly against primed surface throughout length and width of strip.
3. Join strips together with 1 inch overlap to form continuous waterstop.
4. Remove remaining protective paper when ready to install forms and pour concrete.

D. Mechanical and Adhesive Anchors for Connections and Doweling to Concrete:

1. Base Material Strength: Do not drill holes in concrete until concrete has achieved specified 28-day compressive strength.
2. Drill to specified depth of embedment with drill/bit types recommended by anchor/adhesive manufacturer.
3. Avoid over-drilling depth at conditions which will have 3 inches or less concrete below bottom/tip of anchor, so as to avoid spalling at concrete surface behind anchor.
4. Set anchors perpendicular to substrate surface unless otherwise indicated. Skewed or slanted anchor installations with skew/slant exceeding 6 degrees from axis perpendicular to substrate surface shall not be acceptable. All skewed/slanted anchor installations to any degree will be subject to Engineer's discretion and may require remedy at Contractor's cost.
5. Protect threads, where occurs, from damage during anchor installation.
6. Set anchors to manufacturer's recommended torque using manufacturer's recommended procedure.
7. Do not disturb or load set anchor before manufacturer's specified curing time.

3.4 SCHEDULE OF TYPICAL LOCATIONS

- A. Expansion Joint Filler: At concrete expansion joints and at abutting expansion joints between concrete and adjacent structures.
- B. Waterstops: Provide continuous waterstops at below-grade concrete cold joints and where indicated.
- C. Vapor Retarder: Provide vapor retarder membrane beneath concrete slabs-on-grade in accordance with Division 7 Section requirements.
- D. Mechanical and Adhesive Anchors: Where indicated or otherwise required for satisfactory completion of work.

PART 4 - FIELD QUALITY CONTROL FOR POST-INSTALLED ANCHORS

4.1 INSPECTION STANDARDS

- A. Quality control, testing, and inspections shall meet the special inspection requirements of the building code and any local or state provisions.
 1. Minimum periodic and continuous inspection requirements are indicated below. Refer to drawings for supplemental and/or more stringent testing requirements, as required.
 2. Provide for more stringent inspection/testing where specified or required elsewhere in these Specifications.

4.2 TESTING AGENCY

- A. Owner will employ and pay a qualified independent testing agency to perform the quality control indicated in this section, including special inspections required by the building code.

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1. Inspection and testing by owner's testing agency is for verification and shall not relieve contractor of his responsibility to furnish materials and workmanship in accordance with Contract Documents.
 2. Retesting of materials failing to meet specified requirements shall be done at Contractor's expense.
 3. In cases of differences of opinion between Owner's Testing Agency and Contractor's Supervisor regarding conformance, the issue should be brought to the Architect, Engineer of Record and the enforcement agency as part of the resolution process.
- B. Qualification of Testing Personnel: Qualified person employed or retained by approved testing agency acceptable to Building Official as having competence necessary to perform specified inspections. Subject to approval by Architect/Engineer.
- C. Inspection Reports:
1. Provide written inspection report for post-installed anchor installations inspected/tested. Provide following information:
 - a. Date of inspection/test
 - b. Installers name and firm
 - c. Specific location of inspected/tested anchor(s). Use grid designations, member mark(s), graphic description, etc.. in sufficient detail to define anchor(s) location.
 - d. Confirmation indicating that anchor manufacturer's installation recommendations were followed.
 - e. Anchor/adhesive manufacturer and type.
 - f. Notes regarding any non-conforming anchor installation(s).
 - g. When "Field Testing" is performed, provide results of testing.
 - h. Inspector's name with signature
- D. Scope of Testing Services:
1. Visual Inspection: Perform visual inspection of installation procedures at the start of post-installed anchor installations and periodically thereafter. Inspection should be random and periodic in nature and in accordance with SCHEDULE OF POST-INSTALLED ANCHOR FIELD QUALITY CONTROL table below. Purpose is to confirm:
 - a. Qualifications/Training of Contractor's personnel
 - b. Observance of anchor manufacturer's written procedures and recommended equipment
 - c. Visual quality of anchor installation(s) in accordance with anchor manufacturer written recommendations, including but not limited to:
 - 1) Anchor/adhesive type conforms to specified/approved requirements.
 - 2) Anchor/Drill/Bit type(s) conform to anchor manufacturer's written recommendations.
 - 3) Hole dimensions (diameter and depth) and hole cleaning procedures in accordance with anchor manufacturer's written recommendations.
 - 4) Anchor installation torque where required by anchor manufacturer.
 - 5) Anchor orientation with respect to plane of substrate surface (not greater than 6 degree skew from perpendicular in any direction).
 2. Where Testing Agency's Visual Inspection indicate or report unsatisfactory or otherwise questionable post-installed anchor installation(s), the following Field Testing requirements shall be activated and performed at Contractor's expense.
 3. Field Testing of Post-Installed Anchors: Each reported unsatisfactory or otherwise questionable anchor installation and 10% of all anchors of same diameter and type on random basis shall be proof tested by applying pull/tension test load to anchor. Required pull/tension test load shall not be less than 1.5 times nor greater than 2.0 times anchor manufacturer's recommended allowable load.
 - a. Specified anchor size, embedment, spacing and edge distance shall be given consideration in determining pull/tension test load.

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- b. Assume uncracked concrete as substrate condition for determining pull/tension test load unless observed/actual conditions warrant otherwise, or Engineer recommends otherwise.
- c. Consult with anchor/product manufacturer for allowable load level and submit to Engineer for review prior to conducting test(s). Engineer may adjust required load level.
- d. Pull/Tension Testing device shall not restrict concrete shear cone type failure mechanism from occurring.
- e. Anchors shall maintain pull/tension test load for minimum of 15 seconds and shall exhibit no discernible movement during tension test as evidenced by loosening of washer under nut, loss of jacking pressure or by supplemental concrete cracking.
- f. Pull/Tension Testing device shall be calibrated by an approved testing laboratory in accordance with recognized standard procedures.
- g. If any of the tested anchors fail to achieve the required pull/tension, all anchors of same diameter and type as failed anchor shall be tested, unless otherwise instructed by Engineer.

4.3 CONTRACTOR

- A. Utilize only qualified/trained installers for post-installed anchors. See paragraph 1.5.D above.
- B. Notify Owner's independent inspection/testing agency in advance of post-installed anchor installations.
- C. Scope of Contractor's Quality Control Services
 - 1. Supervision: Contractor to provide qualified senior field personnel to perform supervision of installation procedures in accordance with SCHEDULE OF POST-INSTALLED ANCHOR FIELD QUALITY CONTROL table below.
 - a. Supervise quality of anchor installation(s), including but not limited to:
 - 1) Utilization of qualified/trained installers
 - 2) Avoidance of reinforcing or embedded items when installing anchors
 - 3) Installers use of proper anchor/drill/bit types
 - 4) Installer procedures for hole cleaning and anchor installation, including torque where required, in accordance with anchor manufacturer's written recommendations
 - 5) Visual confirmation of anchor orientation with respect to plane of substrate surface
 - 2. Where unsatisfactory or otherwise questionable anchor installation(s) are observed during Supervision, notify and retain Testing Agency to perform Field Testing at Contractor's expense in accordance with paragraph 4.2.D.3 above.
- D. Maintain records of post-installed anchor installations. Include following as minimum record:
 - 1. Date(s) of installation
 - 2. Installer name(s), firm(s) and qualification data
 - 3. Location of visually inspected and tested anchor(s), as performed by Testing Agency. Use grid designations, member mark(s), graphic description, etc.. in sufficient detail to record and define anchor(s) location.
 - 4. Visual observations/notes of Testing Agency and from Contractor's Supervision.
 - 5. Results of field pull/tension testing.
- E. Maintain records on site for review by Architect/Engineer or Testing Agency on request, and for permanent job record.

4.4 SCHEDULE OF POST-INSTALLED ANCHOR FIELD QUALITY CONTROL

Table below denotes minimum percentage of post-installed anchors to receive Field Quality Control in accordance with above requirements.

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ITEMS/ / DESCRIPTION	TESTING AGENCY	CONTRACTOR
	*Visual Inspection	*Supervision
Anchors specified by structural documents	25% (at start-up and random periodic basis thereafter)	100%
Anchors substituted for requirements of structural documents	25% (at start-up and random periodic basis thereafter)	100%
Anchors for Non-structural components	10% (at start-up and random periodic basis thereafter)	100%

*Where noted Testing Agency Visual Inspection or Contractor Supervision reveals unsatisfactory or otherwise questionable post-installed anchor installation, field pull/tension testing as specified under paragraph 4.2.D.3 above shall be activated and performed.

END OF SECTION

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SECTION 031500

CONCRETE ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes concrete accessories and supplementary items necessary to complete work required for their installation.

1.3 DEFINITIONS

- A. Adhesive Anchor: post-installed device (bolt, threaded rod, or reinforcing bar) for transferring load(s) to concrete consisting of a steel element used in conjunction with an adhesive compound and embedded in a drilled round hole in hardened concrete. Adhesive Anchor System includes fastening components and necessary accessories recommended by adhesive manufacturer for appropriate installation.
- B. Anchor Spacing: distance between centerline of adjacent anchors
- C. Cast-in-Place Anchor: headed bolt, headed stud, hooked bolt, or reinforcing bar installed before concrete placement
- D. Cracked Concrete: condition of concrete in which the anchor is installed and/or condition which could occur at or near anchor location over service life of anchor
- E. Edge Distance: dimension from anchor/component centerline to free edge of base material in which component is anchored or installed
- F. Embedment Depth: dimension from surface of base material to tip of anchor/component installed in base material
- G. Mechanical Anchor: post installed device for transferring load(s) to concrete by direct bearing, friction or both. Generally includes expansion type, sleeve type and screw type anchors
- H. Post-Installed Anchor: an anchor or dowel installed into hardened concrete of specified 28-day compressive strength. Includes drilled-in bolts, threaded rods and reinforcing bars/dowels.

1.4 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections.
- B. Product Data (General): Manufacturer's printed literature to evidence compliance with these specifications.

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- C. Product Data (Mechanical and Adhesive Anchors): Manufacturer's product specifications with recommended design values, physical characteristics, installation instructions, ICC-ES Report(s) and necessary calculations to evidence compliance with these specifications.
- D. Samples:
 - 1. Expansion Joint Filler: Two (2) representative samples, 6 inches x 12 inches.
 - 2. Waterstops: Two 6 inch strips, complete with "quick-release" papers.
 - 3. Concrete Inserts: Construction and finish specified.
 - 4. Mechanical and Adhesive Anchors: Two (2) samples of each respective type and size proposed if requested by Architect/Engineer
- E. Source and field quality-control documentation.
 - 1. Test reports as required for indicating compliance with the Quality Control sections below.
- F. Contractor shall submit to the Engineer and the enforcing agency, for acceptance, a quality control or inspection plan that addresses all inspection issues.
- G. Design calculations for Post-Installed Anchors where/if substitution is proposed from requirements shown on Drawings. Include seal/signature of Engineer responsible for design and licensed to practice in jurisdiction of Project.

1.5 QUALITY ASSURANCE

- A. Codes and Standards: Comply with following provisions, except as otherwise indicated:
 - 1. International Building Code (IBC), edition indicated by Drawings including Special Inspection and Quality Control requirements, Chapter 17 of the IBC and any local or State provisions. All following code and standard versions shall be as referenced by IBC Chapter 35 or, where not referenced in IBC, the most recent published versions.
 - 2. ICC-ES approval and related testing to meet ICC-ES Acceptance Criteria required for mechanical and adhesive anchors.
 - 3. ACI 355.2 (for bolted connections to hardened concrete using expansion type and sleeve type anchors)
 - 4. ACI 355.4 (for bolted connections to hardened concrete using adhesive anchors)
- B. Each type product covered under this Section shall be produced by single manufacturer unless otherwise specified.
- C. Manufacturer: Not less than five (5) years successful production of product. Submit evidence if requested by Architect/Engineer.
- D. Mechanical Anchor and Adhesive Anchor Installer Qualifications:
 - 1. Qualification: Post-installed anchors/dowels shall be installed by personnel having minimum of 3 years experience performing similar installations and having applicable certificate or other evidence of previous training from anchor product manufacturer, subject to approval of Architect/Engineer.
 - 2. Training (As Alternate to Above Qualification): Conduct training (with manufacturer or manufacturer's representative) for installer(s) on project. Training to consist of review of complete installation process for drilled-in anchors, to include but not limited to:
 - a. Hole drilling process/bits
 - b. Hole preparation/cleaning
 - c. Adhesive dispenser/injection technique(s)
 - d. Rebar dowel preparation
 - e. Proof loading/torqueing.

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3. Maintain Qualification/Training records on site. Subject to Testing Agency and/or Architect/Engineer review on request.

1.6 PROPOSED SUBSTITUTIONS

- A. Substitution or modifications, if proposed by Contractor, shall be submitted for approval prior to submission of shop drawings, and such substitutions shall be made only when approved by Architect, and at no additional cost to Owner. Total amount of credit, if any, shall be stated in writing with submission.
- B. Substitution of drilled-in anchors for cast-in-place anchors, or alternate type drilled-in anchors, shall not be made without advance proposed substitution and Architect/Engineer's approval.
- C. Corrections for conflicts or inaccuracies that result in change from Structural Drawings or final approved shop drawing details shall be submitted in sketch form for approval. Such substitutions or corrections shall be made only when approved by Architect/Engineer.
- D. Where drilled-in anchors must be substituted for specified anchors due to mis-placement or other reason, Contractor shall be responsible for design/re-design and cost for design/re-design. Assume "cracked" concrete unless otherwise advised in writing by Architect/Engineer. Refer to paragraph 1.4.G above.

1.7 STORAGE AND HANDLING

- A. Storage of materials:
 - 1. Store materials to permit easy access for inspection and identification.
 - 2. Store materials in accordance with manufacturer's recommendations.
 - 3. Note: Adhesive cartridges and capsules have special requirements for temperature/sunlight exposure and shelf life.

1.8 COORDINATION

- A. Coordinate installation of anchorage items to be embedded in or attached to other construction. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.
- B. Coordinate qualifications/training for installers.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Specific product, material or manufacturer listed under each item below is "acceptable" only if manufacturer can evidence product compliance with requirements of Contract Documents.
- B. For manufacturers not listed, submit as substitution according to the Conditions of the Contract and Division 01 Specification Sections.

2.2 MATERIALS

- A. Expansion Joint Filler:
 - 1. Superior-grade, polyethylene, closed cell, expansion joint filler.
 - 2. Strong, ultra-violet stable, resistant to most oils, chemicals, ozone and weathering.

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3. Acceptable manufacturers and product(s):
 - a. ChemRex Inc., Sonneborn Building Products – “Sonoflex F”
 - b. Sealed Air Corporation – “Cellu Joint”
 - c. Williams Products, Inc. – “Everlastic Expand-O-Foam 1380 Series”
 - d. W.R. Meadows, Inc. – “Ceramar”
- B. Waterstops:
 1. Extruded “rope” form, between two protective papers, silicone treated for fast stripping. Bentonite type waterstops not permitted.
 2. In standard cross-section (as extruded) of approximately 1 square inch, 36 inch minimum supplied length.
 3. Primer: As recommended by waterstop manufacturer.
 4. Basis of Design:
 - a. Henry Company – “SF302 Synko-Flex Waterstop”
- C. Concrete Inserts:
 1. Wedge Type Inserts:
 - a. Description: Malleable iron, with 1-1/2 inch stainless steel askew head bolt. Standard or long as required by location.
 - b. Acceptable manufacturers and product(s):
 - 1) Heckmann Building Products, Inc., Cat. No. 425
 - 2) Hohmann & Barnard, Inc., No. HW340 and LW340
 - 3) Dayton/Richmond, Shelf Angle Wedge Inserts – F-7 and F-7-L
 2. Dovetail Anchor Slots: Heckmann Building Products, Inc. No. 100, 1 inch wide back, 1 inch deep, 5/8 inch throat, 20 gage galvanized steel with removable filler.
- D. Mechanical and Adhesive Anchors:
 1. Where specific anchor manufacturer/type is shown on drawings, substitution of alternate anchor is subject to Engineer’s approval.
 2. Size and Embedment: As indicated on Drawings. Where embedment is not indicated, submit proposed embedment prior to installation to Engineer for approval. For adhesive anchorages, use embedment of 12 x anchor/rebar diameter, or, submit proposed embedment prior to installation to Engineer for review.
 3. Material for Bolts, Nuts, and Washers, unless noted otherwise:
 - a. Carbon Steel with Zinc-Plating: ASTM B 633, Type III, Fe/Zn 5. Use at permanent interior environments free of moisture or other potentially corrosive conditions.
 - b. ASTM A 276 or ASTM A 493, Type 316 Stainless Steel: Use at potentially corrosive environments, including but not limited to following:
 - 1) Exterior exposed conditions
 - 2) Potentially wet environments
 - 3) Attachment of exterior cladding materials
 4. Expansion Anchors for Bolted Connections to Concrete (Mechanical Anchor):
 - a. Only expansion anchors with ICC-ES approval and tested to meet the provisions of ACI 355.2 and ICC-ES Acceptance Criteria (AC) 193 are acceptable for use.
 - b. Drawing Reference: Drawing reference to “expansion anchor(s)” shall indicate the use of anchors specified by this paragraph. Sleeve, adhesive, and other type anchors shall only be provided if specifically referenced or otherwise approved in advance of the Work.
 - c. Subject to compliance with requirements, provide one of following:
 - 1) HILTI, Inc. – “Kwik Bolt TZ” (ICC ESR-1917)
 - 2) SIMPSON Strong-Tie Company, Inc. – “Strong Bolt 2” (ICC ESR-3037)
 5. Heavy Duty Sleeve Anchors for Bolted Connections to Concrete (Mechanical Anchor):
 - a. Use ~~Only~~ heavy duty sleeve anchors with ICC-ES approval and tested to meet the provisions of ACI 355.2 and ICC-ES Acceptance Criteria (AC) 193.

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- b. Anchors consist of hex head bolts or threaded studs with hex head nut, along with spacer sleeve, expansion sleeve, expansion cone, and washer.
 - c. Anchors shall be torque controlled expansion type bolts exhibiting follow-up expansion under load, with provision for rotation prevention during installation, and specifically designed for high performance in static and dynamic applications.
 - d. Subject to compliance with requirements, provide following:
 - 1) HILTI, Inc. – “HSL-3 Heavy Duty Expansion Anchor” (ICC ESR-1545)
 - 6. Screw Anchors for Bolted Connections to Concrete (Mechanical Anchor):
 - a. Use screw anchors with ICC-ES approval and tested to meet the provisions of ICC-ES Acceptance Criteria (AC) 193 are acceptable for use.
 - b. Pre-drilling of hole requires standard ANSI drill bit with same diameter as anchor and installing anchor will be done with impact wrench.
 - c. Anchors shall have diameter and length marked on head.
 - d. Materials: Use carbon steel, heat treated with zinc-plating or mechanically galvanized at interior environments free of moisture or other potentially corrosive conditions. Screw anchors shall not be used in potentially corrosive environments, including but not limited to exterior exposed conditions, potentially wet environments, and attachments for exterior cladding materials.
 - e. Screw anchors once tightened may be loosened maximum of one turn and re-tightened with torque wrench. Loosening or removal beyond this limitation will void screw anchor.
 - f. Subject to compliance with requirements, provide following:
 - 1) HILTI, Inc. – “Kwik HUS-EZ” (ICC ESR-3027)
 - 2) SIMPSON Strong-Tie Company, Inc. – “Titen HD” (ICC ESR-2713)
 - 7. Adhesive Anchors for Bolted Connections and Rebar Doweling to Concrete:
 - a. Only adhesive anchor systems with ICC-ES approval and tested to meet the provisions of ACI 355.4 and ICC-ES Acceptance Criteria (AC) 308 are acceptable for use.
 - b. Adhesive anchor system for bolted connections consists of threaded steel rod, nut, washer, two component epoxy or hybrid adhesive injection system and manufacturer’s installation instructions.
 - c. Material for Bolts, Nuts and Washers:
 - 1) Carbon steel conforming to ASTM A36, or better, except as noted below.
 - 2) ASTM F 593, Type 316 Stainless Steel: Use at potentially corrosive environments, as noted above par. D.3.
 - d. Adhesive anchor system for rebar doweling consists of Grade 60 reinforcing bar, two component epoxy injection adhesive injection system and manufacturer’s installation instructions.
 - e. Subject to compliance following products are considered acceptable for use:
 - 1) HILTI, Inc. – “HIT RE 500-SD Adhesive System (ICC ESR-2322)
 - 2) HILTI, Inc. – “HIT HY 200 SAFE SET” Anchoring System (ICC ESR-3187), using one of following techniques: HIT-Z Anchor Rods in drilled holes; Standard threaded rods or rebar dowels in holes drilled with Hilti Hollow Drill Bit and VC 20/40 Vacuum System
 - 3) SIMPSON Strong-Tie Company, Inc. – “SET-XP Epoxy-Tie Adhesive System” (ICC ESR-2508)
 - f. Above epoxy adhesive systems require special attention to ambient conditions and cure time prior to loading. Where ambient or other project conditions require alternate product, such as acrylic based adhesive, other product(s) of listed manufacturers may be considered by Engineer. Consult with product manufacturer and submit proposal for review/approval by Engineer prior to use.
- E. Cast-In Place Internally Threaded Rods:
- 1. Following Product is considered acceptable for use.
 - a. HILTI, Inc. – “HCI-WF” (Wood Form) Cast-in Anchor
 - b. HILTI, Inc. – “HCI-MD” (Metal Deck) Cast-in Anchor
 - c. SIMPSON Strong-Tie Company, Inc. – “Blue Banger Hanger –Wood Form (BBWF)”

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- d. SIMPSON Strong-Tie Company, Inc. – “Blue Banger Hanger – Metal Deck (BBMD)”

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine and verify that receiving substrate surfaces of structure have no defects or errors which would result in poor or potentially defective application, cause latent defects in workmanship and are in compliance with product manufacturer criteria.
- B. Starting installation shall imply acceptable and proper surfaces.

3.2 PREPARATION

- A. Prepare substrate surfaces to insure proper and adequate installation, in accordance with Contract Documents and approved Shop Drawings, and/or manufacturer's requirements.
- B. Field measure and verify dimensions as required.
- C. Protect adjacent areas or surfaces from damage as result of Work of this Section.
- D. Waterstops:
 - 1. Brush clean loose dirt and particles from concrete surfaces.
 - 2. Brush apply 2 to 3 inch wide strip of primer and allow to dry thoroughly (2-3 hours).
- E. Mechanical and Adhesive Anchors:
 - 1. Verify following with anchor manufacturer's printed instructions.
 - a. Drill type and drill bit type/size
 - b. Required clean-out of drilled hole to receive anchor
 - c. Adhesive injection procedure into hole (for adhesive anchor systems)
 - d. Bolt, rod, or dowel insertion procedure into hole
 - e. Adhesive cure time prior to loading (for adhesive anchor systems)
 - f. Nut tightening to proper torque
 - g. Ambient temperature limitations (for adhesive anchor systems)
 - 2. Verify with anchor manufacturer if restrictions exist on type of drilling equipment.
 - 3. Identify position of reinforcing steel and other embedded items prior to drilling/coring holes for anchors. Exercise care in drilling/coring to avoid damaging existing reinforcing or embedded items. Notify Engineer if reinforcing or other embedded items are encountered during drilling.
 - 4. Verify installer qualifications/training.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's latest published requirements, instructions and specifications.
- B. Expansion Joint Filler:
 - 1. Position filler material so it does not protrude above surface of concrete. Provide minimum of ½ inch from surface of concrete to top of filler if sealant is to be used to seal off joint.
 - 2. Interface with Other Products: coordinate and cooperate with adjacent and contiguous materials trades to ensure proper installation.
- C. Waterstops:

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1. Strip protective paper wrapper from one side only of waterstop material.
2. Press waterstop material strip firmly against primed surface throughout length and width of strip.
3. Join strips together with 1 inch overlap to form continuous waterstop.
4. Remove remaining protective paper when ready to install forms and pour concrete.

D. Mechanical and Adhesive Anchors for Connections and Doweling to Concrete:

1. Base Material Strength: Do not drill holes in concrete until concrete has achieved specified 28-day compressive strength.
2. Drill to specified depth of embedment with drill/bit types recommended by anchor/adhesive manufacturer.
3. Avoid over-drilling depth at conditions which will have 3 inches or less concrete below bottom/tip of anchor, so as to avoid spalling at concrete surface behind anchor.
4. Set anchors perpendicular to substrate surface unless otherwise indicated. Skewed or slanted anchor installations with skew/slant exceeding 6 degrees from axis perpendicular to substrate surface shall not be acceptable. All skewed/slanted anchor installations to any degree will be subject to Engineer's discretion and may require remedy at Contractor's cost.
5. Protect threads, where occurs, from damage during anchor installation.
6. Set anchors to manufacturer's recommended torque using manufacturer's recommended procedure.
7. Do not disturb or load set anchor before manufacturer's specified curing time.

3.4 SCHEDULE OF TYPICAL LOCATIONS

- A. Expansion Joint Filler: At concrete expansion joints and at abutting expansion joints between concrete and adjacent structures.
- B. Waterstops: Provide continuous waterstops at below-grade concrete cold joints and where indicated.
- C. Vapor Retarder: Provide vapor retarder membrane beneath concrete slabs-on-grade in accordance with Division 7 Section requirements.
- D. Mechanical and Adhesive Anchors: Where indicated or otherwise required for satisfactory completion of work.

PART 4 - FIELD QUALITY CONTROL FOR POST-INSTALLED ANCHORS

4.1 INSPECTION STANDARDS

- A. Quality control, testing, and inspections shall meet the special inspection requirements of the building code and any local or state provisions.
 1. Minimum periodic and continuous inspection requirements are indicated below. Refer to drawings for supplemental and/or more stringent testing requirements, as required.
 2. Provide for more stringent inspection/testing where specified or required elsewhere in these Specifications.

4.2 TESTING AGENCY

- A. Owner will employ and pay a qualified independent testing agency to perform the quality control indicated in this section, including special inspections required by the building code.

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1. Inspection and testing by owner's testing agency is for verification and shall not relieve contractor of his responsibility to furnish materials and workmanship in accordance with Contract Documents.
 2. Retesting of materials failing to meet specified requirements shall be done at Contractor's expense.
 3. In cases of differences of opinion between Owner's Testing Agency and Contractor's Supervisor regarding conformance, the issue should be brought to the Architect, Engineer of Record and the enforcement agency as part of the resolution process.
- B. Qualification of Testing Personnel: Qualified person employed or retained by approved testing agency acceptable to Building Official as having competence necessary to perform specified inspections. Subject to approval by Architect/Engineer.
- C. Inspection Reports:
1. Provide written inspection report for post-installed anchor installations inspected/tested. Provide following information:
 - a. Date of inspection/test
 - b. Installers name and firm
 - c. Specific location of inspected/tested anchor(s). Use grid designations, member mark(s), graphic description, etc.. in sufficient detail to define anchor(s) location.
 - d. Confirmation indicating that anchor manufacturer's installation recommendations were followed.
 - e. Anchor/adhesive manufacturer and type.
 - f. Notes regarding any non-conforming anchor installation(s).
 - g. When "Field Testing" is performed, provide results of testing.
 - h. Inspector's name with signature
- D. Scope of Testing Services:
1. Visual Inspection: Perform visual inspection of installation procedures at the start of post-installed anchor installations and periodically thereafter. Inspection should be random and periodic in nature and in accordance with SCHEDULE OF POST-INSTALLED ANCHOR FIELD QUALITY CONTROL table below. Purpose is to confirm:
 - a. Qualifications/Training of Contractor's personnel
 - b. Observance of anchor manufacturer's written procedures and recommended equipment
 - c. Visual quality of anchor installation(s) in accordance with anchor manufacturer written recommendations, including but not limited to:
 - 1) Anchor/adhesive type conforms to specified/approved requirements.
 - 2) Anchor/Drill/Bit type(s) conform to anchor manufacturer's written recommendations.
 - 3) Hole dimensions (diameter and depth) and hole cleaning procedures in accordance with anchor manufacturer's written recommendations.
 - 4) Anchor installation torque where required by anchor manufacturer.
 - 5) Anchor orientation with respect to plane of substrate surface (not greater than 6 degree skew from perpendicular in any direction).
 2. Where Testing Agency's Visual Inspection indicate or report unsatisfactory or otherwise questionable post-installed anchor installation(s), the following Field Testing requirements shall be activated and performed at Contractor's expense.
 3. Field Testing of Post-Installed Anchors: Each reported unsatisfactory or otherwise questionable anchor installation and 10% of all anchors of same diameter and type on random basis shall be proof tested by applying pull/tension test load to anchor. Required pull/tension test load shall not be less than 1.5 times nor greater than 2.0 times anchor manufacturer's recommended allowable load.
 - a. Specified anchor size, embedment, spacing and edge distance shall be given consideration in determining pull/tension test load.

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- b. Assume uncracked concrete as substrate condition for determining pull/tension test load unless observed/actual conditions warrant otherwise, or Engineer recommends otherwise.
- c. Consult with anchor/product manufacturer for allowable load level and submit to Engineer for review prior to conducting test(s). Engineer may adjust required load level.
- d. Pull/Tension Testing device shall not restrict concrete shear cone type failure mechanism from occurring.
- e. Anchors shall maintain pull/tension test load for minimum of 15 seconds and shall exhibit no discernible movement during tension test as evidenced by loosening of washer under nut, loss of jacking pressure or by supplemental concrete cracking.
- f. Pull/Tension Testing device shall be calibrated by an approved testing laboratory in accordance with recognized standard procedures.
- g. If any of the tested anchors fail to achieve the required pull/tension, all anchors of same diameter and type as failed anchor shall be tested, unless otherwise instructed by Engineer.

4.3 CONTRACTOR

- A. Utilize only qualified/trained installers for post-installed anchors. See paragraph 1.5.D above.
- B. Notify Owner's independent inspection/testing agency in advance of post-installed anchor installations.
- C. Scope of Contractor's Quality Control Services
 - 1. Supervision: Contractor to provide qualified senior field personnel to perform supervision of installation procedures in accordance with SCHEDULE OF POST-INSTALLED ANCHOR FIELD QUALITY CONTROL table below.
 - a. Supervise quality of anchor installation(s), including but not limited to:
 - 1) Utilization of qualified/trained installers
 - 2) Avoidance of reinforcing or embedded items when installing anchors
 - 3) Installers use of proper anchor/drill/bit types
 - 4) Installer procedures for hole cleaning and anchor installation, including torque where required, in accordance with anchor manufacturer's written recommendations
 - 5) Visual confirmation of anchor orientation with respect to plane of substrate surface
 - 2. Where unsatisfactory or otherwise questionable anchor installation(s) are observed during Supervision, notify and retain Testing Agency to perform Field Testing at Contractor's expense in accordance with paragraph 4.2.D.3 above.
- D. Maintain records of post-installed anchor installations. Include following as minimum record:
 - 1. Date(s) of installation
 - 2. Installer name(s), firm(s) and qualification data
 - 3. Location of visually inspected and tested anchor(s), as performed by Testing Agency. Use grid designations, member mark(s), graphic description, etc.. in sufficient detail to record and define anchor(s) location.
 - 4. Visual observations/notes of Testing Agency and from Contractor's Supervision.
 - 5. Results of field pull/tension testing.
- E. Maintain records on site for review by Architect/Engineer or Testing Agency on request, and for permanent job record.

4.4 SCHEDULE OF POST-INSTALLED ANCHOR FIELD QUALITY CONTROL

Table below denotes minimum percentage of post-installed anchors to receive Field Quality Control in accordance with above requirements.

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ITEMS/ / DESCRIPTION	TESTING AGENCY *Visual Inspection	CONTRACTOR *Supervision
Anchors specified by structural documents	25% (at start-up and random periodic basis thereafter)	100%
Anchors substituted for requirements of structural documents	25% (at start-up and random periodic basis thereafter)	100%
Anchors for Non-structural components	10% (at start-up and random periodic basis thereafter)	100%

*Where noted Testing Agency Visual Inspection or Contractor Supervision reveals unsatisfactory or otherwise questionable post-installed anchor installation, field pull/tension testing as specified under paragraph 4.2.D.3 above shall be activated and performed.

END OF SECTION

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SECTION 032000

CONCRETE REINFORCING

PART 1 - GENERAL

1.01 WORK INCLUDED

Furnish labor and reinforcing materials required to cut, bend, tie, splice, place and support the reinforcement in the material grades, sizes, quantities, and locations specified.

1.02 QUALITY ASSURANCE

TOLERANCES

Reinforcement shall be placed where specified, with the following maximum tolerances, plus or minus:

- A. Cover 1/4"
- B. Spacings 1/4" in 12"

1.03 SUBMITTALS

Submittals shall be in accordance with Section 013300, SUBMITTALS and shall include:

- A. Record data for layouts (shop drawings with bar lists clearly marked with reference to plans.
- B. Certifications of steel quality, size, grade, and manufacturers origin.

1.04 STANDARDS

The applicable provisions of the following standards shall apply as if written here in their entirety:

- A. American Society for Testing and Materials (ASTM) standards:
ASTM A615 "Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement"
- B. American Concrete Institute (ACI) publications:
ACI 301 "Specification for Structural Concrete for Buildings"
ACI 315 "Details and Detailing of Concrete Reinforcement"
ACI 318 "Building Code Requirements for Reinforced Concrete"
- C. Concrete Reinforcing Steel Institute (CRSI) publication:
CRSI Manual of Standard Practice

1.05 DELIVERY AND STORAGE

Store steel reinforcement above the surface of the ground upon platform skids or other supports. Protect from mechanical injury and surface deterioration caused by exposure to conditions producing rust. When placed in the work, steel reinforcement shall be free from dirt, scale, dust, paint, oil, and other foreign material. Tag and store steel reinforcement for ease of correlation with shop drawings.

1.06 JOB CONDITIONS

- A. Proposed deviations from reinforcing indicated on the plans or specifications shall be approved in writing by the Engineer prior to fabrication.

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- B. Bar lengths shall be of the length shown on the plans or tables, not the minimum code length.
- C. Specified cover for reinforcing shall be maintained throughout construction. Bars shall be cut to lengths necessary to allow for proper clearances.
- D. Stirrups shall be hooked.
- E. Steel reinforcing bars shall be produced in the United States of America.
- F. Cover of concrete shall be measured from face of forms to outside face of reinforcement bar, stirrup, or tie.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. STEEL REINFORCING BARS: Billet-Steel bars for concrete reinforcement conforming to ASTM A615; Grade 60 with minimum yield strength of 60,000 psi.
- B. SUPPORTS: Bar supports shall be of the proper type for the intended use. Bar supports shall be uniform high-density polyethylene (plastic) or fiberglass reinforced plastic (FRP) conforming to CRSI Class 1, Maximum Protection.
- C. SPACERS: Pre-cast mortar or concrete blocks.
- D. MECHANICAL BAR SPLICES: Cadweld splices as manufactured by Erico Products, Inc., or equal, installed in strict accordance with the manufacturer's instructions and recommendations. The mechanical devices shall develop at least 125% of the specified yield of the spliced bars.
- E. MECHANICAL THREADED SPLICES: Mechanical threaded connections shall utilize a metal coupling sleeve with internal threads which engage threaded ends of the bars to be spliced and shall develop in tension or compression 125% of the specified yield strength of the bar.

2.02 FABRICATIONS

BENDING: Reinforcement shall be bent cold by machine to shapes indicated on the plans; true to shapes indicated; irregularities in bending shall be cause for rejection. Unless otherwise noted, all hook and bend details and tolerances shall conform to the requirements of ACI 315 and ACI 318.

PART 3 - EXECUTION

3.01 PREPARATION

The reinforcing steel in all concrete walls shall be spaced its proper distance from the face of the forms using chairs.

3.02 INSTALLATION

- A. GENERAL: Place the reinforcement carefully and accurately in the concrete structures. Rigidly tie and support the reinforcement. Welding of any type of reinforcement shall not be permitted.
- B. SPLICES
 - 1. Splicing of bars, except where indicated on the plans, shall not be permitted. Lap splices which are permitted shall have a lap in accordance with ACI 318. Rigidly clamp or wire the bars at all splices, in accordance with ACI. Welding of reinforcing steel splices shall

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not be permitted.

2. Make mechanical splices using "Cadweld" reinforcing bar connectors, installed in strict accordance with the manufacturer's instructions and recommendations. The mechanical device shall develop at least 125% of the specified yield strength of the bar.
3. Lap splice locations not shown on the plans shall be approved by the Engineer prior to fabrication. Splices shall be kept to a minimum. Splices shall occur only at points of minimum stress. Stagger splices in adjacent bars.

C. PLACEMENT

1. Place steel reinforcement, as indicated on the plans, with the specified tolerances. Hold securely in place during the placing of the concrete. The minimum clear distance between bars shall be per ACI 318. Always pass vertical stirrups around the main tension members and securely attach thereto. Wire reinforcing together at a sufficient number of intersections to produce a sound, sturdy mat or cage of reinforcement that will maintain the reinforcement in correct positions when the concrete is placed.
2. Hold the reinforcing steel in concrete slabs firmly in place with wire supports or "chairs". Sizing and spacing of the chairs shall be sufficient to properly support the steel and shall be in accordance with CRSI Publications "Manual of Standard Practice".
3. Space the reinforcing steel in concrete walls the proper distance from the face of the forms, as indicated on the drawings, using galvanized metal spacers.
4. Where reinforcing conflicts with location of anchor bolts, inserts, etc., required to be cast in concrete, submit prompt notifications so that revisions can be made before concrete is placed. No cutting of reinforcing shall be permitted without the prior approval of the Engineer.

3.03 FIELD QUALITY CONTROL

Concrete shall not be deposited until the Engineer has observed the final placing of the reinforcing steel and has given permission to place concrete.

END OF SECTION

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SECTION 03 20 00

CONCRETE REINFORCING

PART 1 - GENERAL

1.01 WORK INCLUDED

Furnish labor and reinforcing materials required to cut, bend, tie, splice, place and support the reinforcement in the material grades, sizes, quantities, and locations specified.

1.02 QUALITY ASSURANCE

TOLERANCES

Reinforcement shall be placed where specified, with the following maximum tolerances, plus or minus:

- A. Cover 1/4"
- B. Spacings 1/4" in 12"

1.03 SUBMITTALS

Submittals shall be in accordance with Section 01 33 00, SUBMITTALS and shall include:

- A. Record data for layouts (shop drawings with bar lists clearly marked with reference to plans.
- B. Certifications of steel quality, size, grade, and manufacturers origin.

1.04 STANDARDS

The applicable provisions of the following standards shall apply as if written here in their entirety:

- A. American Society for Testing and Materials (ASTM) standards:
ASTM A615 "Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement"
- B. American Concrete Institute (ACI) publications:
ACI 301 "Specification for Structural Concrete for Buildings"
ACI 315 "Details and Detailing of Concrete Reinforcement"
ACI 318 "Building Code Requirements for Reinforced Concrete"
- C. Concrete Reinforcing Steel Institute (CRSI) publication:
CRSI Manual of Standard Practice

1.05 DELIVERY AND STORAGE

Store steel reinforcement above the surface of the ground upon platform skids or other supports. Protect from mechanical injury and surface deterioration caused by exposure to conditions producing rust. When placed in the work, steel reinforcement shall be free from dirt, scale, dust, paint, oil, and other foreign material. Tag and store steel reinforcement for ease of correlation with shop drawings.

1.06 JOB CONDITIONS

- A. Proposed deviations from reinforcing indicated on the plans or specifications shall be approved in writing by the Engineer prior to fabrication.
- B. Bar lengths shall be of the length shown on the plans or tables, not the minimum code length.

- C. Specified cover for reinforcing shall be maintained throughout construction. Bars shall be cut to lengths necessary to allow for proper clearances.
- D. Stirrups shall be hooked.
- E. Steel reinforcing bars shall be produced in the United States of America.
- F. Cover of concrete shall be measured from face of forms to outside face of reinforcement bar, stirrup, or tie.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. STEEL REINFORCING BARS: Billet-Steel bars for concrete reinforcement conforming to ASTM A615; Grade 60 with minimum yield strength of 60,000 psi.
- B. SUPPORTS: Bar supports shall be of the proper type for the intended use. Bar supports shall be uniform high-density polyethylene (plastic) or fiberglass reinforced plastic (FRP) conforming to CRSI Class 1, Maximum Protection.
- C. SPACERS: Pre-cast mortar or concrete blocks.
- D. MECHANICAL BAR SPLICES: Cadweld splices as manufactured by Erico Products, Inc., or equal, installed in strict accordance with the manufacturer's instructions and recommendations. The mechanical devices shall develop at least 125% of the specified yield of the spliced bars.
- E. MECHANICAL THREADED SPLICES: Mechanical threaded connections shall utilize a metal coupling sleeve with internal threads which engage threaded ends of the bars to be spliced and shall develop in tension or compression 125% of the specified yield strength of the bar.

2.02 FABRICATIONS

BENDING: Reinforcement shall be bent cold by machine to shapes indicated on the plans; true to shapes indicated; irregularities in bending shall be cause for rejection. Unless otherwise noted, all hook and bend details and tolerances shall conform to the requirements of ACI 315 and ACI 318.

PART 3 - EXECUTION

3.01 PREPARATION

The reinforcing steel in all concrete walls shall be spaced its proper distance from the face of the forms using chairs.

3.02 INSTALLATION

- A. GENERAL: Place the reinforcement carefully and accurately in the concrete structures. Rigidly tie and support the reinforcement. Welding of any type of reinforcement shall not be permitted.
- B. SPLICES
 - 1. Splicing of bars, except where indicated on the plans, shall not be permitted. Lap splices which are permitted shall have a lap in accordance with ACI 318. Rigidly clamp or wire the bars at all splices, in accordance with ACI. Welding of reinforcing steel splices shall not be permitted.
 - 2. Make mechanical splices using "Cadweld" reinforcing bar connectors, installed in strict accordance with the manufacturer's instructions and recommendations. The mechanical device shall develop at least 125% of the specified yield strength of the bar.

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3. Lap splice locations not shown on the plans shall be approved by the Engineer prior to fabrication. Splices shall be kept to a minimum. Splices shall occur only at points of minimum stress. Stagger splices in adjacent bars.

C. PLACEMENT

1. Place steel reinforcement, as indicated on the plans, with the specified tolerances. Hold securely in place during the placing of the concrete. The minimum clear distance between bars shall be per ACI 318. Always pass vertical stirrups around the main tension members and securely attach thereto. Wire reinforcing together at a sufficient number of intersections to produce a sound, sturdy mat or cage of reinforcement that will maintain the reinforcement in correct positions when the concrete is placed.
2. Hold the reinforcing steel in concrete slabs firmly in place with wire supports or "chairs". Sizing and spacing of the chairs shall be sufficient to properly support the steel and shall be in accordance with CRSI Publications "Manual of Standard Practice".
3. Space the reinforcing steel in concrete walls the proper distance from the face of the forms, as indicated on the drawings, using galvanized metal spacers.
4. Where reinforcing conflicts with location of anchor bolts, inserts, etc., required to be cast in concrete, submit prompt notifications so that revisions can be made before concrete is placed. No cutting of reinforcing shall be permitted without the prior approval of the Engineer.

3.03 FIELD QUALITY CONTROL

Concrete shall not be deposited until the Engineer has observed the final placing of the reinforcing steel and has given permission to place concrete.

END OF SECTION

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SECTION 033000

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 QUALITY ASSURANCE

- A. Codes and Standards: Comply with the applicable provisions of the following codes, specifications, and standards:
 - ACI 301 "Specifications for Structural Concrete for Buildings."
 - ACI 304 "Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete."
 - ACI 311 "Recommended Practice for Concrete Inspection."
 - ACI 318 "Building Code Requirements for Reinforced Concrete."
 - ACI 347 "Recommended Practice for Concrete Formwork." Concrete Reinforcing Steel Institute, "Manual for Standard Practice."
- B. Workmanship: Contractor is responsible for correction of concrete work which does not conform to the specified requirements, including strength, tolerance, and finishes. Correct deficient unsatisfactory concrete as directed by Engineer.
- C. Provide testing and inspection service for quality control testing during concrete operations in accordance with General Conditions.

1.02 SUBMITTALS

- A. Shop Drawings: Concrete Reinforcement: Submit in accordance with General Conditions. Include drawings for fabrication, bending, and placement of concrete reinforcement. Comply with the ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete structures"; shows bar schedules, stirrup spacing, diagrams of bent bars, arrangement of concrete reinforcement.

PART 2 - PRODUCTS

2.01 FORM MATERIALS

- A. Forms for Exposed Finish Concrete: Construct formwork for exposed concrete surfaces with plywood, metal, metal-framed plywood-faced or other acceptable panel-type materials to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable size to minimize number of joints. Provide form material with sufficient thickness to withstand pressure of newly placed concrete without bow or deflection. Use plywood complying with U.S. Product Standards PS-1 "B-B High Density Overlaid Concrete Form," Class 1.
- B. Forms for Unexposed Finish Concrete: Form concrete surfaces which will be unexposed in finished structure with plywood, lumber, metal, or other acceptable material. Provide lumber dressed on at least 2 edges and one side for tight fit.

2.02 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A 615, Grade 60.
- B. Supports for Reinforcement: Provide supports for reinforcement including bolsters, chairs and spacers, supporting, and fastening reinforcing bars in place. Use wire bar type supports complying with CRSI recommendations. Wood, brick, plastic, and other devices will not be acceptable

2.03 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I, domestic manufacture. Use only one brand of cement throughout the project.
- B. Normal Weight Aggregates: ASTM C 33.

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1. Fine Aggregate: Clean, sharp, natural sand free from loam, clay, lumps, or other deleterious substances.
2. Coarse Aggregate: Clean, uncoated, processed aggregate containing no clay, mud, loam, or foreign matter, as follows:
 - a. Crushed stone processed from natural rock or stone.
 - b. Washed gravel, either natural or crushed. Use of pit or bankrun gravel is not permitted.
 - c. Maximum Aggregate Size: 1½".
- C. Water: Clean, fresh, free from oil, acid, organic matter, or other deleterious substances.
- D. Air-Entraining Admixture: ASTM C 260.
- E. Fly ash and calcium chloride or admixture containing more than 0.1% chloride ions are not permitted.

2.04 RELATED MATERIAL

- A. Membrane-Forming Curing Compound: ASTM C309, Type I.
- B. Bonding Compound: Polyvinyl acetate or acrylic base, rewettable type.
Product/manufacturer; one of the following:
Weldcrete; Larsen Products
EucoWeld; Euclid Chemical Co.
Sonocrete; Sonneborn-Contech
Acrylic Bondcrete; The Burke Co.

2.05 PROPORTIONING AND DESIGN OF MIXES

- A. Prepare design mix for concrete, to produce a minimum 28-day compressive strength of 3,600 psi, as indicated on Contract Documents. Use an independent testing facility acceptable to the Architect for preparing and reporting proposed mix designs.
- B. Proportion mixes by laboratory trial batch, using materials to be employed on the project for each class of concrete required, complying with ACI 211.1.
- C. Submit written reports to the Architect of each proposed mix for each class concrete at least 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed by the Architect/Engineer.
- D. Admixtures:
 1. Use air-entraining admixture in exterior exposed concrete. Add air-entraining admixture at the manufacturer's prescribed rate to result in concrete at the point of placement having air content of 5% (±1%) with a maximum water cement ratio of 0.50.
- E. Slump Limits: Proportion and design mixes to result in concrete slump at the point of placement of not less than 3" and not more than 5".

2.06 CONCRETE MIXING

- A. Ready-Mix Concrete: Comply with the requirements of ASTM C94, and as herein specified. No additional water to be added to the batch for material with insufficient slump with approval of Architect/Engineer.
- B. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C 94 may be required. When the air temperature is between 85° F and 90° F, reduce the mixing and delivery time from 1-2 hours to 75 minutes, and when the air

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temperature is above 90° F, reduce the mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.01 FORMS

- A. Design, erect, support, brace, and maintain formwork to support vertical and lateral loads that might be applied until such loads can be supported by the concrete structure. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position.
- B. Design formwork to be readily removable without impact, shock, or damage to cast-in-place concrete surfaces and adjacent materials.
- C. Construct forms complying with ACI 347, to sizes, shapes, lines, and dimensions shown, and to obtain accurate alignment, location, grades, level, and plumb work in finished structures. Solidly butt joints and provide backup at joints to prevent leakage of cement paste.
- D. Fabricate forms for easy removal without hammering or prying against the concrete surfaces.
- E. Chamfer exposed corners and edges as shown, using wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.
- F. Form Ties: Factory-fabricated, adjustable-length, removable or snap-off metal form ties, designed to prevent form deflection, and to prevent spalling concrete surfaces upon removal. Provide ties so portion remaining within concrete after removal is at least 1½" inside concrete and which will not leave holes larger than 1" diameter in concrete surface.
- G. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and locations of openings, recesses and chases from trades providing such items. Accurately place and securely support items built into forms.
- H. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before concrete is placed. Retighten forms after concrete placement if required to eliminate leaks.
- I. Forms which are destroyed or damaged and are not capable of supporting the design load shall be replaced with new forms prior to placing concrete.

3.02 PLACING REINFORCEMENT

- A. Comply with the specified codes and standards, and Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars," for details and methods of reinforcement placement and supports.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials which reduce or destroy bond with concrete.
- C. Accurately position, support, and secure reinforcement against displacement by formwork, construction, or concrete-placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers.
- D. Place reinforcement to obtain the minimum coverage for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

3.03 JOINTS

- A. Construction Joints: Locate and install construction joints, which are not shown on the drawings, so

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as not to impair the strength and appearance of the structure, as acceptable to the Engineer.

- B. Provide keyways at least 1½" deep in all construction joints in grade beams.
- C. Place construction joints perpendicular to the main reinforcement. Continue all reinforcement across construction joints.
- D. Control Joints per details.

3.04 INSTALLATION OF EMBEDDED ITEMS

- A. General: Set and build into the work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of the items to be attached thereto.
- B. Edge Forms and Screed Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain the required elevations and contours in the finished slab surface. Provide and secure units sufficiently strong to support the types of screeds required. Align the concrete surface to the elevation of the screed strips by the use of strike-off templates.

3.05 PREPARATION OF FORM SURFACES

- A. Coat the contact surfaces of forms with a form-coating compound before reinforcement is placed.
- B. Do not allow excess form-coating material to accumulate in the forms or to come into contact with concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.

3.06 CONCRETE PLACEMENT

- A. Pre-Placement Inspection: Before placing concrete, inspect and complete the formwork installation, reinforcing steel, and items to be embedded or cast-in. Notify other crafts to permit the installation of their work; cooperate with other trades in setting such work. Thoroughly wet wood forms immediately before placing concrete, where form-coatings are not used. Notify the Architect/Engineer at least one (2) working days prior to concrete placement.
- B. Coordinate the installation of joint materials and moisture barrier with placement of forms and reinforcing steel.
- C. General: Comply with ACI 304, and as herein specified.
- D. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within the section. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practicable to its final location to avoid segregation due to rehandling or flowing.
- E. Placing Concrete in Forms: Deposit concrete in grade beam forms in horizontal layers not deeper than 48" and in a manner to avoid inclined construction joints. Place continuously where possible. Start placing at ends of section and progress toward the center. Do not place concrete in beams supported on piers until the concrete in the piers is no longer plastic.
- F. Consolidate place concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use vibrators designed to operate with vibratory element submerged in concrete, maintaining a speed of not less than 6000 impulses per minute.
- G. Do not use vibrators to transport concrete inside of forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than the visible effectiveness of the machine. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit the duration of vibration to the time necessary to consolidate the concrete and complete embedment of

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reinforcement and other embedded items without causing segregation of the mix.

- H. Placing Concrete: Deposit and consolidate concrete slabs in a continuous operation, within the limits of construction joints, until the placing of a panel or section is completed.
- I. Consolidate concrete during placing operation so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.
- J. Bring surfaces to the correct level with a straight-edge and strike off. Use bull floats and darbies to smooth the surface, leaving it free of humps or hollow. Do not sprinkle water on the plastic surface. Do not disturb the slab surfaces prior to beginning finishing operations or while seep water is present on slab surface.
- K. Maintain reinforcing in the proper position during concrete placement operations.
- L. Cold Weather Placing: Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliances with ACI 306.
- M. Hot Weather Placing: When hot weather conditions exist that would seriously impair the quality and strength of concrete, place concrete in compliance with ACI 305.

3.07 FINISH OR FORMED SURFACES

- A. Related Unformed Surfaces: At horizontal offset and similar unformed surfaces occurring adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces.

3.08 PAVING FINISHES

- A. Non-Slip Broom Finish: Apply non-slip broom finish to exterior concrete platforms, steps, and ramps. Immediately after trowel finishing, slightly roughen surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.09 CONCRETE CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperature and maintain without drying at a relatively proper hardening. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Keep continuously moist for not less than 72 hours. Begin Final curing procedures immediately following initial curing and before concrete has dried. Continue final curing for at least 168 cumulative hours (not necessarily consecutive) during which concrete has been exposed to air temperatures above 50° F. Avoid rapid drying at end of final curing period.
- B. Concrete surfaces shall be cured by application of curing compound. Provide membrane curing by applying membrane-forming curing compound to damp concrete surfaces as soon as water film has disappeared. Apply uniformly in 2-coat continuous operation by power-spray equipment in accordance with manufacturer's directions. Apply second coat at right angle to first coat.

3.10 REMOVAL OF FORMS

- A. Formwork not supporting weight of concrete, such as sides of beams, walls, and similar parts of the work, may be removed 48 hours after placing concrete, provide concrete is sufficiently hard to not be damaged by form removal operations, and provided curing and protection operations are maintained.

3.11 RE-USE OF FORMS

- A. Clean and repair surfaces of forms to be re-used in the work. Split, frayed, delaminated, or

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otherwise damaged form facing material will not be acceptable. Apply new form coating compound materials to concrete contact form surfaces as specified for new formwork.

- B. When forms are extended for successive concrete placement thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joints to avoid offsets. Do not use "patched" forms for exposed concrete surfaces.

3.12 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill-in holes and openings left in concrete structures for passage of work by other trades, after work of other trades is in place. Mix, place, and cure concrete as herein specified, to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete the work.

3.13 CONCRETE SURFACE REPAIRS

- A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removal of forms, but only when acceptable to the Architect/Engineer. Remove and replace damaged concrete as directed by Engineer.
- B. Cut out honeycomb, rock pockets, voids over ½" diameter, and holes left by tie rods and bolts, down to solid concrete, but in no case to a depth of less than 1". Make edge of cuts perpendicular to the concrete surface. Before placing cement mortar, thoroughly clean, dampen with water and brush-coat the area to be patched with neat cement grout. Proprietary patching compounds may be used when acceptable to the Architect/Engineer.

3.14 QUALITY CONTROL TESTING DURING CONSTRUCTION

- A. Concrete shall be sampled and tested for quality control during the placement of concrete, as follows:
 - 1. Slump: ASTM C 143: One test for each concrete load at point of discharge; and one for each set of compressive strength test specimens.
 - 2. Compression Test Specimens: ASTM C 31; one set of 4 standard cylinders for each compressive strength test. Mold and store cylinders for laboratory cured test specimens.
 - 3. Compressive Strength Tests: ASTM C 39; one set for each 100 cu. Yds. or fraction thereof, of each concrete class placed in any day or for each 5,000 sq. Ft. of surface area placed; 1 specimen tested at 7 days, 2 specimens tested at 28 days and the remaining specimen held for future testing, if required. Report test results in writing to the Architect and the Contractor on the same day that tests are made. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of contractor, name of concrete type and class, location of concrete batch in the structure, design compressive strength at 28 days, concrete mix proportions and materials; compressive breaking strength and type of break for both 7-day test and 28-day tests.
- B. Additional Tests: The testing service will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained. Test to determine adequacy of concrete will be by cored cylinders complying with ASTM C 42. Contractor shall pay for such test conducted, and any other additional testing as may be required, when unacceptable concrete is verified.
- C. Concrete shall meet the compressive strength as shown on the plans and specifications regardless of ACI 318. ACI 318 shall have no bearing on pass/fail of all site concrete.

END OF SECTION

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SECTION 033000

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes cast-in-place concrete and supplementary items necessary to complete work required for their installation.
- B. Related Documents: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- C. Related Sections:
 - 1. Division 01 Section "Quality Requirements" for independent testing agency procedures and administrative requirements.
 - 2. Division 01 Section "Sustainable Design Requirements" for requirements related to project sustainability implementation.

1.2 DEFINITIONS

- A. Contraction Joint: Formed, sawed, or tooled groove in a concrete structure to create a weakened plane and regulate location of cracking resulting from dimensional change of different parts of structure.
- B. Construction Joint: A formed contraction joint at the interface between fresh concrete and hardened concrete.
- C. Control Joint: A sawed or tooled groove contraction joint.
- D. Ground Supported Slab (Slab-on-Grade): A concrete slab bearing on and supported by the ground/soil.
- E. SEOR: Structural Engineer of Record or his/her representative

1.3 PERFORMANCE REQUIREMENTS

- A. Concrete Slump: Selected by Contractor within range indicated herein for placement conditions required.
- B. Concrete Compressive Strength: Designated on drawings as minimum 28-day f'c.
- C. Concrete Shrinkage: Applicable to walls and horizontal surfaces. Maximum average drying shrinkage at 28 days of air storage shall not exceed 0.032 percent. Include test data with Concrete Mix Designs. Note: Use of shrinkage-reducing admixture should be last option after consideration has been given to variables of mix design which help contribute to low shrinkage concrete.
- D. Concrete Modulus of Elasticity: 28-day concrete modulus of elasticity has been assumed and shall be in accordance with ACI 318, chapter 19.2.

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- E. Concrete Mix Proportions/Designs: Selected and proposed by Contractor in accordance with requirements herein. Concrete proportions for each mix shall be certified by Independent Testing Laboratory hired by Contractor.
- F. Construction Joint Location Planning: Joint locations selected and proposed by Contractor in accordance with requirements herein and where shown on drawings.

1.4 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections.
 - 1. Shop drawings shall not be made by using reproductions of Contract Drawings.
 - 2. Fabrication of material before approval of drawings will be at risk of Contractor.
 - 3. Fabricated material and connections shall fit within architectural constraints.
 - 4. Fabricator alone shall be responsible for errors of detailing and fabrication.
- B. Product Data: Manufacturer's certification and test data that following furnished items conform to the specifications for each type of product indicated.
 - 1. Laboratory Test Reports for Concrete Materials and Mix Designs.
 - 2. Material Certificates: Certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with or exceeds specified requirements.
 - a. Concrete Admixtures: Certification from admixture manufacturer that admixture is compatible with other required or proposed admixtures, ingredients and applications.
 - b. Chloride Ion Content: Certification for each mix design that chloride ion content does not exceed specified limits when tested in accordance with ASTM C 1218.
 - c. Coloring Pigment
 - 3. Concrete Mix Designs: Include following information for each mix design:
 - a. Project Identification name.
 - b. Specific location, member, etc. for mix usage. Affix code, mix design number, or other identification symbol to each mix design.
 - c. Type of concrete, i.e. normal weight, lightweight, etc.
 - d. Dry unit weight, (pcf).
 - e. Aggregate type, gradation, and source. Include test results of fine and coarse aggregates for reactivity in presence of cement alkalis in accordance with ASTM C289. Confirm coarse aggregates consist of carbonate composition/properties.
 - f. Admixture types, product identification, supplier and literature.
 - g. Cement type and brand, including fly ash and other supplementary cementitious materials when applicable.
 - h. Placement method intended.
 - i. Other characteristics including, but not limited to, 28-day compressive strength, maximum slump, W/C ratio, and proportions of each material in mix.
- C. Shop Drawings:
 - 1. Contraction Joint Locations in Ground Supported Slabs: Plan showing dimensioned location of proposed contraction joints. Include proposed time frame for installation of control joints in ground supported slabs if by saw-cutting methods.
 - 2. Construction Joint Locations in Structural Slabs: Plan showing dimensioned location of proposed construction joints for concrete slabs.
 - 3. Sleeve Locations: Overlay plan of structural framing/layout showing dimensioned locations and sizes for sleeves thru concrete work.

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4. Permanent Embedded Items in Concrete Not Shown by Structural Drawings: Plan and details showing location, quantity and description of item(s) proposed as permanently embedded in concrete.
- D. Qualification Data: Evidence of installer and fabricator qualifications in conformance with Quality Assurance requirements below.
1. Concrete Plant Certification and Qualifications
 2. Concrete Contractor Qualifications
 3. Concrete Testing Service
 4. Specialized Concrete/Processes: Submit names and qualifications of technical representative(s) and trained installer(s) of specialized concrete/processes prior to product installation.
 5. Trained Installer for Specialized Cementitious Products
- E. Source and field quality-control documentation.
1. Test reports as required for indicating compliance with the Quality Control sections below.
- F. Contractor shall submit to the SEOR and the enforcing agency, for acceptance, a quality control or inspection plan that addresses all inspection issues.
- G. Hot and Cold Weather Concreting Procedures: Detailed procedures for production, transportation, placement, protection, curing and temperature monitoring of concrete during hot and cold weather conditions.

1.5 QUALITY ASSURANCE

- A. Codes and Standards: Comply with provisions of following, except as otherwise indicated or where more stringent requirements are shown, specified, or otherwise apply:
1. International Building Code (IBC) Edition indicated by Drawings including Special Inspection and Quality Control requirements, chapter 17 of the IBC and any local or State provisions.
 2. Following code and standard specifications noted below shall be as referenced by IBC chapter 35 or, where not referenced in IBC, the most recent published versions.
 3. American Concrete Institute ACI 301, "Specifications for Structural Concrete"
 4. ACI 318, "Building Code Requirements for Structural Concrete"
 5. ACI 306.1, "Standard Specification for Cold Weather Concreting".
 6. ACI 117, "Specification for Tolerances for Concrete Construction and Materials".
 7. Concrete Reinforcing Steel Institute (CRSI), "Manual of Standard Practice".
 8. ASTM E 1155, "Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers".
 9. ACI 503.1, "Standard Specification for Bonding Hardened Concrete, Steel, Wood, Brick, and Other Materials to Hardened Concrete with a Multi-Component Epoxy Adhesive".
 10. ACI 503.2, "Standard Specification for Bonding Plastic Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive".
 - a. Paragraph 2.3.7.1 of above specification is hereby replaced in its entirety with following:
 - 1) Independent Testing Laboratory approved by Architect/Engineer shall evaluate bonding of fresh concrete to existing concrete after fresh concrete has cured for not less than 28 days. Written report prepared by Independent Testing Laboratory shall be submitted to Architect/Engineer for review.

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- B. Document Conflict and Priority: In case of concrete work conflict between documents, notify Architect/Engineer prior to submitting proposal or performing work. Most stringent criteria shall govern and be given priority, unless otherwise indicated by Architect/Engineer in writing.
- C. Compatibility of Concrete Admixtures and Surface Treatments: Contractor shall be responsible for:
1. Selection of admixtures and surface treatments compatible with one another.
 2. Specified requirements of concrete work including final surface treatments.
 3. Product manufacturer's instructions for use, limitations and precautions.
- D. Certifications and Qualifications:
1. Concrete Plant: Certified in accordance with National Ready Mixed Concrete Association (NRMCA) Plant Certification Checklist. Minimum of 5 years successful experience in manufacturing ready-mixed concrete complying with ASTM C94.
 2. Concrete Contractor: Minimum of 5 years successful experience with installation and finishing of concrete similar in materials, system and project scope to that indicated.
 3. Concrete Testing Service: Engaged testing service acceptable to Architect to perform material evaluation tests and to evaluate concrete mixes on request of Architect/SEOR.
 4. Specialized Concrete and Processes: Services of a manufacturer's trained technical representative shall be obtained to provide assistance with proportioning, batching, mixing, placing, consolidating and finishing of specialized structural concrete. Technical representative shall provide services until field controls indicate product(s) of specified quality is furnished and Contractor's crews are capable of continued satisfactory work. Provide services for following materials and products:
 - a. Pre-mixed cementitious and polymer-modified cementitious overlay/repair products.
 - b. Concrete with shrinkage-reducing admixture.
 - c. Concrete with corrosion inhibitor admixture.
 5. Trained Installer: Services of trained installer, preferably with product manufacturer's certification as certified installer, shall be obtained to install specialized cementitious products. If installer does not hold manufacturer's certification, installer shall have 5 years minimum successful experience with product installation or similar product installation. Provide services for following materials and products:
 - a. Bonded cementitious and polymer-modified cementitious toppings less than 3" thick.
 - b. Bonded cementitious and polymer-modified mortar for structural bonding applications at concrete surface repairs of structural nature/significance as determined by SEOR.
- E. Testing/Retesting of Materials and Installed Work: May be required at any time during progress of Work as directed by Architect. Such test/retests, not indicated to be performed at Owner's expense, will be at Contractor's expense.
- F. Contractor's Conference: Conduct conference at Project site to comply with requirements of Division 01 Section "Project Meetings" and following:
1. Conduct meeting in advance of Concrete Pre-Construction Conference to review detailed requirements for preparing concrete design mixes and to determine procedures for satisfactory concrete operations.
 2. Review requirements for submittals, status of coordinating work, and availability of materials.
 3. Establish preliminary work progress schedule and procedures for materials inspection, testing and certifications.
 4. Require representatives of each entity directly concerned with cast-in-place concrete to attend conference, including, but not limited to following:
 - a. Contractor's superintendent
 - b. Agency responsible for concrete design mixes

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- c. Agency responsible for field quality control
- d. Ready-mix concrete supplier
- e. Concrete subcontractor
- f. Primary admixture manufacturer(s)
- 5. Minutes of meeting shall be maintained and distributed by Contractor to parties concerned within 5 days of meeting. Transmit minutes also to following parties for information:
 - a. Owner's representative
 - b. Architect
 - c. SEOR

G. Concrete Pre-Construction Conference:

- 1. At least 15 days prior to start of concrete construction, Contractor shall hold meeting to review detailed requirements of concrete mix designs and to determine procedures for producing proper concrete construction.
- 2. At minimum, discuss following:
 - a. Requirements for submittals
 - b. Status of Coordinating Work
 - c. Availability of materials and procedures for materials inspection/testing
 - d. Concrete construction activities critical to time/schedule
 - e. Certifications
 - f. Floor surface tolerance requirements (flatness/levelness)
 - g. Slab construction/control joint planning
 - h. Finishing and curing of floor surfaces. Curing columns, pilasters and walls.
 - i. Requirements for architectural concrete, including but not limited to: mock-up; forming; tolerances; and uniformity of finished concrete in color, texture and appearance.
 - j. Procedures for concreting during hot and cold weather conditions
 - k. Time period for concrete use after water is introduced into mixer
 - l. Control of concrete temperature
 - m. Control of concrete mixing water from all sources within 3% of approved mix design(s)
 - n. Control of concrete moisture/wetness during/after placement and the affects of moisture vapor transmission (MVT) on finish flooring materials
 - o. Contractor's intent, if applicable, to utilize Maturity Method for time sensitive concrete construction. Discuss advance pre-planning for development of strength-maturity relationships.
- 3. Contractor shall require responsible representatives of every party concerned with concrete work to attend conference, including but not limited to following:
 - a. Contractor's superintendent
 - b. Contractor's Laboratory responsible for concrete mix design(s)
 - c. Owner's Testing Agency responsible for field quality control
 - d. Concrete subcontractor
 - e. Ready-mix concrete producer
 - f. Admixture manufacturer representative
 - g. Concrete pumping subcontractor
 - h. Owner's and Architect's/SEOR's representative
 - i. Testing Agency's Floor Flatness/Levelness Inspector
 - j. Finish flooring subcontractor(s)
- 4. Minutes of meeting shall be maintained and distributed by Contractor to parties concerned within 5 days of meeting. Transmit minutes also to following parties for information purposes:
 - a. Owner's representative
 - b. Architect
 - c. SEOR
 - d. Owner's Testing Agency responsible for field quality control

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5. SEOR may attend conference. Notify SEOR at least 7 days prior to scheduled date of conference.

H. Column and Wall Panel Mockup: Cast mockup(s) for columns/walls of size indicated or as required to demonstrate typical joints, form tie spacing, proposed surface finish texture and color. Maintain mockup(s) exposed to view for duration of Project, after Architect's acceptance of visual qualities. Demolish mockup and remove from site when directed by Architect.

1.6 TOLERANCES

A. Conform to requirements of ACI 117, "Specification for Tolerances for Concrete Construction and Materials", except as modified by requirements of these Contract Documents.

B. Floor finish tolerances for surfaces designated to receive troweled finish shall be measured in accordance with ACI 117, Section 4.8.5, except as modified by these Contract Documents. Refer to Div. 03 Section "Concrete Finishing" for Flatness and Levelness Inspection and finished surface F-number requirements.

1.7 PROPOSED SUBSTITUTIONS

A. Substitutions or modifications, if proposed by Contractor, shall be submitted for approval prior to submission of shop drawings, and such substitutions shall be made only when approved by Architect, and at no additional cost to Owner. Total amount of credit, if any, shall be stated in writing with submission.

B. Corrections for inaccuracies that result in change from Structural Drawings or final approved shop drawing details shall be submitted for approval. Such substitutions or corrections shall be made only when approved by Architect.

1.8 HANDLING, STORAGE AND COORDINATION

A. Storage of materials: Store materials to permit easy access for inspection and identification.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

C. Coordinate openings, penetrations, and sleeve requirements with final equipment selections and locations by MEP sub-contractors. Verify any changes with SEOR prior to the Work.

PART 2 - PRODUCTS

2.1 GENERAL

A. Specific product, material or manufacturer listed under each item below is "acceptable" only if manufacturer can evidence product compliance with requirements of Contract Documents.

B. For manufacturers not listed, submit as substitution according to the Conditions of the Contract and Division 01 Specification Sections.

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- C. Chloride Ion Content: Limit water soluble chloride ion concentrations in hardened concrete, at ages from 28 to 42 days, that is contributed from ingredients including water, aggregates, cementitious materials and admixtures to following percent by mass of cementitious materials.
- | | |
|--|-------|
| 1. Concrete protected from moisture in service and dry in service: | 0.15% |
| 2. Concrete not protected from moisture in service and having continuous or intermittent wet/damp cycles in service: | 0.08% |
| 3. Concrete placed on metal deck; Post-tensioned concrete | 0.06% |

2.2 CONCRETE MATERIALS

- A. Cementitious Materials:
1. Portland Cement: ASTM C 150, Type I or Type III.
 2. Supplementary Cementitious Materials:
 - a. Fly Ash: ASTM C 618, Class C or F
 - b. Ground Granulated Blast-Furnace Slag (GGBFS): ASTM C 989, Grade 100 or 120
 - c. Limestone Powder: ASTM C1797, Type C
 3. Blended Hydraulic Cements: ASTM C 595, Type "IP", Type "IS" or Type "IL"
- B. Aggregates: Washed and screened, consisting of hard, durable particles without adherent coatings or other deleterious matter.
1. Fine Aggregate: ASTM C 33, natural sand, manufactured sand, or combination thereof, and shall be so graded from coarse to fine as to produce minimum percentage of voids.
 2. Normal Weight Coarse Aggregate: ASTM C 33, gravel or crushed stone of carbonate composition/properties.
 3. Lightweight Coarse Aggregate: ASTM C 330, suitably processed.
- C. Water: ASTM C 94, paragraph 6.1.3. Free of foreign matter potentially harmful to concrete, reinforcement, or concrete accessories. Free of deleterious amounts of chloride ions.
- D. Admixtures:
1. General:
 - a. Calcium chloride, thiocyanates, or admixtures with more than 0.05 percent chloride ions are not permitted.
 - b. Admixtures or manufacturer listed under each item below is "acceptable" only if manufacturer can evidence product compatibility with other products comprising, related or applied to concrete work.
 2. Air-Entraining Admixture: ASTM C 260; Provide air entraining agent in sufficient quantity to assure controlled entrainment within specified percentage limits required herein.
 - a. Master Builders Solutions: "MasterAir AE400"; "MasterAir AE 90"; "MasterAir AE 200"
 - b. Euclid Chemical Company: "Air-Mix" or "AEA 92"
 - c. Chryso: "Darex AEA" or "Daravair"
 - d. Sika Corporation; "AER" or "AIR"
 - e. SCHEDULE FOR USE:
 - 1) Normal weight concrete exposed to weather: Air content per ACI 318, Table entitled "Total Air Content for Concrete exposed to Cycles of Freezing and Thawing". Exposure F1, unless noted otherwise. [\[Exposure F3 at Parking Garage Slabs.\]](#) Reduce air content by 1 percent where concrete 28-day f'c is greater than 5,000 psi. Reduce air content percent for normal weight concrete at unformed surfaces scheduled to receive troweled finish or dry shake hardeners to 3 percent.
 - 2) Lightweight Concrete Mixes: Air content percent as recommended by concrete supplier, but, not less than 4 percent.

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3. Water-Reducing Admixtures:
 - a. Water-Reducing: ASTM C 494, Type "A";
 - 1) Master Builders Solutions: "MasterPozzoloth Series"
 - 2) Euclid Chemical Company: "Eucon WR" or "Eucon NW"
 - 3) Chryso: "WRDA"
 - 4) Sika Corporation: "Plastocrete 161"
 - b. Water-Reducing and Retarding: ASTM C494, Type "D".
 - 1) Master Builders Solutions: "MasterPozzoloth R Series; or "MasterSet DELVO Series".
 - 2) Euclid Chemical Company: "Eucon Retarder-75"
 - 3) Sika Corporation: "Plastiment"
 - c. Water-Reducing and Accelerating: ASTM C 494, type "C" or "E"; non-corrosive, non-chloride.
 - 1) Master Builders Solutions: "MasterSet FP 20"; "MasterSet AC 534".
 - 2) Euclid Chemical Company: "Accelguard 80"
 - 3) Sika Corporation: "Plastocrete 161FL"
 - d. High-Range Water-Reducing (Superplasticizer): ASTM C 494, Type "F" or "G".
 - 1) Master Builders Solutions: "MasterRheobuild 1000"; "MasterGlenium Series"
 - 2) Euclid Chemical Company: "Eucon 37"
 - 3) Sika Corporation: "Sikament 300"
 - 4) Chryso: "Daracem"
 - e. SCHEDULE FOR USE:
 - 1) Use water-reducing admixture conforming to one or more of above requirements in concrete, unless otherwise noted herein.
 - 2) Use Super-plasticizer where Flowable Concrete is indicated and as required to improve placement and workability; to lower W/C ratio; or for shrinkage or permeability reduction.
 - 3) Use Super-plasticizer in concrete with W/C ratio of 0.42 and less.
4. Shrinkage-Reducing Admixture: For reduction of concrete drying shrinkage by reduction of capillary tension of pore water. Non-corrosive and non-chloride. Consult with admixture manufacturers when used with air-entrained concrete mixes. Use as last option after consideration has been given to variables of mix design which help contribute to low shrinkage concrete.
 - a. Master Builders Solutions: "MasterLife SRA 200 " (at non-air-entrained concrete only); "MasterLife CRA 007" (at air-entrained concrete only)
 - b. Chryso: "Eclipse Floor 200" (at non-air-entrained concrete only); "Eclipse 4500" (at air-entrained concrete only)
 - c. Euclid Chemical Company: Eucon SRA Floor (at non-air-entrained concrete only); Eucon SRA-XT (at air-entrained concrete only)
 - d. SCHEDULE FOR POTENTIAL USE:
 - 1) Horizontal Surfaces including slabs-on-grade, elevated slabs/beams and slabs over metal deck
 - 2) Walls
5. Corrosion Inhibiting Admixture:
 - a. Calcium Nitrite Type: Minimum 30% calcium nitrite.
 - 1) Master Builders Solutions: "MasterLife CI 30"
 - 2) Chryso: "DCI" or "DCI S"
 - 3) Euclid Chemical Company: "Eucon CIA" or "Eucon BCN"
 - b. Amine-Ester Type:
 - 1) Master Builders Solutions: "MasterLife CI 222"
 - c. SCHEDULE FOR USE:
 - 1) At Parking Garage slabs and beams. Apply 1, [2, 3, 4, 5, 6] gallon per cu. yd.
6. Coloring Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, non-fading and resistant to lime and other alkalis.

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- a. Product Standard: SIKA Corporation "CHROMIX Admixture" for color-conditioned concrete.
- b. Color: As Selected by Architect.

2.3 CURING MATERIALS

A. Evaporation Retardant:

- 1. Description: Waterborne monomolecular film-forming compound manufactured for application to plastic concrete, preferably leaving no residue after concrete hardens. Residue remaining after concrete hardens shall be removed in accordance with manufacturer's recommendations.
- 2. Manufacturers and Products:
 - a. Euclid Chemical Co.; "Eucobar".
 - b. Lambert Corp.; "Lambco Skin".
 - c. Laticrete International, Inc. "L&M E-Con".
 - d. W.R. Meadows; "EVAPRE".
 - e. SIKA Corporation; "Sika Film".

B. Moisture-Retaining Cover:

- 1. Description: ASTM C 171, curing paper, white opaque polyethylene film, and polypropylene nonwoven fabric with white coating applied to one side, or white burlap-polyethylene sheeting. Polyethylene film not permitted at unformed surfaces. Clear or black polyethylene film permitted at interior formed surfaces with no exposure to sunlight during curing period.
- 2. Manufacturer and Product:
 - a. Curing Paper: Fortifiber Building Systems Group; "Orange Label, Sisaldraft curing paper".
 - b. Polyethylene Film: As recommended by Contractor; submit for Architect's review.
 - c. Polypropylene Nonwoven Fabric:
 - 1) Reef Industries Inc.: "Armorlon Transguard 4000".
 - 2) PNA Construction Technologies: "Hydracure".
 - 3) SIKA Corporation; "UltraCure NCF".
 - d. White Burlap-Polyethylene Sheeting: As recommended by Contractor; submit for Architect's review.

C. Absorptive Cover: AASHTO M 182, Class 2, Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd.

D. Liquid Membrane-Forming Curing Compound:

- 1. Description: ASTM C 1315, Type 1, Class A, clear water-based acrylic blend curing compound with 25 percent solid content (minimum); non-yellowing under ultraviolet light after 500 hours of test in accordance with ASTM D 4587; water based, VOC/AIM compliant. Sodium silicate compounds are not acceptable.
- 2. Manufacturers and Products: Selected by Contractor with strict attention given to limitations for usage and removal stated herein.

E. Dissipating Resin Membrane-Forming Curing Compound with Fugitive Dye:

- 1. Description: ASTM C 309, Type 1-D, Class B, water-based and formulated with hydrocarbon resins, which begins chemical break-down after approximately 4 weeks.
- 2. Manufacturers and Products: Selected by Contractor with strict attention given to limitations for usage and removal stated herein.

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2.4 RELATED MATERIALS

A. General

1. Use materials in strict conformance with manufacturer's written recommended application limitations, precautions and directions.
2. Consult with Manufacturer when specific product name is not listed giving attention to application requirements, compatibility with substrate conditions and ambient conditions. Subject to Architect's/Engineer's review/approval.

B. Bonding Compounds:

1. Latex Bonding Agents, Admixtures and Adhesives: ASTM C 1059, Type II
 - a. Suitable at non-structural and structural bonding applications, interior or exterior, unless noted otherwise in Contract Documents.
 - b. Use only acrylic or styrene butadiene latex based adhesives.
 - c. Manufacturers and Products:
 - 1) Euclid Chemical Company: "SBR Latex"
 - 2) Laticrete International, Inc.: "L & M Everbond"
 - 3) W.R. Meadows, Inc.: "ACRY-LOK"
2. Polyvinyl Acetate Bonding Agents: ASTM C 1059, Type I
 - a. Suitable at non-structural and structural bonding applications, only at interior surfaces not subject to water exposure or high humidity during construction or in-service.
 - b. Manufacturers and Products:
 - 1) Euclid Chemical Company: "Euco Weld"
 - 2) Laticrete International, Inc.: "L & M Everweld"
 - 3) W.R. Meadows, Inc.: "Intralok"
3. Epoxy-Resin Bonding Adhesives: ASTM C 881/C 881M, Types I, II, IV and V.
 - a. Types I and II: Acceptable at non-structural bonding applications.
 - b. Types IV and V: Acceptable at structural bonding applications.
 - c. Suitable for use on dry or damp surfaces.
 - d. Multi-Component Epoxy Adhesive for Bonding to Concrete: Conform to requirements of ACI 548.13-2, unless modified herein.
 - e. Epoxy Resin for Bonding Hardened Concrete, Steel, Wood, Brick, and other Materials to Hardened Concrete with a multi-component Epoxy Adhesive: Conform to requirements of ACI 503.1-92 (R2003) unless modified herein.
 - f. Manufacturers:
 - 1) Master Builders Solutions
 - 2) Euclid Chemical Company
 - 3) Sika Corporation
 - 4) W.R. Meadows

C. Overlay and Repair Mortar

1. Polymer Modified Cementitious Mortar: ASTM C 1059, Type II:
 - a. Suitable at structural and non-structural applications, interior or exterior.
 - b. Manufacturers:
 - 1) Master Builders Solutions
 - 2) Euclid Chemical Company
 - 3) Sika Corporation
 - 4) W.R. Meadows
2. Epoxy Mortar: ASTM C 881/C 881M, Types I and IV
 - a. Suitable at interior applications only, unless otherwise directed by Engineer.
 - b. Appropriate applications include locations susceptible to high wear or high corrosion.

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- c. Type I: Suitable at non-structural applications.
 - d. Type IV: Suitable at structural applications.
 - e. Manufacturers:
 - 1) Master Builders Solutions
 - 2) Euclid Chemical Company
 - 3) Sika Corporation
 - 4) W.R. Meadows
 - 3. Self-Leveling Underlayment Compound: Specified in Division 03 Section "Concrete Finishing".
- D. Non-Shrink Grout: ASTM C 1107. Material shall be ready-to-use non-metallic or metallic aggregate product requiring only addition of water at jobsite and shall produce flowable cementitious grouting material having no drying shrinkage at any age.
- 1. Use non-metallic grout for exposed conditions, unless indicated otherwise.
 - 2. Compressive strength at 7 and 28 days: 6,000 psi (7 day); 8,000 psi (28 day) minimum, at flowable consistency.
 - 3. Manufacturers and Products:
 - a. Master Builders Solutions: "Masterflow 815 or 870 Grout"
 - b. Euclid Chemical Company: "Euco NS Grout"
 - c. W.R. Meadows, Inc.: "588-10K"
 - d. Sika Corporation: "SikaGrout 328" or "SikaGrout 928"

PART 3 - EXECUTION

3.1 PROPORTIONING AND DESIGNING CONCRETE MIXES

- A. Contractor shall provide design mixes for each type and class of concrete by either "Field Experience Method" or by "Laboratory Trial Batch Method".
 - 1. Selection of concrete proportions for each mix shall be certified by an Independent Testing Laboratory hired by Contractor.
 - 2. Types and classes of concrete, minimum 28-day compressive strength (f'_c), and maximum nominal coarse aggregate sizes are shown in drawings.
- B. Field Experience Method: Prior established mix designs proportioned in accordance with ACI 211, accompanied by test data indicating acceptable strength history in accordance with ACI 318, unless modified herein.
 - 1. Data shall be no older than 12 months and shall be certified by Independent Testing Laboratory.
 - 2. Data shall be representative of similar ingredients, materials, quality control procedures, placement and ambient conditions expected for this project and under no more restrictive conditions of control over material quality and production methods than on proposed Work.
 - 3. Compressive strength in supporting data shall deviate no more than plus 1,000 psi or minus 500 psi from that specified.
 - 4. Shrinkage limits for mix(es) proposed for walls and horizontal surfaces shall accompany mix design(s) in accordance with requirements below.
- C. Laboratory Trial Batch Method: Establish mix proportions in accordance with ACI 211, and ACI 318, unless otherwise modified herein.
 - 1. Test cylinders at 7 days and at 28 days in accordance with ASTM C 39.
 - 2. Prepare and test additional set of cylinders at 56 days where specified compressive strength is 6,000 psi or higher.

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3. Temperature of concrete in trial batches shall be representative of conditions to be encountered at time of placement.
4. Optimize combination of aggregates, size(s) of coarse aggregates, water (W) content, cement (C) content and W/C relationship to effectively minimize and control shrinkage of concrete.
5. Avoid overdosing cement content to meet W/C relationships as such practice generally results in higher shrinkage characteristics.
6. Shrinkage Test: ASTM C 157; Applies to each mix proposed for walls and horizontal surfaces.
 - a. Average drying shrinkage at 28 days of air storage: 0.032 percent (maximum) determined from following procedure:
 - 1) Mold and cure three specimens for each mix proposed.
 - 2) Store specimens in lime-saturated water until 7 day curing age is attained, including period in the molds.
 - 3) Take initial comparator reading on removal from lime-saturated water, followed by subsequent comparator readings after air storage periods of 4, 7, 14 and 28 days after the initial 7 day curing.
 - b. When shrinkage test results do not meet specified limitation, revise mix as required. Consider following options for reduction of shrinkage:
 - 1) Increase aggregate content in mix.
 - 2) Increase coarse aggregate volume and decrease fine aggregate volume within mix.
 - 3) Evaluate coarse aggregate properties, including but not limited to hardness and clay content.
 - 4) Use shrinkage reducing admixture only when other available options for controlling shrinkage have been considered and dismissed.

D. Mix Design Information: Requirements specified under paragraph 1.5 SUBMITTALS, above.

E. Water-to-Cement Ratio (W/C): Lowest possible value consistent with maximum consolidation, workability and density.

1. Intent is to achieve low porosity concrete, minimize drying shrinkage and to minimize cracking, thus minimizing potential for harmful moisture or ion penetrations, and thereby protecting reinforcement.
2. Maximum W/C ratios for following normal weight concrete classes are as follows, unless otherwise noted herein:

F'c at 28-days (psi)	Air-entrained Concrete	Non-Air-entrained Concrete
3,000	0.50	0.55
3,500 to 4,000	0.45	0.48
4,500 & above	0.40	0.45

F. Supplementary Cementitious Materials (SCM's):

1. Use at Contractor's option, unless otherwise indicated, to improve consistency, placement, finishing and economics.
2. Mixes with higher percentages than indicated may be proposed by Contractor, but are subject to Engineer's approval prior to use. Provide reasoning for higher percentage.
3. Limits below represent percentage of total cementitious material in mix, by weight:
 - a. Fly Ash: 25 percent

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- b. Ground-Granulated Blast-Furnace Slag (GGBFS): 50 percent, except where used in hydraulic blend with other SCM's whereby GGBFS percentage shall be reduced such that sum of SCM's does not exceed 50 percent, by weight, of total cementitious materials.
 - c. Limestone Powder: 10 percent
 - d. Silica Fume: 10 percent
 - 4. Conform to more stringent of above percentage limitations or ACI 318 for concrete subject to exposure to de-icing chemicals
 - 5. Contractor's use of SCM's acknowledges understanding that water demand, challenges with plastic concrete workability/finishing and time for concrete setting and strength gain may be longer than similar mix with Portland Cement only, therefore precautions to avoid premature finishing shall be considered and undertaken.
- G. Admixtures:
- 1. Refer to Part 2 – Products above for SCHEDULE FOR USE under each admixture type.
 - 2. Use admixtures in compliance with manufacturer's directions. Control dosage rates. Do not overdose mixes.
- H. Slump Ranges: Proportion and design mixes to exhibit slump within following ranges at point of deposit.
- 1. Slump ranges indicated assume vibration is used for consolidation of concrete.
 - 2. Slump indicated below may be increased when admixtures are used provided that concrete has same or lower water-cement ratio and does not exhibit segregation potential or excessive bleeding.

Concrete, unless noted otherwise	1" minimum - 5" maximum
Elevated slabs; Slabs-on-grade; Slabs-on-metal deck; Basement Walls; Topping Slabs; Mass Concrete	1" minimum - 4" maximum
Pier Concrete	Flowable Concrete required (see below)
Flowable Concrete (concrete with Super-plasticizer denoted as "SP")	4" maximum slump prior to addition of "SP" 9" maximum slump after addition of "SP"

3.2 GENERAL REQUIREMENTS FOR CONCRETE

- A. Coordination with Other Products/Trades:
- 1. Give various trades and subcontractors ample notification and opportunity to furnish anchors, nailers, pipes, conduits, boxes, inserts, sleeves, frames, vents, wires, supports, or other items required to be built into concrete.
 - 2. Obtain suitable templates or instructions for installation of those items which are required to be placed in forms.

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- B. Control of Water: Control water at all times during mixing, placing, finishing, curing and after completion of curing phase.
1. Excess water during mixing and placing phases effects properties of concrete, including but not limited to strength, shrinkage/cracking, set-time and long-term durability.
 2. Excess water after curing phase effects drying of hardened concrete with direct affect on application of finish materials applied with adhesives sensitive to moisture and/or water vapor.
 3. Control of water includes water at place of mixing, truck water, water at jobsite, and moisture due to rain, ice or snow.
 4. Additions of water to batched air-entrained concrete can potentially lead to above normal decreases in concrete strength, therefore shall be avoided.
 5. Contractor is responsible for control of water and affects on concrete and material(s) to be applied to hardened concrete.
- C. Concrete Characteristics:
1. Classes: Concrete shall have characteristics shown on Drawings or as specified herein.
 2. Water Content: Concrete shall not be placed when its total mixing water content is more than 3% (tolerance) greater than indicated by approved mix design(s). Avoid addition of water to ready-mixed concrete at job site unless it is part of amount initially required for proportioned mix design maximum W/C ratio. Addition of water in excess of tolerance stated above to compensate for loss of workability is prohibited. Contractor shall control water addition to ready mixed concrete at job site at all times.
 3. Slump: Concrete shall not be placed when its plasticity, as measured by slump tests, is more than 10 percent greater than maximum slump indicated by approved mix design, unless W/C content is known to be in accordance with specified requirements and valid reason for excessive slump is known.
- D. Mixing Concrete:
1. Batch, mix and transport ready-mixed concrete in accordance with requirements of ASTM C 94.
 2. Concrete shall not be transported or used after period in excess of 90 minutes has elapsed after introduction of water into mixer. When concrete temperature exceeds 86 degrees F, time shall be reduced to 60 minutes.
 3. Agency supplying concrete shall have plant of sufficient capacity and adequate transportation facilities to assure continuous delivery at rate required.
 4. Plant equipment and facilities shall conform to "Certification of Ready Mixed Concrete Production Facilities (Checklist with Instructions)" of National Ready Mixed Concrete Association.
- E. Conveying Concrete:
1. Convey concrete from mixer to place of final deposit by methods which will prevent separation or loss of ingredients.
 2. Concrete to be conveyed by pumping will require approval of Architect for each class of concrete specified before being used.
 3. Equipment for chuting, pumping and pneumatically conveying concrete shall be of size and design as to assure practically continuous flow of concrete at delivery end without separation of materials.
 4. Use of gravity flow or aluminum chutes or conveyors for transporting concrete horizontally is not permitted.

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3.3 JOINTS

- A. General: Locate joints as indicated on Drawings or, if not shown, at locations approved by Architect/Engineer. Intent of this Specification is to locate joints so as not to adversely affect either structural integrity or appearance of structure, and to control cracking.
- B. Construction Joints: Place joints perpendicular to main reinforcement. Locate joints within middle third of span and continue reinforcement across joint unless otherwise indicated by Drawings. Provide dowels across joints as indicated by Drawings. Dowels shall be supported during concreting operations so as to remain parallel with slab or wall surface and perpendicular to joint.
1. Keyways: 1 ½" deep x d/3 x continuous in walls, slabs and between walls and footings, where "d" denotes specified wall or slab thickness, unless otherwise indicated by Drawings.
 2. Waterstops: Refer to Division 03 Section "Concrete Accessories".
 3. Walls: Space construction joints as follows:
 - a. Horizontal Spacing: 60 feet maximum
 - b. Vertical Spacing: as shown on Drawings.
 4. Allow minimum of 72 hours between placement of adjacent pour areas not separated by expansion joint.
 5. Avoid slab construction joints at areas specified to receive thin-set tile, terrazzo and resilient floor finish materials to greatest extent possible. Slab grinding, chipping or filling at such occurrences to achieve specified floor surface tolerances will be at Contractor's expense.
 6. Preparation of Construction Joints:
 - a. Clean construction joints of all dirt, dust, debris, wood forming, oil, grease, loose fragments and other bond inhibiting materials.
 - b. Bond inhibiting materials which cannot be removed by hand processes shall be removed by mechanical methods such as chipping, grinding and sandblasting.
 - c. Intentional Roughening: Intentionally roughen contact surfaces at construction joints through elevated concrete beams and girders (not grade beams) which are 12" wide or wider. Purpose of intentional roughening is to expose clean aggregate which is solidly embedded in mortar matrix. Intent is to achieve an approximate ¼" surface profile/amplitude. Follow intentional roughening with pressure washing using clean water to remove dust and other loose materials.
 - d. Do not make additional construction joints without Architect/Engineer's approval.
 7. Bonding Requirements at Construction Joints:
 - a. Perform Intentional Roughening at surfaces noted above and where indicated on Drawings.
 - b. Clean Water Pre-Dampening: Minimum requirement at vertical construction joints through elevated structural joists, beams, girders, formed slabs 6 inch thick or greater, consists of pre-dampening surface of previously deposited and hardened concrete.
 - 1) Pre-dampen contact surfaces to condition of "saturated surface dry".
 - 2) Avoid over-soaking or over-saturation to extent which has result of standing water in formwork or otherwise excessive or undesirable water/moisture.
 - 3) Maintain pre-dampened condition until fresh concrete is placed.
 - c. Bonding Compound: Apply approved bonding compound to surfaces designated on Drawings or as otherwise directed by Architect/Engineer. Follow bonding compound manufacturer's written procedure(s) for mixing, application and pot-life limitation.
 - d. Horizontal Construction Joints: Hardened concrete at horizontal joints in exposed work; horizontal construction joints in beams, girders, joists and slabs shall be cleaned and intentionally roughened same as described above. Additional requirements are as follows:
 - 1) Apply approved bonding compound to cleaned and roughened surface of set concrete. Follow written procedure(s) of bonding compound manufacturer for mixing and application.

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- 2) Apply fresh concrete to prepared surface within time limit (pot-life) recommended by bonding compound manufacturer.
- C. Joints in Slabs-on-Grade: Jointing of slabs-on-grade shall be provided by combination of construction joints and control joints which contribute to define individual "slab panels". Pre-plan joint locations, slab panel sizes and pre-place additional joint reinforcement as indicated on Drawings.
1. Construction Joints: Vertically formed, keyed and doweled as indicated by Drawings. Finish with edging tool having radius of 1/8".
 2. Control Joints: Sawcut or formed with continuous inserts at Contractor's option, as follows:
 - a. Sawcut Option: Perform initial sawcuts no later than 3 hours after final slab surface finishing with equipment suited and designed for early concrete sawcutting (dry cut saw). Perform final sawcuts as soon as possible where required to achieve specified joint size/depth. Coordinate sawcut locations with slab control joint detail to avoid cutting continuous bars to remain. Remove dust and laitance from joints.
 - 1) Initial Sawcuts: 1/8" min. width x 1" min. depth.
 - 2) Final Sawcuts: 1/8" min. width x t/4 depth where "t" denotes slab thickness.
 - 3) Final joint width of joints to receive sealant or grout shall be 1/4".
 - 4) If Initial Sawcuts can be installed to achieve final required joint size, this is permitted.
 - b. Continuous Inserts Option: Form joints by inserting continuous pre-molded plastic, hardboard or fiberboard strips into fresh concrete until top surface of strip is flush with slab surface. Maintain straight and true alignment. Tool slab edges on each side of insert. Remove inserts and clean grooves of loose debris after concrete has hardened. Finished joint shall be 1/4" width x t/4 min. depth, where "t" denotes slab thickness.
 3. Slab Panels shall be approximately rectangular. Locate joints at column centerlines and at intermediate intervals to restrict "slab panel" size to following limits:

Slab Thickness	Max. slab panel side length	Max. slab panel size/area
5"	15'	225 sf
6"	18'	325 sf
7"	21'	440 sf
8"	24'	575 sf
9"	27'	730 sf
10" and greater	30'	900 sf
 4. Slab-on-Grade Placement Options:
 - a. LARGE BLOCK PLACEMENT: Consists of 10,000 sf (maximum) placement area having construction joint at perimeter edges and checkerboard interior control joints thereby defining "slab panels".
 - 1) Plan geometry approximately rectangular (where possible) with no edge longer than 1.5 times shortest edge.
 - 2) Plan placement area size to comply with time limit for initial sawcutting of control joints, where sawcut option is used.
 - b. LANE PATTERN PLACEMENT: Consists of placement lane which is one (1) slab panel in width x full length of slab in direction of lane placement.
 - 1) Plan lane length to comply with time limit for initial sawcutting of control joints, where sawcut option is used.
 - 2) Reduce lane length as required to conform with initial sawcutting time limit.
 5. Expansion Joints and Isolation Joints: Construct as shown by Drawings, typically without dowels unless otherwise indicated.

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3.4 CONCRETE PLACEMENT

A. General:

1. Complete formwork and reinforcement inspection procedures, including corrections, prior to commencement of concrete placement.
2. Remove debris and hardened or partially hardened concrete which has accumulated on forms or reinforcement before commencement of concrete placement.
3. Deposit concrete in forms as close to its final position as possible to avoid rehandling.
4. Place concrete in reasonably uniform layers, approximately horizontal, and no deeper than 18 inches except that slabs shall be placed in single layer. Avoid unplanned vertical, horizontal or inclined construction joints, or other planes of weakness.
5. Place concrete at rate whereby concrete is plastic at all times and flows readily into spaces.
6. Do not place concrete that has partially set or has been contaminated by foreign materials.
7. Do not retemper concrete or remix after initial set.
8. Do not place concrete on previously deposited concrete which has partially set or hardened sufficiently to cause formation of seams or planes of weakness. If section cannot be placed continuously, provide appropriate construction joint as specified herein.
9. Do not permit concrete to drop freely greater than 8 feet where plastic concrete is likely to collide with reinforcement. Use suitable equipment such as chute, tremie or other approved conveyance where longer drops are necessary.
10. Where concrete can be placed without colliding with reinforcement, no vertical drop distance limitation is imposed.
11. Do not pour directly into excavations where water is standing.
12. Maintain reinforcement in proper position during concreting operations.

B. Vibration and Consolidation: Consolidate each layer of concrete as it is deposited with mechanical vibrators and suitable hand tools. Internal vibrators (spud or poker type) for consolidation shall conform to ACI 309R.

1. Avoid under-vibration, over-vibration and use of vibrators to transport concrete in forms
2. Insert and withdraw vibrators in vertical manner at sufficient points no farther apart than visible effectiveness of vibrator.
3. Do not insert vibrator into lower layers that have begun to set.

C. Hot Weather Concreting:

1. Hot Weather Placement Criteria:
 - a. Concrete work shall conform to requirements of ACI 305.1, "Specification for Hot Weather Concreting", unless modified or more stringent requirements are provided in these Contract Documents.
 - b. Conditions Requiring Hot Weather Concrete Practices: Any combination of high ambient temperature (80 degrees F or higher), high concrete temperature, low relative humidity, and high wind speed that tend to impair quality of freshly mixed or hardened concrete by accelerating rate of moisture loss and rate of cement hydration, or otherwise causing abnormal or detrimental results.
 - c. Maximum Acceptable Fresh Concrete Temperature: 95 degrees F at truck discharge point.
 - d. Delivery/Discharge Time Limitation: When concrete temperature exceeds 86 degrees F, time limitation for delivery/discharge shall be 60 minutes after introduction of water into mixer.
2. Records: Maintain records of outside air temperature, concrete temperature per ASTM C 1064, wind speed, relative humidity and other general weather conditions that might impair concrete quality or strength during hot weather conditions.

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3. Actions During Hot Weather Conditions: When hot weather conditions occur or are anticipated, pre-plan and implement following actions, all or in part, as required to maintain acceptable concrete temperature and to minimize possibility of plastic shrinkage cracking. Other actions may be necessary and are responsibility of Contractor.
- a. Concreting Actions:
- 1) Utilize fly ash, GGBFS or both as partial replacements for Portland Cement.
 - 2) Schedule early morning or night concrete placements, unless not permitted by Owner or other governing authority.
 - 3) Cool ingredients before mixing. Mixing water may be chilled or use chopped ice, provided water equivalent of ice is calculated to total amount of mixing water.
 - 4) Use water-reducing retarding admixture when required by conditions.
 - 5) Minimize time between mixing and placement of concrete.
 - 6) Protect slab concrete during stages of placing and finishing against moisture loss due to rapid evaporation by applying fog mist spray above surface and applying monomolecular film, evaporation retarding agent.
 - 7) Plan for continuous curing, preferably moist curing during first 72 hours using absorptive blankets kept continuously wet, or, at appropriate pre-planned locations by applying curing compound. Refer to Div. 03 Section – “Concrete Finishing” for use of curing compounds. Continue curing for minimum of 7 days. Do not change curing methods until concrete is at least 3 days old.
- b. Other Actions:
- 1) Keep equipment cool by spraying with water, however do not permit cooling water to effect water content and properties of fresh concrete.
 - 2) Fog spray forms, reinforcing steel and subgrade just prior to placing concrete. Keep subgrade moisture uniform without puddles or dry areas.
 - 3) Cover reinforcing steel with water-soaked burlap such that steel temperature will not exceed ambient air temperature sufficiently in advance of embedding in concrete.
 - 4) Loosen forms as soon as possible and run curing water down inside. When forms are removed, provide wet blanket curing cover to newly exposed surfaces for minimum of 7 days curing period. After curing period, covering should stay in place without wetting for additional 4 days.

D. Cold Weather Concreting:

1. Cold Weather Placement Criteria:
- a. Concrete work shall conform to requirements of ACI 306.1, “Standard Specification for Cold Weather Concreting”, unless modified or more stringent requirements are provided in these Contract Documents.
 - b. Do not place concrete when outside air temperature at time of placement or at any time during the protection period is 40 degrees F or less unless cold weather concreting practices are followed.
 - c. Apply cold weather concreting practices whenever following conditions exist or are anticipated for more than 3 successive days:
 - 1) Average daily air temperature less than 40 degrees F, where average temperature is average of highest and lowest temperatures occurring during period from midnight to midnight.
 - 2) Air temperature not greater than 50 degrees F for more than one half of any 24 hour period duration.
 - d. Concrete temperature as mixed and delivered to jobsite as follows:

<u>Air Temperature</u>	<u>Min. Conc. Temp.</u>	<u>Max. Conc. Temp.</u>
Above 30 deg. F	60 deg. F	75 deg. F

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0 to 30 deg. F	65 deg. F	80 deg. F
Below 0 deg. F	70 deg. F	85 deg. F

- e. Concrete temperature as placed and maintained during protection period, measured at surface of concrete, as follows:

<u>Min. Conc. Temp.</u>	<u>Max. Conc. Temp.</u>
50 deg. F	85 deg. F

- f. Maximum concrete surface gradual temperature decrease during any 24 hour period after end of protection period per ACI 306.1 Table 3.2.1.
2. Protection Period: Not less than 3 days. Continue curing as specified herein to facilitate concrete strength gain and minimize cracking.
3. Large Embedded Items in Concrete: Maintain large embedded items above 35 deg. F. prior to placing concrete. Large embedded items are not specifically alerted on the drawings, but generally consist of wide flange steel members, tubes, pipes, channels, ducts, or other similar large items which have potential to damage concrete if embedded as a large frozen mass.
4. Records:
- a. Maintain records of date, time, ambient air temperature, temperature of concrete as delivered and placed, and general weather conditions during cold weather conditions.
 - b. Record air temperature and concrete surface temperatures at regular intervals, but not less than 3 times per 24 hour period. Record concrete surface temperature at several locations including corners and edges to monitor effectiveness of protection provided. Use lowest temperature to represent temperature of section at that time.
 - c. Record maximum and minimum temperatures for each 24 hour period.
5. Actions During Cold Weather Conditions: When cold weather conditions occur or are anticipated, pre-plan and implement following actions, all or in part, as required to maintain acceptable concrete temperature. Other actions may be necessary and are responsibility of Contractor.
- a. Design concrete mixes specifically for cold weather conditions. Use air-entrainment (where acceptable).
 - b. Heat mixing water by blending hot/cold water as suitable for concrete temperature range.
 - c. Uniformly heat aggregates to eliminate ice, snow and frozen lumps of aggregate.
 - d. Cover thawed and heated stockpiles to retain heat.
 - e. Thaw frozen subgrades prior to concrete placement.
 - f. Remove ice, snow and frost from formwork and reinforcing steel.
 - g. Cover metal embeds and wrap protruding reinforcing bars with insulation to avoid heat drain from fresh concrete and to prevent localized freezing of concrete.

3.5 MISCELLANEOUS CONCRETE ITEMS

A. Floor Toppings:

1. Bonded Toppings: Topping slabs less than 3 inches thick shall be considered to be bonded toppings unless indicated otherwise. Topping slabs 3 inches thick and greater which are intended as bonded toppings are noted as such on Drawings. Pre-plan and prepare for placement of bonded topping slabs as follows:
- a. Finish surface of freshly placed concrete to consist of "scratch finish" obtained when base concrete is partially set by texturing with stiff brushes, brooms, or rakes to produce surface profile amplitude of 1/4 inch in one direction. No trowelling permitted.

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- b. Apply intentional roughening to concrete surfaces not having scratch finish. Roughen surface by sandblasting or other mechanical methods to achieve minimum surface amplitude of 1/8", or as otherwise recommended by overlay installer and approved by Engineer.
- c. Roughening technique/equipment shall be a process selected by Contractor, however, high-impact techniques (including but not limited to scarifying, scabbling, and roto-milling) are known to result in "bruising" and/or "micro-cracking" thereby weakening tensile/bond strength of surface to receive bonded overlay. Where high impact techniques are used, follow with sandblasting or other approved method(s).
- d. Clean roughened surface by removing deteriorated concrete, and other bond-inhibiting materials from prepared roughened surface.
- e. Pre-Dampen surface with clean water to condition of "saturated surface dry", having no standing or glistening water at time of topping placement. Where topping product manufacturer's instructions do not require pre-dampening of prepared surface, omission of this step may be considered but only with approval of SEOR.
- f. Apply bonding compound as recommended by overlay product manufacturer's written instructions.
- g. Basis of Bonded Topping Design:

<u>Topping Thickness (T)</u>	<u>Product</u>
T = 1/2" to 1"	Polymer-Modified Cementitious (PMC) Mortar
1" < T < 3"	PMC Mortar extended with 3/8" max. aggregate
T = 3" and greater	Conventional concrete as specified in Drawings with bonding compound applied to base concrete.

- h. In lieu of PMC Mortar applications noted above, use of other pre-mixed cement based mortars suitable for thin overlay applications may be considered but only with approval of SEOR. No topping shall be less than 1/2 inch in total thickness.
2. Un-bonded Toppings: Topping slabs 3 inches thick and greater shall be considered as un-bonded toppings unless indicated otherwise. Pre-plan and prepare for placement of un-bonded toppings as follows:
- a. Broom and vacuum clean base surface to receive topping.
 - b. Apply bond breaker compound to base surface when indicated on Drawings.
 - c. Use conventional concrete as specified in Drawings.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by troweling surfaces to hard, dense finish with corners, intersections and terminations slightly rounded.
- C. Column Base Plates, Equipment Bases, and Foundations:
- 1. Grout column base plates, equipment bases and foundations as indicated using specified non-shrink grout. Use non-metallic grout for exposed conditions, unless noted otherwise.
 - 2. Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment to template at correct elevations.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings and associated items. Cast-in-safety inserts and accessories as shown on Drawings. Screed, tamp and finish as required by Division 03 Section "Concrete Finishing".

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- E. Filling In: Fill in holes and openings left in concrete work for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place and cure concrete as specified to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete Work.

3.6 SCREEDING, FINISHING, AND PROTECTING CONCRETE

- A. Refer to Division 03 Section "Concrete Finishing" for screeding and finishing.
- B. Protection:
 - 1. Protect freshly placed concrete from washing by rain or flowing water.
 - 2. Do not allow freshly placed concrete to dry out from time deposited in forms until expiration of curing period.
 - 3. After curing period, control water at areas to receive adhesives, coatings, or other finish material(s) sensitive to moisture or water vapor.
 - 4. Protect concrete surfaces whenever other work is being done adjacent to or above finished concrete surfaces.

3.7 CONCRETE CURING

- A. General Curing Requirements
 - 1. Curing Unformed Surfaces – Interior Concrete Floors Scheduled to Receive Additional Floor Finishes. Intent of this Specification is to utilize moisture curing. Do not use curing compounds on concrete surfaces that are to receive the following finishes:
 - a. Floors to Receive Penetrating Liquid Floor Treatments:
 - 1) Including but not limited to hardeners, sealers, densifiers and water repellents,
 - b. Floors to Receive Polished Finish:
 - c. Floors to Receive Chemical Stain:
 - d. Floors to Receive Urethane Flooring:
 - e. Floors to Receive Adhered Floor Finishes:
 - 1) Including but not limited to cementitious toppings and overlays, waterproofing and other membranes, tiling and underlayments, direct glue wood flooring, resilient flooring, terrazzo, resinous flooring, adhesive applied carpet, paint and other coatings, epoxy overlays and other adhered floor covering systems.
 - 2. Incorrect Use and Removal: If curing compounds are used on surfaces, exterior or interior, formed or unformed, that are scheduled or specified to receive surface-adhered finishes or treatments, then mechanically (bead blast) or chemically remove curing compound completely. Confirm required surface finish with flooring manufacturers and installers.
 - a. Removal: After curing period has elapsed, but not later than 7 days after end of curing period, remove curing compound using method recommended by curing compound manufacturer without damaging or otherwise creating unsuitable concrete surfaces to receive flooring systems. Removal of curing compounds shall be provided at Contractor's expense.
 - 1) Acid etching is not permitted.
 - b. Allow additional time after curing compound removal for concrete surfaces to reach required concrete moisture and water vapor limitations required for successful application of subsequent floor finishes and treatments.
 - c. Dry-Shake Hardener: Consult with hardener manufacturer to confirm curing compound product and application method on surfaces where dry-shake hardener has been applied.

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- B. Curing Period: Protect freshly placed and finished concrete for minimum period indicated below from premature drying and excessive cold or hot temperatures. Curing period begins on completion of final finishing.

Cement Type	Minimum Curing Period
Type I Portland Cement	7 days
Type II Portland Cement	10 days
Type III Portland Cement	3 days (when ambient temp. is 73 deg F or higher)
Type IV or V Portland Cement	14 days
Blended Cements	Variable, but, not less than period above for Type of Portland Cement in blended mix.

- C. Curing Time Reduction: Curing times may be reduced from periods noted above at concrete which will have permanent in-service interior exposure to conditioned air if either of following provisions is complied with.

1. When tests are made of field cured cylinders cured by same methods as structure, curing period may be terminated when average compressive strength has attained 75% of specified 28-day compressive strength. Minimum curing period not less than 72 hours.
2. When temperature of structure concrete is maintained at minimum of 50 deg F (10 deg C) for same length of time required for laboratory cured cylinders of same concrete to reach 85% of specified 28-day compressive strength, curing period may be terminated. Minimum curing period not less than 72 hours.

- D. Evaporation Retardant: Apply evaporation retardant to unformed concrete surfaces if hot, dry, or windy conditions are prevalent or anticipated to occur before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

- E. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, columns, walls, and other similar surfaces. If forms remain during curing period, moisture cure after loosening forms. If forms are removed before end of curing period, continue curing by one or a combination of specified curing methods as applicable. Contractor shall select method which is compatible with requirements for subsequent material application on surface.

- F. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces, by one or a combination of specified curing methods as applicable. Contractor shall select method which is compatible with requirements for subsequent material application on surface.

- G. Curing Methods: Cure formed and unformed surfaces by one or a combination of following methods as applicable.

1. Moisture Curing:
 - a. Procedures: Keep concrete surface continuously wet by covering with absorptive cover or by using continuous water-fog spray. Cover concrete surface with specified absorptive cover, thoroughly saturate cover with water, and keep continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 12 in (300 mm) lap over adjacent absorptive covers. Secure absorptive covers to maintain close contact with

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concrete surface, withstand wind, and prevent air circulation below cover during entire curing period.

- b. Precautions: Apply following precautions during moisture curing.
 - 1) Water shall be potable meeting requirements of ASTM C 94.
 - 2) Temperature of supply curing water shall not exceed 10 deg F (-9.4 deg C) warmer than internal temperature of concrete or 90 deg F (32 deg C), whichever is lower.
 - 3) Temperature of supply curing water shall not be lower than 15 deg F (-12.2 deg C) cooler than internal temperature of concrete or 50 deg F (10 deg C), whichever is higher.
 - 4) Discontinue moisture curing 24 hours minimum prior to exposure or anticipated exposure of concrete to freezing ambient temperatures.
 - 2. Moisture-Retaining Cover:
 - a. Procedures: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least: 4 in (100 mm) for curing paper; and 12 in (300 mm) for polyethylene film or burlap-polyethylene sheeting, and sealed by waterproof tape or adhesive. Immediately repair holes or tears during curing period using cover material and waterproof tape. Secure moisture-retaining cover to maintain close contact with concrete surface, withstand wind, and prevent air circulation below cover during entire curing period.
 - b. Polyethylene film not permitted at unformed surfaces.
 - 3. Curing Compounds:
 - a. Limitations on Use: Refer to General Curing Requirements above.
 - b. Procedures: Apply curing compound to concrete surfaces as soon as final finishing operations are complete (within 2 hours and after surface water sheen has disappeared). Apply uniformly in continuous operation by power spray or roller according to manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - c. Do not use curing compounds which exhibit yellowing or moderate yellowing at surfaces to be permanently exposed in finished Work.
- H. Control of Water after Curing: Continuously monitor and control water, including but not limited to rain, ice or snow, on surfaces after curing period. Rewetting surfaces affects the drying period for hardened concrete and directly affects installation of finish materials applied with adhesives sensitive to moisture or water vapor. Contractor is responsible for controlling water and the resulting effects on concrete and material(s) to be applied to hardened concrete.

3.8 FLOOR SURFACE FLATNESS/LEVELNESS MEASUREMENT AND TOLERANCES

- A. Refer to Division 03 Section "Concrete Finishing" for required floor surface flatness and levelness criteria and related Quality Control.

3.9 FINAL PROCEDURES

- A. Satisfactorily replace imperfect or damaged work and material damaged or determined to be defective, before final completion and acceptance of entire job in conformity with requirements of Drawings and Specifications, at Contractor's expense.
- B. Remove forms, equipment, protective coverings and rubbish from premises upon completion of Work.
- C. Leave finished concrete surfaces in clean and undamaged condition, free of mortar, concrete droppings, loose dirt and mud, and satisfactory to Owner.

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PART 4 - QUALITY CONTROL

4.1 INSPECTION STANDARDS

- A. Quality control, testing, and inspections shall meet the special inspection requirements of the building code and any local or state provisions.
 - 1. Minimum periodic and continuous inspection requirements are indicated below. Refer to Drawings for supplemental and/or more stringent testing requirements, as required.
 - 2. Provide for more stringent inspection/testing where specified on Drawings or required elsewhere in these Specifications.

4.2 TESTING AGENCY

- A. Owner will employ and pay a qualified independent testing agency to perform the quality control indicated in this section, including special inspections required by the building code.
- B. Qualifications of Testing Agency and Personnel:
 - 1. Agency/Laboratory responsible for testing/inspection shall conform to requirements of ASTM C 1077.
 - 2. Field personnel responsible for tests/inspections of concrete required to determine compliance with this specification shall be certified as ACI Concrete Field Testing Technician, Grade I or equivalent.
 - 3. Laboratory personnel performing strength tests for compliance with this specification shall be certified as an ACI Concrete Laboratory Testing Technician, Grade 1 or 2 or by an equivalent written and performance test program.
 - 4. Personnel performing Concrete Plant Inspection shall be certified as ACI Concrete Field Testing Technician, Grade I, and Aggregate Testing Technician, Level 1.
- C. Field Inspection Scope of Services:
 - 1. Secure composite samples in accordance with ASTM C 172. Obtain each sample from different batch of concrete on random basis.
 - 2. Perform sampling at following locations:
 - a. Adjacent to concrete mixer as concrete is delivered from mixer to conveying vehicle, unless otherwise noted.
 - b. At end of discharge hose, when concrete is pumped. Location shall be in reasonable close proximity to placement area, so as to satisfactorily simulate conditions at end of hose.
 - 3. Verify water to cement ratio is not exceeded if water is added to concrete mix in truck or otherwise. Addition of water beyond limits given on approved mix design shall not be permitted.
 - 4. Verify air content in concrete. Re-verify air content in air-entrained concrete if late additions of water occur to concrete mix in truck or otherwise.
 - 5. Molding and Curing of Test Cylinders:
 - a. Mold and cure cylinders (one set for strength testing) from each sample in accordance with ASTM C 31.
 - b. Cylinders may be 6" diameter x 12" length, or 4" diameter x 8" length.
 - c. Quantity of cylinders per set: 4 (minimum) for 6x12 cylinders; 6 (minimum) for 4x8 cylinders.
 - d. Quantity of cylinders per set for high-strength concrete: Minimum quantity of cylinders per set for concrete with specified compressive strength greater than 6000 psi shall be six (6) regardless of size of cylinders.
 - e. Make one set of cylinders for each 150 cu. yd. or fraction thereof, or for each 5,000 square feet of floor slab or wall area, for each mix design of concrete placed in one day.

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- f. Make one additional set of cylinders for each truck in which 2.5 gallons per cubic yard or more mixing water has been added to truck after concrete has been batched in Batch Plant. This additional set and subsequent strength tests shall be at Contractor's expense.
 - g. Contractor may elect to mold and cure more than minimum number of cylinders to allow for discarding an individual cylinder strength in accordance with ACI 214R, or for option of having reserve cylinders for potential additional strength tests. Additional cylinder(s) for such purposes shall be at Contractor's expense.
 - h. Refer to paragraphs 4.3.E and 4.3.F for additional testing requirements for early formwork removal and/or time sensitive concrete construction activities.
- 6. Determine slump of concrete sample representative of each set of cylinders and whenever consistency of concrete appears to vary in accordance with ASTM C 143.
- 7. Field Inspection Reports: Inspect each batch of concrete in accordance with approved mix designs, check mixing time of concrete in trucks and report adjustment to amounts of mixing water with reason(s) for adjustment, to assure uniform consistency from truck to truck. Submit Report of Field Inspection of Concrete for each concrete pour. Report shall identify project name, client, concrete supplier, date of placement and name/signature of inspector. Include following information for each truck of concrete.
 - a. Number of cylinders molded and concrete cylinder set numbers taken from truck.
 - b. Truck ticket number and time truck was dispatched and time unloaded.
 - c. Concrete mix designation, number, or other identification.
 - d. Number of yards of concrete in truck.
 - e. Water-to-cement (W/C) ratio, slump, air content, admixtures, concrete temperature and air temperature at time of sampling.
 - f. Descriptive/Graphic Location of placement. Use column grids when possible.
 - g. Other remarks, i.e.. amount of mixing water added, if any, and reason(s); deviations from ASTM Specifications, if any, and reason(s); elapsed time between start of mixing to completion of placement; variations in curing requirements; etc...
 - h. Name of field technician performing sampling and ACI certification ID number.
- 8. Concrete Plant Inspection: Provide qualified inspector with necessary equipment to inspect weighing and batching of controlled concrete at batch plant.
 - a. Provide batch plant inspection during first placement of concrete in structure.
 - b. Provide batch plant inspection on remainder of project on random basis approximately 10 percent of time concrete is being placed on project.
 - c. Inspector shall observe that facilities, scales and truck mixers meet requirements of ASTM C94 "Standard Specification for Ready-Mixed Concrete".
 - d. Confirm that materials used meet requirements of Specifications and that mixture proportions are batched in accordance with approved mix designs.
 - e. Conduct or witness performance by concrete producer of following tests at least once during batch plant inspection:
 - 1) Moisture content determination for fine and coarse aggregate, ASTM C 566.
 - 2) Aggregate gradation, fine and coarse, in accordance with ASTM C 136 and in compliance with ASTM C 33 and ASTM C 330 as applicable.
 - f. Check for adjustment in batch weights to compensate for variations in moisture content, allowing for free moisture contained in fine and coarse aggregate.
 - g. Promptly submit to Architect/Engineer report of certification of weights used in loads of acceptable concrete which has been batched during plant inspection time.
 - 1) Submit report for each batch plant inspection showing test results and observations made during inspection.

D. Laboratory Testing Scope of Services:

- 1. Test concrete cylinders in accordance with ASTM C 39.
- 2. Test each set of cylinders as follows:

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- a. For 6x12 cylinders: Two cylinders shall be tested at 7 days for information and two cylinders shall be tested at 28 days for acceptance.
 - b. For 4x8 cylinders: Three cylinders shall be tested at 7 days for information and three cylinders shall be tested at 28 days for acceptance.
 - c. For concrete with 28-day compressive strength greater than 6,000 psi: Three cylinders shall be tested at 7 days for information and three cylinders shall be tested at 28 days for acceptance regardless of size of cylinders.
 - d. Acceptance test results shall be average of cylinder test results at 28 days unless otherwise noted.
3. Submit timely consecutively numbered Concrete Compressive Strength Reports with following minimum information for each set of strength test cylinders:
- a. Project identification, Client, and concrete supplier.
 - b. Concrete cylinder set number.
 - c. Date of sampling; Date of testing and concrete age.
 - d. Specified 28 day compressive strength requirement, f'c.
 - e. Descriptive Location of placement which cylinders are representative of.
 - f. Compressive strength results from cylinder testing.
 - g. Notation of compliance or non-compliance with specified requirements.
 - h. Remarks in regard to testing procedure(s) which may have impact on results.
4. Report promptly to Architect/SEOR details of non-conforming concrete. Give information concerning locations of concrete pours, quantities, dates and other pertinent facts.

4.3 CONTRACTOR

- A. Materials and Workmanship: Owner's employment of a qualified independent testing agency to perform the testing/inspection services indicated above shall not operate to relieve Contractor of responsibility to furnish materials and workmanship in accordance with Contract Documents.
- B. Contractor Inspection/Testing: Owner's employment of a qualified independent testing agency to perform the testing/inspection services indicated above is for verification and does not prevent Contractor from providing supplemental inspection/testing at Contractor's discretion and expense.
- C. Qualifications of Contractor's Testing/Inspection Personnel: Contractor's personnel performing testing/inspection services are subject to same qualifications as noted by paragraph 4.2.B above.
- D. Re-Testing of Materials: Retesting of materials failing to meet specified requirements shall be done at Contractor's expense.
1. In cases of differences of opinion between Owner's testing agency and the Contractor's inspector regarding conformance, the issue shall be brought to the Architect, SEOR of Record and the enforcement agency as part of the resolution process.
 2. Where resolve of difference of opinions is not possible, joint supplemental testing between Owner's testing agency and Contractor's inspector may be required and will be at Contractor's expense.
 3. Architect's and SEOR's cost for consideration and participation with resolve of non-conforming work may be subject to fee imposition on Contractor.
- E. Early Formwork Removal Time Control and Testing
1. If early formwork removal is desired by Contractor, additional cylinders and testing performed for this purpose are required and shall be at Contractor's expense.
 2. Testing requirements are specified in Division 03 Section "Concrete Forming".
- F. Testing for Start of Early or Time Sensitive Concrete Construction Activities

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1. If early or time sensitive concrete construction activities are desired by Contractor, additional cylinders and testing performed for this purpose/confirmation and cured under field conditions are required and shall be at Contractor's expense.
2. Potential early or time sensitive concrete construction activities include, but are not limited to:
 - a. Early formwork or shoring removal.
 - b. Termination of cold weather protection.
3. As an alternative to performing additional cylinders for early or time sensitive concrete construction activities, consideration may be given to the in situ strength of concrete determined by the maturity method in accordance with requirements of ASTM C 1074
 - a. Estimating Concrete Strength by the Maturity Method requires advance pre-planning for development of strength-maturity relationships.
 - b. Maturity Method shall be supplemented with other tests of potential strength of concrete for confirmation, in accordance with ASTM C 1074.
 - c. Contractor shall provide all correlations, field validation testing and other work necessary for use of Maturity Method.
 - d. If Maturity Method is intended, include as topic for discussion during Concrete Pre-Construction Conference.
 - e. Basis of Maturity Method testing: "InSite System"; manufactured and supplied by RPX Technologies; Stillwater, Oklahoma.

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END OF SECTION

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SECTION 033500
CONCRETE FINISHING

PART 1 - GENERAL

1.1 SUMMARY

- A. Work required for this Section includes concrete finishing of cast-in-place concrete including supplementary products necessary to complete the concrete installation.
- B. Related Sections:
 - 1. Refer to Division 3 Sections Cast-in-Place Concrete or Concrete Curing for curing and other concrete requirements.

1.2 DEFINITIONS

- A. Curing: Action taken by which hydraulic-cement concrete matures and develops hardened properties over time as result of continued hydration of cement in presence of sufficient water and heat.
- B. Envelope: Vertical distance between two level lines or planes.
- C. Flatness: Degree to which surface approximates plane.
- D. Levelness: Degree to which line or surface parallels horizontal. Horizontal is normal to direction of gravity.
- E. Minimum Local Value: Minimum local F(F) or F(L) value at given floor level, taken within one floor test area defined as Minimum Local Area.
 - 1. Boundaries of Minimum Local Areas may not cross construction joints.
 - 2. Slabs-on-Grade: Minimum Local Area will be bounded by construction and/or control joints, or by column lines and half-column lines, whichever is smaller.
 - 3. Elevated Slabs: Minimum Local Area will be bounded by column lines and/or half-column lines.
- F. Specified Overall Value: Composite value of samples taken at given level, regardless of number of concrete placements required to complete level. Specified overall F-numbers represent minimum values allowed for entire floor, looked at as whole.

1.3 ACTION SUBMITTALS

- A. Product Data: Submit copies of manufacturers' technical literature for specified products.
 - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
 - 2. Submittal(s) shall identify location(s) of Contractor's intended application of product(s).

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1.4 INFORMATIONAL SUBMITTALS

- A. Field Quality Control Reports: Written report of testing and inspection required by "Field Quality Control".
- B. Repair Records: At conclusion of project, submit record of repairs as part of job close-out information. Record shall be complete in detail and will serve as Owner's documentation of repairs made to concrete work. Include following information.
 - 1. Location and size of repair. Include individual identification number for each repair and provide dimension(s) from established grids, elevations, and approximate repair size.
 - 2. Statement of reason(s) for repair.
 - 3. Repair material(s) applied.
 - 4. Date of repair application.
 - 5. Name(s) of trained installer used for each repair.

1.5 QUALITY ASSURANCE

- A. Finisher Qualifications: Finisher with not less than 5 years experience with successful concrete finishing and systems similar to scope of this Project, with a record of successful in-service performance and completion of projects for a period of not less than 5 years, and with sufficient production capability, facilities, and personnel to produce required Work.
- B. Installer Qualifications for Specialized Concrete Finishes:
 - 1. Experience: Installer's personnel with not less than 5 years of experience in the successful performance of Work similar to scope of this Project.
 - 2. Supervision: Installer shall maintain a competent supervisor at Project while the Work is in progress, and who has not less than 5 years of experience installing products and systems similar to scope of this Project.
 - 3. Manufacturer Acceptance: Installer shall be certified, approved, licensed, or acceptable to manufacturer to install products including but not limited to the following:
 - a. Overlay and repair mortar.
 - b. Crack repair/injection.
- C. Work Plan for Out-of-Tolerance Floor Surfaces:
 - 1. Detailed work plan for areas where remedial measures are necessary to correct unsatisfactory as-built floor flatness/levelness conditions. Include following information:
 - 2. Specific boundaries of area to receive remedial work
 - 3. Methods and products proposed.
 - 4. Grout/topping/underlayment product literature.
- D. Mock-Ups for Specialized Concrete Finishes: Prior to fabrication and installation, build mock-up for each form of construction and finish required to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mock-up using materials indicated for the completed Work.
 - 1. Build mock-up in the location and of the size indicated or, if not indicated, as directed by Architect. Contractor shall provide structural support framework.
 - a. Show typical components, attachments to building structure, and requirements of installation.

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2. Notify Architect seven days in advance of the dates and times when mock-up will be installed.
3. Obtain Architect's acceptance of mock-ups before starting fabrication or installation.
4. Acceptance of mock-ups does not constitute acceptance of deviations from the Contract Documents contained in mock-ups unless such deviations are specifically noted by Contractor and accepted by Architect in writing.
5. Demolish and remove mock-ups when directed by Architect unless accepted to become part of the completed Work.

1.6 PRE-INSTALLATION CONFERENCE

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.
 1. Participants:
 - a. Architect.
 - b. Contractor, including superintendent.
 - c. Installer, including project manager and supervisor.
 - d. If requested, Manufacturer's qualified technical representative.
 - e. Installers of other construction interfaced with Work.
 2. Minimum Agenda: Installer shall demonstrate understanding of the Work required by describing detailed procedures for preparing, installing, and cleaning the Work. Demonstration shall include, but not be limited to, following topics:
 - a. Tour representative areas of Work, inspect and discuss condition of substrate, and other preparatory work performed by other trades.
 - b. Review Contract Document requirements.
 - c. Review approved submittals.
 - d. Review inspection and testing requirements.
 - e. Review environmental conditions and procedures for coping with unfavorable conditions.
 - f. Resolve deviations or differences between Contract Documents and the manufacturer's specifications.
 3. Record discussions, including decisions and agreements, and prepare report.

1.7 COORDINATION

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation
- C. Coordinate openings, penetrations, and sleeve requirements with final equipment selections and locations by MEP sub-contractors. Verify any changes with Engineer of Record prior to fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND PRODUCTS

- A. Acceptable Manufacturers/Fabricators and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers/fabricators listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".
- B. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other available manufacturers/fabricators offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.

2.2 MATERIALS, GENERAL

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

2.3 CURING MATERIALS

- A. Refer to Division 3 Sections Cast-in-Place Concrete or Concrete Curing for curing and other concrete requirements.

2.4 VERTICAL AND HORIZONTAL TREATMENTS

- A. **Modified Oleophobic Penetrating Concrete Protectant: Exempt solvent, low VOC, synthetic-modified, silane-siloxane concrete protectant. Clear, penetrating, breathable protectant for use on interior/exterior, horizontal/vertical concrete, natural or synthetic stone surfaces top resist oil, water, food, stains, and many other liquid contaminants.**

- 1. **Manufacturer Products, subject to specified written warranty:**

- a. **Spec Chem: All Shield EX**

2.5 FLOOR AND SLAB TREATMENTS

- A. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery with emery aggregate containing not less than 50 percent aluminum oxide and not less than 25 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.
- B. Mineral Dry-Shake Floor Hardener: Factory-packaged dry combination of portland cement, graded quartz aggregate, coloring pigments, and plasticizing admixture. Use coloring pigments that are finely ground, nonfading mineral oxides interground with cement.
 - 1. Colors: As scheduled in Division 01 Section "Design Selections", or where not scheduled, as selected by Architect from manufacturer's full range of standard colors.
 - 2. Consult with manufacturer's trained technical representative where dry-shake floor hardener will be applied over air-entrained concrete.
 - 3. Manufacturers and Products:
 - a. Euclid Chemical Co.; Surflex.
 - b. Lambert Corporation; Colorhard.
 - c. L&M Construction Chemicals, Inc.; Quartzplate FF.

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- C. Penetrating Liquid Floor Hardener and Sealer (Sealed Concrete): Chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; colorless; that penetrates, hardens, densifies, and seals concrete surfaces. Minimum manufacturer's written warranty of 10 years to effectively harden, densify, and dustproof concrete surfaces.

1. Manufacturer Products, subject to specified written warranty:
 - a. Curecrete Chemical Co., Inc.; Ashford Formula or Ashford Formula ND.
 - b. Euclid Chemical Co.; Euco Diamond Hard.
 - c. L&M Construction Chemicals, Inc.; Seal Hard.
 - d. Sika Corp.; Scofield Formula One Lithium Densifier MP.

2.6 REPAIR MATERIALS

- A. Self-Leveling Concrete Underlayment (Non-wear surface):

1. Description: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 in (3 mm) to 1 in (25 mm) and that can be feathered at edges to match adjacent floor elevations. Interior use only, unless exterior application recommended by manufacturer within written literature.
2. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
3. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
4. Aggregate: Well-graded, washed sand as recommended by underlayment manufacturer.
5. Compressive Strength: 4,000 psi minimum at 28 days when tested according to ASTM C 109.
6. Substrate Preparation: Bead blast as recommended by product manufacturer.
7. Basis of Design (Product Standard): Ardex, Inc.; "Ardex K-15".
8. Manufacturers: (Consult manufacturer for specific product and compatibility with substrate conditions. Subject to Architect's and Engineer's review and approval.)
 - a. ARDEX Engineered Cements.
 - b. Custom Building Products.
 - c. Euclid Chemical Co.
 - d. Sika Corporation.

- B. Self-Leveling Concrete Topping (Wear surface):

1. Description: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/2 in (12 mm) to 2 in (50 mm). Consult manufacturer for thickness exceeding 2 in (50 mm). Interior use only, unless exterior application recommended by manufacturer within written literature.
2. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
3. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
4. Aggregate: Well-graded, washed gravel, 1/8 in (3 mm) to 3/8 in (10 mm) or coarse sand as recommended by topping manufacturer for specific application thickness. No coarse aggregate permitted for thicknesses of 1 in (25 mm) or less.
5. Compressive Strength: 5,000 psi minimum at 28 days when tested according to ASTM C 109.

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6. Substrate Preparation: Bead blast as recommended by product manufacturer.
 7. Basis of Design (Product Standard): ARDEX Engineered Cements; "Ardex SD-T".
 8. Manufacturers: (Consult manufacturer for specific product and compatibility with substrate conditions. Subject to Architect's and Engineer's review and approval.)
 - a. ARDEX Engineered Cements.
 - b. Custom Building Products.
 - c. Euclid Chemical Co.
 - d. Sika Corp.
- C. Polyurethane Control Joint Filler: Semi-self-leveling, single component, moisture-curing, low-modulus, polyurethane sealant, Shore A hardness of 40-45 per ASTM D 2240, OT Traffic Rating.
1. Basis of Design: TREMCO; Vulkem 455SL.
- D. Overlay and Repair Mortar:
1. General: Use of overlay and repair mortar shall be in accordance with manufacturer's application limitations, precautions, and directions for use, including but not limited to surface preparation, mixing, placing, curing, and compatibility with substrate conditions.
 2. Product types listed below are basis of design, however, it is recognized by Architect/Engineer that high performance cement based overlay/repair mortars are available which may be satisfactory to specific application. Intent is not to omit such products from consideration. Subject to Architect and Engineer's approval prior to use.
 3. Epoxy Mortar:
 - a. Description: ASTM C 881, acceptable at interior applications only, unless otherwise directed by Engineer; appropriate applications include locations susceptible to high wear or high corrosion.
 - 1) Type I: Acceptable at non-structural applications.
 - 2) Type IV: Acceptable at structural applications.
 - b. Manufacturers: (Consult manufacturer for specific product and compatibility with substrate conditions. Subject to Engineer's review and approval.)
 - 1) ARDEX Engineered Cements.
 - 2) Euclid Chemical Company.
 - 3) Sika Corporation.
 4. Polymer Modified Cementitious Mortar:
 - a. Description: ASTM C 1059, Type II, acceptable at structural and non-structural applications, interior or exterior.
 - b. Manufacturers: (Consult manufacturer for specific product and compatibility with substrate conditions. Subject to Engineer's review and approval.)
 - 1) ARDEX Engineered Cements.
 - 2) Euclid Chemical Company.
 - 3) Sika Corporation.
- E. Epoxy Grout Fill:

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1. General: Use epoxy grout fill in accordance with manufacturer's application limitations, precautions, and directions for use, including but not limited to surface preparation, mixing, placing, curing, and compatibility with substrate conditions.
2. Description: Multi-component, high strength epoxy grout.
3. Manufacturers and Products:
 - a. Sika Corporation; SikaFlow 648.
 - b. Laticrete; L&M EpoGrout 758 Epoxy Structural Grout.

2.7 WATERPROOFING FOR CONCRETE TOPPINGS AT ELEVATED KITCHENS

- A. Faced Chlorinated Polyethylene (CPE) Waterproof Membrane: Non-plasticized, chlorinated polyethylene faced on both sides with high-strength, nonwoven polyester fabric; minimum 0.030 in (0.75 mm) nominal thickness.
 1. Manufacturer and Product: The Noble Company; Nobleseal TS.
- B. Waterproofing Sealant and Seamer: Synthetic co-polymer rubber used to seal seams, penetrations, and edges of waterproofing sheet membrane.
 1. Manufacturer and Product: The Noble Company; NobleSealant 150.
- C. Locations: Kitchens to receive resinous flooring and are located on elevated slabs over occupied space. Install on top of structural slab beneath concrete topping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive concrete finishing, products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

3.2 INSTALLATION, GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
 1. Respective manufacturer/fabricator's written installation instructions.
 2. Accepted submittals.
 3. Contract Documents.

3.3 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants or errors which would result in poor or potentially defective installation or would cause latent defects in Work.

3.4 FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:

1. ACI 301 (ACI 301M) Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.
 - a. No formwork facing material is specified.
 - b. Patch voids larger than 1-1/2 inches (38 mm) wide or 1/2 inch (13 mm) deep.
 - c. Remove projections larger than 1 inch (25 mm).
 - d. Tie holes do not require patching.
 - e. Surface Tolerance: ACI 117 (ACI 117M) Class D. Maximum abrupt or gradual irregularity limited to 1 inch (25 mm).
 - f. Locations:
 - 1) Concrete surfaces not exposed to view; such as foundations and crawl spaces.
2. ACI 301 (ACI 301M) Surface Finish SF-1.1: As-cast concrete texture imparted by form-facing material.
 - a. No formwork facing material is specified.
 - b. Patch voids larger than 1 inch (25 mm) wide or 1/2 inch (13 mm) deep.
 - c. Remove projections larger than 1/2 inch (13 mm).
 - d. Tie holes do not require patching.
 - e. Surface Tolerance: ACI 117 (ACI 117M) Class C. Maximum abrupt or gradual irregularity limited to 1/2 inch (13 mm).
 - f. Locations:
 - 1) Concrete surfaces not exposed to public view, such as concrete surfaces concealed by other construction.
3. ACI 301 (ACI 301M) Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.
 - a. Formwork facing material is specified.
 - b. Patch voids larger than 3/4 inch (19 mm) wide or 1/2 inch (13 mm) deep.
 - c. Remove projections larger than 1/4 inch (6 mm).
 - d. Patch tie holes.
 - e. Surface Tolerance: ACI 117 (ACI 117M) Class B. Maximum abrupt or gradual irregularity limited to 1/4 in (6 mm).
 - f. Locations:
 - 1) Concrete surfaces to receive coating or covering material applied directly to concrete, such as waterproofing, dampproofing, or plastering.
 - 2) Concrete surfaces exposed to view in Parking Garages.
4. ACI 301 (ACI 301M) Surface Finish SF-3.0:
 - a. Formwork facing material is specified
 - b. Patch voids larger than 3/4 inch (19 mm) wide or 1/2 inch (13 mm) deep.
 - c. Remove projections larger than 1/8 inch (3 mm).
 - d. Patch tie holes.

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- e. Surface Tolerance: ACI 117 (ACI 117M) Class A. Maximum abrupt or gradual irregularity limited to 1/8 in (3 mm).
- f. Locations:
 - 1) Concrete surfaces exposed to view.
 - 2) Concrete surfaces to receive rubbed finishes.

B. Rubbed Finish: Apply the following to as cast surface finishes where indicated on Drawings:

1. Smooth-Rubbed Finish:

- a. Perform no later than one day after form removal.
- b. Moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture.
- c. If sufficient cement paste cannot be drawn from the concrete by the rubbing process, use a grout made from the same cementitious materials used in the in-place concrete.
- d. Maintain required patterns or variances as shown on Drawings or to match mockups approved by Architect.

C. Related Unformed Surfaces:

- 1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike-off smooth and finish with texture matching adjacent formed surfaces.
- 2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.5 VERTICAL AND HORIZONTAL TREATMENTS

- A. **General:** Surface should be dry, well cured (21 day minimum). Substrate must be free of all moisture, curing residue, dust debris, oil, and other contaminants and must be absorptive. All joint sealant, caulks, and patching should be in place before applying.
- B. **Equipment:** Must use a low pressure (<50 psi) non atomizing sprayer.

3.6 FINISHING FLOORS AND SLABS (UNFORMED SURFACES)

- A. **General:** Prior to proceeding with any finishing operation, complete initial placement procedures consisting of deposit in form(s), consolidation, screeding, leveling, bull-floating, and initial re-straightening. Do not commence finishing operation when excess moisture or bleed water remains on surface. Do not wet concrete surfaces during finishing operations.
- B. **Screeding Concrete:**
 - 1. Act of striking off surface of concrete to pre-determined grade conforming to elevations shown on Drawings shall be accomplished with use of rigid screed guides. Use of wet screed guides is to be avoided on elevated surfaces.
 - 2. At elevated placements, metal deck and other formwork continues to deflect for short period after strike off. Subsequent re-straightening of surface often moves concrete paste from over beams into resulting depressions. It is suggested that Contractor plan for initial slab thickness of design depth plus 1/8 in (3 mm) (minimum). Intent shall be to satisfactorily plan for sufficient material to re-straighten slab surface and still maintain specified slab thickness and adequate cover over reinforcing steel.

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3. Contractor shall include in his bid any additional concrete required to achieve specified slab surface finish tolerance. Finish floor tolerances shall be as specified elsewhere in this Section.
4. Cast-in-Place Concrete Framing System(s):
 - a. Grade for strike off shall be set at predetermined distance above top surface of formwork.
 - b. Minimum slab thickness, as specified on Drawings, shall be maintained throughout slab surface.
 - c. It is anticipated that occasional Local Areas may be identified where actual deflection of formwork during concreting operations differs from that anticipated by Contractor. At such isolated areas, modify procedures by one or combination of following:
 - 1) Modify formwork camber where possible.
 - 2) Where over deflection of formwork occurs, maintain concrete slab design thickness at each end of affected beams and increase slab thickness at mid-span by amount of over deflection experienced.
5. Concrete on Metal Deck over Steel Framing System:
 - a. Grade for strike off shall be set at predetermined distance above top surface of steel floor members.
 - b. It is anticipated that occasional areas will be identified where actual deflection of steel beams during concreting operations differs from that anticipated by Engineer. At such locations, modify procedures by one or combination of following:
 - 1) Residual Camber after concrete placement: Modify fabricated camber in shop where possible for subsequent member placements having same conditions. Where this is not possible, maintain initial thickness at mid-span and increase slab thickness at each end of beam by 1/2 of amount of residual camber. In case of beam with 1/2 in (12 mm) of residual camber, slab thickness at ends of this beam only might be increased by 1/4 in (6 mm).
 - 2) Over-Deflection of Beam during concrete placement: Modify fabricated camber where possible for subsequent member placements having same conditions. Where this is not possible, two options are suggested:
 - a) Option 1: Attach loose shore to underside of this beam only at midspan. Leave initial gap below shore equal to beam camber. As beam deflects during concrete placement, shore will halt deflection at desired point.
 - b) Option 2: Maintain initial concrete slab thickness at each end of this beam only, and increase slab thickness at mid-span by amount of over deflection experienced.
 - c. Provide bench mark on each column for use by finishers as guide when they are completing finishing in these areas. It is suggested that mark be placed at predetermined distance above design grade for use by finishers in the removal of excess material as needed.

C. Scratch Finish:

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1. Procedure: After placing concrete, finish surface to tolerances of specified overall value of F(F) 15 (floor flatness) and F(L) 13 (floor levelness) when measured according to ASTM E 1155, with minimum local value of F(F) 13 and F(L) 10.
 - a. Slope surfaces uniformly to drains where required.
 - b. While still plastic, texture concrete surface that has been screeded and bull-floated or darbied with stiff brushes, brooms, or rakes to produce surface profile amplitude of 1/4 in (6 mm) in one direction.
 - c. Re-straightening of surface with modified highway straightedge may follow screeding or bull-floating as necessary to maintain flatness/levelness.
 - d. No troweling permitted.
2. Locations to receive Scratch Finish:
 - a. Surfaces to receive bonded concrete floor topping and other bonded cementitious finish flooring material excluding thin-set tile.
 - b. Drive ramps.

D. Float Finish:

1. Procedures:
 - a. After concrete has been placed, consolidated, screeded, and restraightened, concrete shall not be worked further until ready for floating. Begin floating operations when water sheen has disappeared, and/or when mix has stiffened sufficiently to permit proper operation of float.
 - b. Floating with power machine equipped with normal trowel blades is not permitted.
 - c. Floating with power machine equipped with water attachment for wetting concrete surface during finishing is not permitted.
 - d. Consolidate surface with power-driven machine initially equipped with float-shoe blades. Hand float with wood or cork faced floats in locations inaccessible to power-driven machine. Restraighten surface with ten-foot highway straightedge applied at not less than two different angles approximately perpendicular.
 - e. Finish surfaces to following tolerances when measured according to ASTM E 1155.
 - 1) Specified Overall Values: F(F) 18 ; F(L) 15
 - 2) Minimum Local Values: F(F) 15 ; F(L) 10
 - f. Cut down high spots and fill low spots during this procedure to produce planes checking true under straightedge in any direction. Uniformly slope surfaces to drains.
 - g. Follow restraightening operation by final float pass with power machine equipped with "pizza type" metal pan clipped to float blades to uniform, smooth, granular texture.
 - h. Pre-plan floating operations sufficiently in advance to avoid over-finishing and incorporating additional water into surface.
2. Locations to receive Float Finish:
 - a. Surfaces to receive trowel finish.
 - b. Surfaces to be covered with fluid applied or sheet waterproofing.
 - c. Surfaces to be covered with built-up or membrane roofing.
 - d. Surfaces to receive mortar setting bed for tile flooring.
 - e. Surfaces composed of air-entrained concrete.

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E. Trowel Finish:

1. Procedures: Perform after applying float finish. Intent is to perform minimum troweling effort necessary to achieve satisfactory surfaces. Avoid over-troweling of surfaces and working of water into surfaces. Where bleedwater is present prior to troweling, excess water shall be dragged off or removed by absorption with porous material such as burlap. Incorporate steps to prevent "blistering". If blistering occurs during finishing or otherwise becomes evident after placement, re-evaluate and correct finishing operations immediately.
 - a. Perform first trowel finish operation with power-driven trowel, fitted with blades as flat to surface as possible and driven at slow speed, to produce smooth surface which is relatively free of defects but may still contain some trowel marks.
 - b. Additional trowelings with power-driven trowel or by hand troweling may be necessary, with waiting period between each successive troweling effort.
 - c. Perform final troweling with hand trowels after surface has hardened sufficiently to permit final consolidation of surface, free of trowel marks, and uniform in texture and appearance.
 - d. Avoid degree of troweling effort(s) resulting in surfaces which exhibit a sheen or glossy appearance.
 - e. Avoid trowel patterns at surfaces exposed to view. Resulting trowel patterns at exposed surfaces are subject to Architect's approval.
 - f. Finish surfaces to following F(F) and F(L) tolerances when measured according to ASTM E 1155:
 - 1) Floor levelness does not apply to slabs placed on unsupported form surfaces, such as slabs over unshored metal deck, and to inclined slabs.
 - 2) Slabs-on-Grade:
 - a) Specified Overall Value: F(F)-25/F(L)-20
 - b) Minimum Local Value: F(F)-17/F(L)-14
 - 3) Elevated Cast-in-Place Concrete Framing System:
 - a) Specified Overall Value: F(F)-25/F(L)-20
 - b) Minimum Local Value: F(F)-17/F(L)-14
 - 4) Elevated Concrete on Metal Deck and Steel Beam Framing System:
 - a) Specified Overall Value: F(F)-25
 - b) Minimum Local Value: F(F)-17
 - g. Repair defects of sufficient magnitude to telegraph through floor covering by grinding or by application of topping. Refer to Remedy for Out-of-Tolerance Floor Surfaces article below for additional remedial measures.
2. Locations to receive Trowel Finish:
 - a. Monolithic slab surfaces exposed to view in finished Work, unless noted otherwise.
 - b. Slab surfaces to be covered with resilient flooring, carpet, paint, or other thin film-finish coating system.

F. Partial Trowel and Fine-Broom Finish:

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1. Procedures: Apply a "partial trowel" finish. Start partial trowel finish with first trowel operation as described above. Perform second troweling with power trowel or by hand trowel, but only if considered necessary to remove trowel marks from initial trowel which may show through fine-broom finish, or, to achieve proper uniform surface texture ready to receive fine-brooming. Immediately after second troweling, and when concrete is still plastic, slightly scarify surface with a fine broom.
2. Locations for Partial Trowel and Fine-Broom Finish:
 - a. Surfaces to receive tile flooring installed with thin-set mortar or other adhesive.
 - b. Surfaces to receive traffic bearing membrane/coating.
3. Confirmation: Consult with floor finish supplier and installer to confirm suitability of partial trowel and fine-broom finish specified. Where supplier or installer anticipates or otherwise recommends other surface preparation techniques for product application, (such as sand, bead, or shot blasting), waiver for partial trowel and fine-broom finish requirement may be considered by Architect. Submit written description of proposed surface finishing technique for Architect's review prior to Work. Written description shall include statements from supplier and installer.

G. Broom Finish:

1. Procedures: Immediately after float finishing, slightly roughen concrete surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.
2. Locations for Broom Finish:
 - a. Exterior concrete platforms and steps.
 - b. Parking garage floors and ramps.
 - c. Where indicated on drawings.

3.7 FLOOR AND SLAB TREATMENTS

A. Aggregate Finish:

1. Procedures: Before final floating, apply slip-resistive aggregate finish where indicated. Apply according to manufacturer's written instructions and as follows:
2. Uniformly spread 25 lb/100 sq. ft. (12 kg/10 sq. m) of slip-resistive aggregate over surface in 1 or 2 applications. Tamp aggregate flush with surface, but do not force below surface.
3. After broadcasting and tamping, apply float finish.
4. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive aggregate.
5. Locations:
 - a. Where indicated on drawings.

B. Dry Shake Floor Hardener Finish:

1. Procedures:
 - a. Uniformly apply dry shake materials at rate of 100 lb per 100 sq. ft., unless greater amount is recommended by material manufacturer's trained technical representative.

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- b. Cast trial slab, not less than 100 sq. ft. in area and approximately square, to determine actual application rate, color, and finish, as acceptable to Architect. Use same concrete mix, finishing, and curing planned for project areas to receive dry shake floor finish.
 - c. Immediately following first floating operation, uniformly distribute by hand or with mechanical spreader approximately two-thirds of dry shake material over concrete surface, and embed by power floating.
 - d. Follow floating operation with second shake application, uniformly distributing remainder of dry shake material with overlapping applications to ensure uniform color, and embed by power floating.
 - e. After broadcasting and floating, apply trowel finish as specified. Cure slab surface with procedure compatible with dry-shake hardener and as recommended by material manufacturer's trained technical representative. Apply curing compound immediately after final finishing.
2. Locations:
- a. Truck dock slab surface.
- C. Penetrating Liquid Floor Hardener and Sealer (Sealed Concrete): Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions including preparation, application, precautions, limitations, and compatibility with other surface conditions.
- 1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
 - 2. Do not apply to concrete that is less than seven days old unless recommended by manufacturer in written literature describing application procedure, but only with prior approval of Architect.
 - 3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.
 - 4. Locations:
 - a. Where indicated on room finish schedule or on drawings, including exposed concrete floors noted or scheduled as having "sealed concrete" or similar wording.

3.8 WATERPROOFING FOR CONCRETE TOPPINGS AT ELEVATED KITCHENS

- A. Installation Quality Standard: Manufacturer's written instructions to produce waterproof membrane of uniform thickness and bonded securely to substrate.
- B. General Requirements:
 - 1. If required by manufacturer, prime concrete substrate.
 - 2. Install to produce a continuous waterproof membrane of uniform thickness bonded securely to substrate, without wrinkles, bubbles, buckles or kinks.
 - 3. Overlap sheets and seal seams.
 - 4. Turn membrane up wall.
 - 5. Roll installed sheet if required by manufacturer.
 - 6. Cast concrete topping after waterproofing has cured and been tested determined it is watertight.

3.9 CONCRETE CURING

- A. General: Refer to Division 3 Sections Cast-in-Place Concrete or Concrete Curing for curing and other concrete requirements.
- B. Curing Unformed Surfaces - Interior Concrete Floors Scheduled to Receive Additional Floor Finishes. Do not use curing compounds on concrete surfaces that are to receive the following finishes:
 - 1. Floors to Receive Penetrating Liquid Floor Treatments.
 - a. Including but not limited to hardeners, sealers, densifiers and water repellents.
 - 2. Floors to Receive Polished Finish.
 - 3. Floors to Receive Chemical Stain.
 - 4. Floors to Receive Resinous Flooring.
 - 5. Floors to Receive Adhered Floor Finishes.
 - a. Including but not limited to cementitious toppings and overlays, waterproofing and other membranes, tiling and underlayments, direct glue wood flooring, resilient flooring, terrazzo, resinous flooring, adhesive applied carpet, resilient flooring, paint and other coatings, epoxy overlays and other adhered floor covering systems.
- C. Incorrect Use and Removal of Curing Compounds: If curing compounds are used on surfaces, exterior or interior, formed or unformed, that are scheduled or specified to receive surface-adhered finishes or treatments, then mechanically (bead blast) or chemically remove curing compound completely. Confirm required surface finish with flooring manufacturers and installers
 - 1. Removal: After curing period has elapsed, but not later than 7 days after end of curing period, remove curing compound using method recommended by curing compound manufacturer without damaging or otherwise creating an unsuitable concrete surfaces to receive flooring systems. Removal of curing compounds shall be provided at Contractor's expense.
 - a. Acid etching is not permitted.
 - 2. Allow additional time after curing compound removal for concrete surfaces to reach required concrete moisture and water vapor limitations required for successful application of subsequent floor finishes and treatments.
 - 3. Dry-Shake Hardener: Consult with hardener manufacturer to confirm curing compound product and application method on surfaces where dry-shake hardener has been applied.
- D. Control of Water after Curing: Continuously monitor and control water, including but not limited to rain, ice or snow, on surfaces after curing period. Rewetting surfaces affects the drying period for hardened concrete and directly affects installation of finish materials applied with adhesives sensitive to moisture or water vapor. Contractor is responsible for controlling water and the resulting effects on concrete and material(s) to be applied to hardened concrete.

3.10 FLOOR SURFACE TOLERANCES

- A. Specified Overall Value(s) and Minimum Local Value(s) herein represent minimum floor flatness/levelness criteria for project.

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1. Where normal data collection under provisions of ASTM E 1155 indicate possibility of work below these values, additional data collection may be required to confirm extent, or boundary, of defective work at Contractor's expense.
2. When areas are identified as not meeting specified Minimum Local Value(s), such areas are deemed as out-of-tolerance floor surfaces and shall be replaced or repaired in accordance with "Remedy for Out-of-Tolerance Floor Surfaces" below.

B. Floor Elevation Tolerances: These tolerances supersede ACI requirements.

1. Permissible Vertical Envelope: When tested in accordance with requirements of ASTM E 1155, following percentages of elevation samples on floor slabs at single elevation shall fall within level 3/4 in (19 mm) envelope centered about mean elevation of readings.
 - a. Slabs-on-Grade: 85 percent.
 - b. Shored Elevated Slabs (Before Removal of Shores): 80 percent.
 - c. Elevated Slabs on Metal Deck and Steel Framing: 75 percent.
2. Permissible Arithmetic Mean Deviation of Floor Samples: Arithmetic mean of these elevation samples shall not deviate from design grade more than following amounts:
 - a. Slabs-on-Grade: 3/8 in (10 mm), plus or minus.
 - b. Shored Elevated Slabs (Before Removal of Shores): 1/2 in. (13 mm), plus or minus.
 - c. Elevated Slabs on Metal Deck and Steel Framing: 3/4 in. (19mm), plus or minus

C. Contractor shall take immediate action to correct work that does not meet specified tolerances.

3.11 REMEDY FOR OUT-OF-TOLERANCE FLOOR SURFACES

A. General:

1. Remedial work, testing, retesting, and consulting services necessary to correct out-of-tolerance floor surfaces shall be at Contractor's expense with no extension to construction schedule.
2. Repair and/or replacement procedures, limits, and products shall be in manner that does not diminish desired appearance or serviceability of structure, and acceptable to Architect/Engineer and Owner. Contractor shall submit detailed work plan for areas where remedial measures are necessary, prior to work, and in accordance with Contractor's submittal "Work Plan for Out of Tolerance Floor Surfaces".

B. Remedial Measures:

1. Minimum local areas measuring below specified minimum local value(s) shall be repaired by grinding or by application of topping or underlayment to entire surface of minimum local area, and retested, unless following conditions occur:
 - a. Such area is acceptable to Architect/Engineer and Owner, and written acceptance is provided.
 - b. Repair of such area would diminish desired appearance and/or serviceability of structure, or is in general considered unacceptable to Architect/Engineer and Owner for other reasons, in which case minimum local area(s) shall be replaced and retested.
2. Application of topping or underlayment:

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- a. Prime floor surface as recommended by topping or underlayment manufacturer.
- b. Add aggregate for thicker areas as recommended by topping or underlayment manufacturer.
- c. Install in accordance with manufacturer's directions.
- d. For interior areas which are to have finish flooring, use self-leveling concrete underlayment.
- e. For areas which will be exposed as wearing surface, use self-leveling concrete topping.

3.12 CONCRETE SURFACE REPAIRS

A. General:

1. Locate surface defects where repair is required by visual inspection of formed and unformed surfaces. Mark location in manner that does not cause further defect. Record and maintain record of such defects for Repair Records Submittal.
2. Remove and replace concrete with surface defects if defects cannot be repaired to satisfaction of Architect/Engineer or Owner.
3. Concrete removal shall be with equipment and procedures which will prevent cracking, micro-cracking, and bruising of sound concrete to remain. Follow initial concrete removal process with sandblasting to remove any remaining deleterious effects.
4. Repairs shall be performed by trained installer, experienced with type repair and repair products required.
5. Avoid cutting reinforcement during repairs, but, where reinforcement is encountered, remove concrete so as to expose reinforcement within repair area for 1 in (25 mm) minimum on all sides.
6. Protect freshly applied repair mortars from exposure to direct sunlight, wind, rain, and frost.
7. Repair procedures outlined below are general in nature and not intended as complete repair preparation or installation instructions. Intent is to provide minimum basic repair criteria allowing for flexibility of means/methods based on experience of trained installers.

B. Surface Defects: Repair and patch surface defects which become evident during construction and warranty periods, when such conditions are exposed to view, or when durability, serviceability, and/or structural integrity of structure is affected by defect. Surface defects requiring attention include, but are not limited to, following.

1. Honeycombs, rock pockets, and voids over 1/4 in (6 mm) in any dimension.
2. Holes left by tie rods, bolts, or other.
3. Exposed reinforcing.
4. Cracks 0.02 in (0.50 mm) wide or wider at interior exposed or non-exposed conditions.
5. Cracks in excess of 0.01 in (0.25 mm) wide at exterior exposed conditions and/or where water tightness is critical as determined by Architect/Engineer.
6. Cracks which penetrate completely through member, regardless of width.
7. Spalls which affect durability, structural integrity, or finish appearance at surfaces exposed to view.
8. Surface crazing which affects durability, structural integrity, or finish appearance at surfaces exposed to view.
9. Stains, discolorations, and texture irregularities at surfaces exposed to view which cannot be corrected by cleaning or rubbing processes.
10. High or low irregularities in unformed surfaces other than as specified for Out-of-Tolerance Floor Surfaces.

C. Repairing Formed Surfaces:

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1. After form removal, cut out honeycombs, rock pockets, and voids more than 1/2 in (12 mm) in any dimension in solid concrete.
 - a. Mark perimeter of area to be removed with straight-line segments forming rectangular or square repair area on formed surface. Intent is for repair area edges to be linear and repair area shape to be parallelogram.
 - b. Saw cut perimeter of repair area to pre-determined repair depth, but not less than 1/2 in (12 mm). Make edges of cuts perpendicular to concrete surface.
 - c. Remove concrete within repair area by appropriate method to obtain exposed aggregate surface with minimum surface profile of 1/8 in (3 mm).
 - d. Clean substrate of dust, dirt, loose concrete, or other bond inhibiting material.
 - e. Dampen prepared substrate with water to saturated surface dry condition, and brush-coat surface with bonding agent. Pre-dampening may be omitted if not required by repair mortar manufacturer.
 - f. Fill and compact with repair mortar before bonding agent has available exceeded pot life.
 - g. Finish repair surface to match plane and texture of adjacent concrete.
 - h. Cure repair surface by moisture retaining cover for minimum period of 72 hours, but not less than period recommended by repair mortar manufacturer.
 2. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 3. Repair defects on surfaces exposed to view with patching mortar consisting of blend of white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color.
 - a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
 - b. Prepare substrate to receive patching mortar same as described above, except, repair depth not less than 1 in (25 mm).
 - c. Compact mortar in place and strike off slightly higher than surrounding surface.
 - d. Cure repair surface with moisture retaining cover for 7 days minimum.
 4. Repair cracks exceeding limitations noted above by high or low pressure epoxy injection procedure acceptable to Architect/Engineer. Gravity flow techniques for epoxy resin repair of cracks not permitted.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
1. After concrete has cured at least 14 days, correct high areas by removal with mechanical equipment and procedures which will not cause cracking, micro-cracking, or bruising of sound concrete.
 2. Correct localized non-exposed low areas by cutting out low areas to minimum depth of 1/2 in (12 mm) and 1/8 in (3 mm) surface profile. Apply bonding agent and replace with repair mortar. Finish repaired areas to blend into adjacent concrete.
 3. Correct low interior areas scheduled to receive floor coverings with self-leveling concrete underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.

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4. Correct low interior areas scheduled to remain exposed with self-leveling concrete topping. Cut out low areas to ensure a minimum repair topping depth of 1/2 in (12 mm) to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
5. Correct low exterior areas to remain exposed with overlay or repair mortar suitable for application. Cut out defective areas to ensure minimum repair mortar depth of 1/2 in (12 mm) and 1/8 in (3 mm) surface profile. Prepare, mix, apply, and cure repair mortar and primer according to manufacturer's written instructions
6. Repair defective areas which cannot be satisfactorily repaired, by cutting out defective area in its entirety and replacing with fresh concrete. Remove defective areas with clean, square cuts. Preserve and expose steel reinforcement with at least 1 in (25 mm) clearance all around. Dampen concrete surfaces in contact with fresh concrete and apply bonding agent. Mix fresh concrete of same materials and mix as original concrete unless smaller coarse aggregate necessary for application. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair single holes 1 in (25 mm) or less in diameter with patching mortar. Cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
8. Repair cracks exceeding limitations noted above by high or low pressure epoxy injection procedure acceptable to Architect/Engineer. Gravity flow techniques for epoxy resin repair of cracks not permitted.

E. Structural Repairs:

1. Definition: Defects described above at structural load-bearing members where structural integrity of structure is jeopardized or of concern to Engineer.
2. Procedures:
 - a. Defects requiring structural repair shall be determined by Engineer.
 - b. Perform structural repairs with prior approval of Engineer for method and procedure using specified bonding compound and/or repair materials.

F. Repair methods not specified above may be considered, subject to approval of Architect/Engineer prior to work.

3.13 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install joint filler full depth in saw-cut joints and in tooled joints. Overfill joint and trim joint filler flush with top of joint after hardening.

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PART 4 - QUALITY CONTROL

4.1 INSPECTION STANDARDS

- A. Quality control, testing, and inspections shall meet the special inspection requirements of the building code and any local or state provisions.

4.2 TESTING AGENCY

- A. Owner will employ and pay a qualified independent testing agency to perform the quality control indicated in this section, including special inspections required by the building code.
- B. Floor Flatness Inspector to perform floor surface profile measurements shall be certified by manufacturer of floor profile measurement apparatus.
- C. Flatness and Levelness Inspection and Reporting for Floor Slabs:
 - 1. Determine flatness and levelness of interior floor slabs designated to receive troweled finish. Data shall be collected in manner consistent with requirements of ASTM E 1155 and using Type II Apparatus.
 - 2. Coordinate with Contractor to establish measurement program and desired lines for data collection, in accordance with requirements of ASTM E 1155.
 - 3. Mark clearly on floor surface beginning point and ending point of each line of data collection.
 - 4. Those lines of data which will be used to study time-dependent behavior of floor will be collected along chalk line which has been established by Inspector. Each chalk line is to be protected in manner which will allow subsequent data to be collected at same locations.
 - 5. Measurements shall be made within 24 hours after completion of concrete finishing operations.
 - 6. Immediately following data collection, Inspector will process data. Contractor will provide Inspector with actual elevation of "Start" and "End" points for each data line marked by Inspector.
 - 7. Within 48 hours of data collection, Inspector will provide Contractor with written report stating results of floor profile measurements and surface analysis for each slab placement. Report(s) shall include following:
 - a. Key plan showing location of data collected.
 - b. Results required by ASTM E 1155.
 - c. Running tabulation of composite FF and FL values for surfaces installed to date.
 - d. Calculated percentage of elevation samples falling within level 3/4 in (19 mm) envelope, centered about mean elevation of samples taken to date at subject floor level(s).
 - e. Comments on possible cause of floor surface deviations noted during analysis of data.
 - f. Recommendations for adjustments in future construction based on analysis of data.

4.3 CONTRACTOR

- A. Owner's employment of a qualified independent testing agency to perform the testing/inspection services shall not operate to relieve Contractor of responsibility to furnish materials and workmanship in accordance with Contract Documents.

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- B. Owner's employment of a qualified independent testing agency to perform the testing/inspection services is for verification and does not prevent Contractor from providing supplemental testing/inspection at Contractor's discretion and expense.
- C. Qualifications of Contractor's Testing/Inspection Personnel: Contractor's personnel performing testing/inspection services are subject to same qualifications as Owner's Testing Agency.
- D. Re-testing of conditions failing to meet specified requirements shall be provided at Contractor's expense.
 - 1. In the event of differences between Owner's testing agency and Contractor's inspector regarding conformance, such differences shall be brought to the attention of the Architect, Engineer of Record and enforcement agency as part of the resolution.
 - 2. Where there is no resolution of differences, joint supplemental testing between Owner's testing agency and Contractor's inspector may be required and provided at Contractor's expense.
 - 3. Additional fees for Architect and Engineer of Record participation in resolution of non-conforming work may be required and provided at Contractor's expense.
- E. Manufacturer's Field Service: Manufacturer's qualified technical representative shall periodically inspect Work to ensure installation is proceeding in accordance with manufacturer's designs, recommendations, instructions, and warranty requirements. Representative shall submit written reports of each visit indicating observations, findings, and conclusions of inspection.
 - 1. Manufacturer's Technical Representative Qualifications: Direct employee of technical services department of manufacturer with experience in providing recommendations, observations, evaluations, and problem diagnostics.
 - a. Concrete underlayments, self-leveling concrete toppings, and overlay/repair mortars
 - b. Crack repair/injection.

END OF SECTION

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SECTION 034100

PLANT-PRECAST STRUCTURAL CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. Perform Work required to complete the plant-precast structural concrete indicated by the Contract Documents and furnish supplementary items necessary for its proper installation.

1.2 QUALITY ASSURANCE

- A. Codes and Standards: Comply with the provisions of the following codes, Specifications and Standards, except as otherwise shown or specified.
 - 1. ACI 301, "Specifications for Structural Concrete for Buildings."
 - 2. ACI 318, "Building Code Requirements for Reinforced Concrete."
 - 3. ACI 304, "Recommended Practice for Measuring, Mixing, Transporting and Placing Cement."
 - 4. ACI 311, "Recommended Practice for Concrete Inspection."
- B. Where provisions of the above Codes and Standards are in conflict with the building code in force for this project, the building code shall govern.

1.3 FABRICATOR QUALIFICATIONS

- A. Only a firm which has had a minimum of 5 years successful experience in fabrication of precast concrete units similar to the units required for this project will be acceptable. Fabricator must have sufficient production capacity to produce the required units without causing delay in the work. Fabricator must be approved by the Architect.
- B. Fabricator must be an active member of the Prestressed Concrete Institute (PCI) and participate in its Plant Certification Program.
- C. Comply with PCI MNL-116 "Manual for Quality Control" for Plants and Production of Precast Prestressed Concrete Products except as herein otherwise specified.
- D. Fabrication tolerances: Fabricate units complying with dimensional tolerances specified in PCI MNL-116, unless noted otherwise.

1.4 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Shop Drawings:
 - 1. Submit shop drawings showing complete information for the fabrication and installation of precast concrete units. Indicate member dimensions and cross-section; location, size and type of reinforcement, including special reinforcement and lifting devices necessary for handling and erection.

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2. Submit complete design calculations bearing the seal of a registered engineer for review. Calculations shall include complete stress histories for flexure, shear, torsion, and bearing; camber and deflection; erection stresses; and other information required to verify conformance with governing codes.
3. Show layout, dimensions, and identification of each precast unit corresponding to the sequence and procedure of installation. Indicate welded connections by AWS standard symbols. Detail inserts, connections, and joints, including accessories and construction at openings in precast units.
4. Show location and details of anchorage devices that are to be embedded in other construction.
5. Submit two (2) copies each to the contractor and architect of each and every precast concrete test report.

1.5 DESIGN

- A. Fabricator shall design precast units to withstand lateral pressures, loads, and shipping and erection stresses to conform to Drawings and applicable codes of governing authorities. Submit design notes as indicated on Drawings.
- B. Design precast members to have a minimum compressive strength of the concrete as shown on the Drawings.
- C. Design modifications may be made only as necessary to meet field conditions and to insure proper fitting of work, and only as acceptable to the Architect. Maintain general design concept shown without increasing or decreasing size of members or altering profiles and alignment shown.

1.6 Storm Shelter Requirements

- A. Special Storm Shelter Requirements:
 1. Documents prepared for ICC-500 compliant storm shelters shall meet the requirements of the ICC-500 code. This includes all envelope design requirements, missile impact requirements, baffling for penetrations, impact/laydown requirements, fire resistance rating, joints/gaps/voids in envelope, wind speed requirements, and all other applicable codified requirements set forth in the ICC-500.
 2. Modifying and updating design/fabrication drawings based on responses to third party engineer's peer review are required to address all third party engineer critiques of the documents pertaining to precast scope.
 3. Precast drawings shall indicate requirements of the "Design Information" as stipulated by ICC Section 106 and a "Quality Assurance Plan" as stipulated by ICC-500 section 107.
- B. Reference 03500 – Architectural Precast Concrete for additional information.

1.7 PRODUCT DELIVERY AND HANDLING

- A. Deliver precast concrete units to project site in such quantities and at such times as will assure continuity of installation. Carefully pack precast units for transportation to destination with exercise of reasonable and customary precautions against damage in transit to panels or inserts. Provide adequate protection from damage to arises and from contact with anything which would result in accumulation of dirt, dust, soot, mud, grease, or other staining or disfiguring elements.

1.8 PREPARATION FOR OTHER TRADES

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- A. Do any cutting, notching, forming and drilling of precast items required for the installation of the work of other trades, as shown on approved shop drawings. Provide lifting inserts for lifting and erection of members.
- B. Fully coordinate all penetrations in precast walls with other trades.

1.9 MOCK-UP

- A. Provide one (1) 4'-0" x 4'-0" full size unit "Mock-Up" sample cast from the approved design mixes. This sample beam shall be used to establish the desired abrasive blast finish to be used. Locate mock-ups where directed by Architect.
- B. Sample panels shall be prepared subsequent to approval of concrete design mix and after Architect has approved abrasive blast texture to be used, sample panels shall be protected and retained on the site for the duration of the project.
- C. If initial mock-ups prove unsatisfactory, construct additional mock-ups as necessary until approved by Architect. Promptly remove rejected mock-up from site.
- D. Maintain approved mock-ups in place until removal is directed by Architect. When directed by Architect, completely dismantle mock-up and remove from Site.
- E. Various size abrasives shall be tried on mock-ups to determine the best abrasive to use for finish desired.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Portland Cement: ASTM C 150, Type I or III regular gray Portland Cement. Cement manufacturer shall warrant in writing that the color variation in the cement shall not exceed a total color deviation $E = 1.7$ from the manufacturer's standard, when measured by the Hunterlab Color and Color Difference Meter, Model D-25.
- B. Coarse Aggregates: ASTM C 33. Quality gradation and color of aggregate must be consistent. Samples and analysis of aggregate shall be approved by Architect.
- C. Fine Aggregate: ASTM C 33, Equal to manufactured stone sand.
- D. Concrete Admixtures: Cement-dispersing water-reducing types that follow water-cement ratio law. ASTM C 494, Type A or D, use strictly in accordance with manufacturer's recommendations and as determined by testing laboratory. Use an admixture that will not discolor concrete or in any way affect appearance of concrete. Do not use calcium chloride. Admixtures must be approved by Architect.
- E. Water: Clean, fresh and free from oil and various amounts of vegetable matter, alkalies or other impurities.
- F. Reinforcement and Anchoring Materials:
 - 1. Anchors, Angles and Accessories: Sizes and types indicated, and as required to meet design conditions.

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2. Bolts and Nuts: ASTM A 307, low-carbon steel bolts, regular hexagon nuts and carbon steel washers, unless otherwise noted.
 3. Steel Shapes: ASTM A 36.
 4. Prestressing Tendons: Uncoated seven-wire stress relieved or low relaxation strand, ASTM A 416, Grade 270.
 5. Welding Rods: American Welding Society AWS D1.1 Series electrodes of suitable operating characteristics.
- G. Forms: Provide precast plant steel forms of dimensions shown.
- H. Structural Steel Attachments:
1. Items totally embedded in concrete need not have an applied finish, but shall be clean and free of rust.
 2. Items exposed in areas of the building which are not exposed to weathering, shall have exposed surfaces painted with shop coat gray primers.
 3. Items exposed to weathering or corrosive atmosphere, or where otherwise indicated, shall be hot dip galvanized per ASTM A 123.
- I. Bar Supports: Plastic chairs of the color of the concrete.
- J. Grout: Master Builders, Inc. "EMBEKO 636" or Cormix, "Supreme Grout". Mix in accordance with manufacturer's recommendation. Compressive strength of grout shall be not less than 5000 psi at 7 days and 7500 psi at 28 days.
- K. Neoprene Bearing Pads: Section 25 of Standard Specification for Highway Bridges (60 durometer).
- L. Curing Compound: ASTM C 309 clear acrylic curing/sealing compound.

PART 3 - EXECUTION

3.1 FORMS

- A. Unless forms for plant manufactured prestressed concrete units are stripped prior to detensioning, design forms so that stresses are not induced in precast units due to deformation of concrete under prestress.
- B. Rustications and Corner Strips: Nonabsorbent material designed to be compatible with the form surface. Apply rustications so as to prohibit the loss of paste or water between the two surfaces.
- C. Form design shall allow easy removal. Prying against concrete will not be allowed. Thoroughly clean and recondition forms prior to re-use.
- D. Accurately locate required setting anchorage devices, etc., as shown on approved shop drawings, and as required for proper and adequate attachment to supporting structure. Anchorages should be so designed to preclude the necessity for force of any kind during installation and to allow requisite adjustment to line, level and position.

3.2 PLACING REINFORCING

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- A. Comply with the specified codes and standards, and Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports, and as herein specified.
- B. Design reinforcement for lateral pressures that will be imposed upon elements due to the weight of the cast-in-place concrete and for handling, lifting, stripping and erection conditions which require additional reinforcement and/or inserts, shall be the responsibility of the Contractor.
- C. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials which reduce or destroy bond with concrete.
- D. Accurately position, support and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by plastic chairs, runners, bolsters, and spacers as required.
- E. Reinforcing Bars to be Welded: Bars shall have a carbon content not exceeding 0.30 per cent and a manganese content not exceeding 0.60 percent. Reinforcing steel to be welded shall be domestic steel conforming to ASTM A 706, unless otherwise noted. Provide certified copies of the ladle analysis for each lot of bars to be welded. Bars that are to be welded shall be clearly identified with the heat from which they are rolled. Welding shall not be permitted on bars without such identification.
- F. Welding of Bars: Welding of steel bars shall comply with requirements of AWS D12.1. Welding: done by AWS certified welders.
- G. Pretensioning of tendons for prestressed concrete may be accomplished either by the single strand tensioning method or by the multiple-strand tensioning method.
- H. Delay detensioning of prestressed units until the concrete has attained at least 75 per cent of the design ultimate compressive strength as established by test cylinders.

3.3 PREPARATION OF FORM SURFACES

- A. Coat steel forms with a nonstaining, rust-preventative form oil or otherwise protect against rusting. Rust-stained steel formwork is not acceptable.

3.4 CONCRETE PLACEMENT

- A. General: Comply with ACI 304, and as herein specified.
- B. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within the section. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practical to its final location to avoid segregation due to rehandling or flowing.
- C. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping. Use vibrators designed to operate with vibratory element submerged in concrete, maintaining a speed of not less than 7000 vibrations per minute.

3.5 CURING METHODS

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- A. Perform curing of concrete by moist curing, by moisture-retaining cover curing, by membrane curing, or by combinations thereof, as herein specified.
 - 1. Provide moisture curing by the following methods:
 - a. Keep concrete surface continuously wet by covering with water.
 - b. Continuous water-fog spray.
 - c. Covering concrete surface with an absorptive cover, thoroughly saturating cover with water and keeping continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4" lap over adjacent absorptive covers.
 - d. Curing by low-pressure steam, by steam vapor, by radiant heat and moisture, or other similar process may be employed to accelerate concrete hardening and to reduce the curing time.

3.6 FINISHED SURFACES

- A. Precast Beams and Column Units: Formed surfaces shall be produced in forms that impart a smooth finish to the concrete (e.g., plastic-lined or metal). Small surface holes caused by air bubbles, and normal form joint marks, will be tolerated, but no major or unsightly imperfections, honeycomb, or structural defects will be permitted.
- B. Sandblast Finish: Portions of precast elements to be sandblasted shall match sample prepared by the Contractor and approved by the Architect.
- C. Exposed Aggregate Finish:
 - 1. Placing Aggregate: Place the finish aggregate material on the bottom of the form on top of a screeded layer of sand. Stones shall be tightly set together using smaller aggregate as may be required to fill voids between the larger stones. Bed to one-half their diameter. It is intended to have little or no cement showing on the outside face.
 - 2. Pouring: The concrete panels shall be poured on top of the finished aggregate to the thickness shown in the drawings and finished to yield a light uniform sand finish.
 - 3. Cleaning: Clean panels with water and brushes immediately after panel is raised to remove sand and dirt. Use water hose nozzle velocity as required.
 - 4. Pieces of exposed aggregate that become loose or fall out during the lifting and/or cleaning operation shall be replaced with an approved epoxy in a workmanlike manner. The epoxy material shall be used in accordance with the manufacturer's recommendations.
- D. Patching: Areas which have been patched must be indistinguishable from surrounding areas.

3.7 DIMENSIONAL TOLERANCES

- A. Members shall be straight and true. Bowed or deformed members will not be accepted. The following tolerances shall not be exceeded:
 - 1. Length for units - plus or minus 3/8".
 - 2. Width (overall) for units - plus or minus 1/4".
 - 3. Depth for units - plus or minus 1/4".
 - 4. Position of blockouts and inserts - plus or minus 3/8".
 - 5. Horizontal deviation from straight line - 1/8" in 10', total not to exceed 3/8".
 - 6. Twist - end to end 1/4 degree.

3.8 COLD WEATHER PLACING

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- A. Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306 and as herein specified.
- B. When air temperature has fallen to or is expected to fall below 40 Deg. F., uniformly heat water and aggregates before mixing as required to obtain a concrete mixture temperature of not less than 50 Deg. F., and not more than 80 deg. F. at point of placement.

3.9 HOT WEATHER PLACING

- A. When hot weather conditions exist that would seriously impair the quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.
- B. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 deg. F. Mixing water may be chilled, or chopped ice may be used to control the concrete temperature provided the water equivalent of the ice is calculated to the total amount of mixing water.
- C. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that the steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.

3.10 PATCHING

- A. Before commencing any patching, Contractor shall confirm patching procedures with Architect and establish by trial mix the formula for patching of finish.

3.11 SETTING GROUT

- A. Grout shall be mixed only in such quantities as are needed for immediate use. No retempering shall be permitted and materials which have been mixed for a period exceeding thirty (30) minutes shall in no case be used upon any portion of the work.

3.12 PROTECTION

- A. Take proper precautions to protect the work of other trades over which or against which precast concrete work occurs.

3.13 DAMAGED MATERIAL

- A. Any cracked or broken items shall not be set but shall be replaced with satisfactory work. Patching of minor defects, by skilled mechanics, will be permitted, but hiding of large defects or those which affect the appearance of the items will not be permitted.

3.14 HANDLING AND ERECTION

- A. Prior to commencement of erection operations, check relevant job site conditions insofar as they affect the future installation of precast elements. Any discrepancies or variations or other conditions that may prevent the satisfactory and proper execution of erection operations will be duly noted and corrective action taken prior to the execution of the erection operations.
- B. Elements shall be erected by competent tradesmen and accurately set in the positions assigned to them on the approval installation and/or erection drawings, and securely anchored in final position. Joints shall be treated in conformity with detail Drawings.

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- C. Erection procedures shall be determined by the Contractor and shall represent the most economical procedures, methods and sequences possible and consistent with Drawings and Specifications.
- D. Precast units shall be adequately braced and supported during erection to insure proper alignment and safety and such bracing or support shall be maintained until there are adequate permanent connections.
- E. Units shall be erected with particular care both with regard to damage to the exposed exterior surface of the members, including previously erected units, and with regard to their tolerances in respect to line, plane, and elevation of adjacent units.
- F. The bases of precast concrete columns shall be grouted in accordance with the manufacturer's recommendations immediately after connecting members are set, plumb, shimmed and aligned.

END OF SECTION

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SECTION 034500
ARCHITECTURAL PRECAST CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Plant precast reinforced architectural concrete units and supplementary items necessary for installation.
 - 1. Architectural precast concrete cladding units.
 - 2. Insulated, architectural precast concrete units.
 - 3. Masonry-faced, architectural precast concrete units.
 - 4. Stone-faced, architectural precast concrete units.
- B. Related Requirements:
 - 1. Refer to Division 01 Section Field Test for Air and Water Leakage.

1.2 DEFINITIONS

- A. Design Reference Sample: Sample of approved architectural precast concrete color, finish and texture, approved by Architect.

1.3 DELEGATED ENGINEERING REQUIREMENTS

- A. Delegated Engineering Responsibility: Contractor shall engage a qualified professional engineer to provide engineering for products and systems required to comply with the design intent of Contract Documents.
 - 1. Contract Documents Design Intent: Drawings and Specifications indicate design intent for products and systems and do not necessarily indicate or specify total Work required. Contract Documents shall not be construed as an engineered design; furnish and install Work required for a complete installation.
 - 2. Delegated Engineer Professional Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated with a record of successful in-service performance. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.
 - 3. Submittals: Preparation of structural analysis data including engineering calculations, shop drawings and other submittals signed and sealed by the qualified professional engineer.
 - 4. Coordination of Work:
 - a. Product Variations: In the event of minor differences between products and systems of acceptable or available manufacturers, Contractor shall notify Architect of such differences and resolve conflicts in a timely manner. Failure of Contractor to provide notification shall be construed as acceptance of conditions indicated, and changes caused by minor differences between products and Contract Documents shall be included in the Work at no additional cost to Owner.
 - b. Allowable Adjustments: Minor dimension and profile adjustments may be made in interest of fabrication or erection methods or techniques or ability to satisfy design intent, provided design intent is maintained as determined by Architect. Proposed deviations shall include a detailed analysis of impact to adjacent substrates or other building systems, including related design or construction cost impacts. If accepted by Architect, deviations causing changes in materials, constructability,

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substrates, or conditions shall be included in the Work at no additional cost to Owner.

1.4 ACTION SUBMITTALS

- A. Product Data: Manufacturer/fabricator's technical literature for each product and system indicated.
 - 1. Include manufacturer/fabricator's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
- B. Design Mixtures: Manufacturer/fabricator's detailed ingredients list for each concrete mixture. Include compressive strength and water-absorption tests.
- C. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components and attachments to other work. Distinguish between shop and field-assembled work. Indicate details at building corners.
 - 1. Indicate separate face and backup mixture locations and thicknesses.
 - 2. Indicate welded connections by AWS standard symbols. Detail loose and cast-in hardware and connections.
 - 3. Indicate locations, tolerances, and details of anchorage devices to be embedded in or attached to structure or other construction.
 - 4. Indicate locations, extent, and treatment of dry joints if two-stage casting is proposed.
 - 5. Indicate relationship of units to adjacent materials.
 - 6. Indicate joints, reveals, and extent and location of each surface finish.
 - 7. Thin Masonry Facing Units: Indicate locations and details of thin masonry facing units, including corner units, special shapes, and joint treatments.
 - 8. Stone Facing Units: Indicate locations and details of stone facing units, anchors, and joint treatments.
 - 9. Design Modifications: If design modifications are proposed to meet performance requirements and field conditions, submit design calculations and Shop Drawings. Do not adversely affect the appearance, durability, or strength of units when modifying details or materials and maintain the general design concept.
- D. Concrete-Faced Unit Samples for Verification Purposes: Design reference samples for verification of design intent, for each type of finish indicated on exposed surfaces of architectural precast concrete units, in sets of three, representative of finish, color, and texture variations expected; approximately 12 by 12 by 2 inches (300 by 300 by 50 mm).
- E. Thin Masonry Facing Unit Samples for Verification Purposes: Exposed surfaces of masonry-faced units for each type of finish indicated, in sets of 3, illustrating full range of color and texture variations expected; approximately 12 in by 12 in by 2 in (300 mm by 300 mm by 50 mm).
- F. Stone Facing Unit Samples for Verification Purposes: Exposed surfaces of stone-faced units for each type of finish indicated, in sets of 3, illustrating full range of color and texture variations expected; approximately 12 in by 12 in by 2 in (300 mm by 300 mm by 50 mm).
- G. Pre-Production Sample Panels: After sample approval and before fabricating architectural precast units, produce sample units for review by Architect. Produce as many sample units as required, but not less than a minimum of two sample panels approximately 16 sq. ft. (1.5 sq. m) in area for review by Architect to verify selections made under Sample submittals. Incorporate full-scale details of architectural features, finishes, textures, and transitions in sample panels.
 - 1. Locate panels as indicated or, if not indicated, as directed by Architect.

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2. Damage part of an exposed-face surface for each finish, color, and texture, and demonstrate adequacy of repair techniques proposed for repair of surface blemishes.
 3. After acceptance of repair technique, maintain one sample panel at manufacturer's plant and one at Project site in an undisturbed condition as a standard for judging the completed Work.
 4. Demolish and remove field sample units when directed by Architect.
- H. Range Samples: After sample panel approval and before fabricating architectural precast concrete units, produce a minimum of three sets of samples, approximately 16 sq. ft. (1.5 sq. m) in area, representing anticipated range of each color and texture on Project's units. Maintain one set of range samples at Project site and remaining sets at manufacturer's plant as color and texture approval reference.
- 1.5 INFORMATIONAL SUBMITTALS
- A. Delegated Engineering Submittal: For products and systems indicating compliance with performance requirements. Include structural analysis, calculations and other performance data signed and sealed by the qualified professional engineer responsible for their preparation.
- B. Product Test Reports: Written reports based on evaluation of comprehensive tests performed by qualified testing agency indicating that each product complies with requirements.
1. Results that materials, including water, in concrete mix are free of ferrous or other material which will cause surface staining during curing operations or upon exposure to weather.
 2. Results that aggregates have a stain index of less than 20 according to ASTM C 641.
- C. Source Quality-Control Submittals:
1. Source Quality-Control Programs: For architectural precast manufacturer.
- D. Field Quality Control Reports: Written report of testing and inspection required by "Field Quality Control" Article.
- 1.6 QUALITY ASSURANCE
- A. Manufacturer Qualifications: Manufacturer with not less than 10 years of experience in the successful production and in-service performance of products and systems similar to scope of this Project.
1. Certification Program Participant: Participates in one of following:
 - a. PCI's plant certification program and designated a PCI-certified plant for Group A, Category A1 - Architectural Cladding and Load Bearing Units.
 - b. APA's "Plant Certification Program for Production of Architectural Precast Concrete Products" and designated an APA-certified plant.
- B. Installer Qualifications:
1. Experience: Installer's personnel with not less than 5 years of experience in the successful performance of Work similar to scope of this Project.
 2. Supervision: Installer shall maintain a competent supervisor at Project while the Work is in progress, and who has not less than 5 years of experience installing products and systems similar to scope of this Project.
 3. Manufacturer/Fabricator Acceptance: Installer shall be certified, approved, licensed, or acceptable to manufacturer/fabricator to install products.
- C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

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- D. Design Standards: Comply with **ACI 318 (ACI 318M)** and design recommendations of PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of architectural precast concrete units indicated.
- E. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for types of units required, comply with PCI MNL 117, "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products" unless more stringent requirements are indicated.
- F. Welding: Qualify procedures and personnel according to AWS qualification requirements and following:
 - 1. AWS D1.1/D.1.1M, "Structural Welding Code - Steel".
 - 2. AWS D1.4, "Structural Welding Code - Reinforcing Steel".

1.7 MOCKUPS

- A. Mock-ups: Prior to fabrication and installation, build mock-up for each form of construction and finish required to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mock-up using materials indicated for the completed Work.
 - 1. Build mock-up in the location and of the size indicated or, if not indicated, as directed by Architect. Contractor shall provide structural support framework.
 - a. Show typical components, attachments to building structure, and requirements of installation.
 - 2. Notify Architect seven days in advance of the dates and times when mock-up will be installed.
 - 3. Obtain Architect's acceptance of mock-ups before starting fabrication or installation.
 - 4. Acceptance of mock-ups does not constitute acceptance of deviations from the Contract Documents contained in mock-ups unless such deviations are specifically noted by Contractor and accepted by Architect in writing.
 - 5. Demolish and remove mock-ups when directed by Architect unless accepted to become part of the completed Work.

1.8 PRE-INSTALLATION CONFERENCE

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.
 - 1. Participants:
 - a. Architect.
 - b. Contractor, including superintendent.
 - c. Installer, including project manager and supervisor.
 - d. If requested, Manufacturer's qualified technical representative.
 - e. Installers of other construction interfaced with Work.
 - 2. Minimum Agenda: Installer shall demonstrate understanding of the Work required by describing detailed procedures for preparing, installing, and cleaning the Work. Demonstration shall include, but not be limited to, following topics:
 - a. Tour representative areas of Work, inspect and discuss condition of substrate, and other preparatory work performed by other trades.
 - b. Review Contract Document requirements.
 - c. Review approved submittals.
 - d. Review inspection and testing requirements.

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- e. Review environmental conditions and procedures for coping with unfavorable conditions.
 - f. Resolve deviations or differences between Contract Documents and the manufacturer's specifications.
 - 3. Record discussions, including decisions and agreements, and prepare report.
- 1.9 DELIVERY, STORAGE, AND HANDLING
- A. Delivery: Deliver units in such quantities and at such times to limit unloading units temporarily on ground. Support units during shipment on nonstaining shock-absorbing material.
 - B. Storage: Store units with adequate dunnage and bracing and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping, or other physical damage.
 - C. Handling: Handle and transport units in a position consistent with their shape and design in order to avoid excessive stresses which would cause cracking or damage. Lift and support units only at designated points shown on Shop Drawings.
- 1.10 COORDINATION
- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.
- 1.11 SEQUENCING
- A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction without delaying the Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Single Source Responsibility: Furnish each type of product from single manufacturer/fabricator. Provide secondary materials only as recommended by manufacturer/fabricator of primary materials.

2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Comply with performance requirements specified, as determined by testing of products and systems representing those indicated for this Project, without failure due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Design Standards: Comply with **ACI 318 (ACI 318M)** and design recommendations of PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of architectural precast concrete units indicated.
- C. Structural Loads: Engineer products and systems to withstand loads within limits of allowable working stresses of the materials involved under conditions indicated including, but not limited to gravity, wind, seismic, and erection design loads and thermal movements established by authorities having jurisdiction, applicable building codes, and as indicated.
 - 1. Wind Loads: As indicated on Drawings or Wind Analysis Report.
 - 2. Other Loads: As indicated on Drawings.

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- D. Structural Movement: Engineer system to withstand movements of supporting structure including, but not limited to inter-story drift, twist, column shortening, long-term creep and deflection from uniformly distributed and concentrated live loads:
 - 1. Live Load Deflection: Accommodate differential vertical deflection of floors:
 - a. Deflection: As indicated on Drawings.
 - 2. Inter-story Drift: Accommodate inter-story drift between adjacent floors perpendicular and/or parallel to the wall:
 - a. Design Displacement: As indicated on Drawings.
- E. Seismic Performance: Systems shall withstand the effects of earthquake motions determined in accordance with the building code and authorities having jurisdiction.
- F. Building Maintenance Equipment: Engineer units supporting building maintenance equipment to resist pull-out and horizontal shear forces transmitted from equipment.
- G. Vehicular Impact Loads: Engineer precast units acting as vehicular barriers for passenger cars to resist a single 6000 lb (26.7 kN) service load and 10,000 lb (44.5 kN) ultimate load applied horizontally in any direction to the unit, with anchorages or attachments capable of transferring this load to the structure. Engineer units assuming the load to act at a height of 18 in (450 mm) above the floor or ramp surface on an area not to exceed 1 sq ft (0.93 sq m).
- H. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:
 - 1. Temperature Change (Range): 120 deg F (49 deg C), ambient; 180 deg F (82 deg C), material surfaces.
- I. Dimensional Tolerances: Engineer products and systems to accommodate dimensional tolerances of framing members and adjacent construction.

2.3 MOLD MATERIALS

- A. Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that will provide continuous and true precast concrete surfaces within fabrication tolerances indicated; non-reactive with concrete and suitable for producing required finishes.
- B. Mold-Release Agent: Commercially produced liquid-release agent that will not bond with, stain or adversely affect concrete surfaces and will not impair subsequent surface or joint treatments of concrete.
- C. Form Liners: Units of face design, texture, arrangement, and configuration indicated. Furnish with manufacturer/fabricator's recommended liquid-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent surface or joint treatments of concrete.

2.4 REINFORCING MATERIALS

- A. Reinforcing Bars: One of both of the following as required:
 - 1. Reinforcing Bars: ASTM A 615 / A 615M, Grade 60 (Grade 420), deformed.
 - 2. Low-Alloy-Steel Reinforcing Bars: ASTM A 706 / A 706M, deformed.
- B. Steel Bar Mats: ASTM A 184 / A 184M, fabricated from ASTM A 615 / A 615M, Grade 60 (Grade 420) or ASTM A 706 / A 706M, deformed bars, assembled with clips.
- C. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn or galvanized steel wire into flat sheets.

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- D. Deformed-Steel Welded Wire Reinforcement: ASTM A 497 / A 497M, flat sheet.
- E. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 117.

2.5 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type III, gray for non-exposed backup concrete, unless otherwise indicated.
 - 1. For surfaces exposed to view in finished structure, mix gray, white, tan, or a combination to produce exposed finish color selected, of same type, brand, and mill source.
- B. Supplementary Cementitious Materials: Not to be used in face mixture; allowed in back of unit mixture only
 - 1. Fly Ash: ASTM C 618, Class C or F, with maximum loss on ignition of 3 percent.
 - 2. Silica Fume Admixture: ASTM C 1240, with optional chemical and physical requirement.
 - 3. Metakaolin Admixture: ASTM C 618, Class N.
 - 4. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- C. Normal-Weight Aggregates: Except as modified by PCI MNL 117, ASTM C 33, with coarse aggregates complying with Class 5S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.
 - 1. Face-Mixture-Coarse Aggregates: Selected, hard, and durable; free of material that reacts with cement or causes staining. Uniformly or gap graded to match approved sample.
 - 2. Face-Mixture-Fine Aggregates: Selected, natural or manufactured sand of same material as coarse aggregate, unless otherwise approved by Architect.
- D. Coloring Admixture: ASTM C 979, synthetic or natural mineral-oxide pigments or colored water-reducing admixtures, temperature stable, non-fading, and alkali resistant.
- E. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 117.
- F. Air-Entraining Admixture: ASTM C 260, certified by manufacturer/fabricator to be compatible with other required admixtures.
- G. Chemical Admixtures: Certified by manufacturer/fabricator to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.

2.6 ANCHORS, CONNECTORS, AND MISCELLANEOUS MATERIALS

- A. General: Select anchors and connectors for type, grade, and class required to comply with performance requirements and produce connections suitable for environmental exposure.
 - 1. Shop-Primed Finish: For steel items and connections exposed to interior and conditioned areas, prepare surfaces of non-galvanized steel items, except those surfaces to be embedded in concrete, according to requirements in SSPC-SP 3 and shop-apply lead- and chromate-free, rust-inhibitive primer, complying with performance requirements in MPI 79 or SSPC-Paint 25 according to SSPC-PA 1.
 - 2. Zinc-Coated Finish: For steel items and connections exposed to exterior and unconditioned areas, Zinc coated by hot-dip process in accordance with ASTM A123/A123M, after fabrication, or ASTM A153/A153M, as applicable.

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- a. Galvanizing Repair Paint: Touch up damaged galvanized surfaces in accordance with ASTM A780/A780M or SSPC-Paint 20.
 - B. Carbon-Steel Shapes and Plates: ASTM A 36 / A 36M.
 - C. Carbon-Steel-Headed Studs: ASTM A 108, AISI 1018 through AISI 1020, cold finished, AWS D1.1/D1.1M, Type A or B, with arc shields and with minimum mechanical properties of PCI MNL 117, Table 3.2.3.
 - D. Carbon-Steel Plate: ASTM A 283 / A 283M.
 - E. High-Strength, Low-Alloy Structural Steel: ASTM A 572/A 572M.
 - F. Carbon-Steel Structural Tubing: ASTM A 500, Grade B.
 - G. Deformed-Steel Wire or Bar Anchors: ASTM A 496 or ASTM A 706/A 706M.
 - H. Carbon-Steel Bolts and Studs: ASTM A 307, Grade A / ASTM F 568M, Property Class 4.6; carbon-steel, hex-head bolts and studs; carbon-steel nuts, ASTM A 563 / A 563M; and flat, unhardened steel washers, ASTM F 844.
 - I. Welding Electrodes: Comply with AWS standards.
 - J. Accessories: Cast-in structural steel anchors, inserts, plates, angles, clips, hangers, shims, bearing pads, and other similar accessories required to install units.
- 2.7 GROUT MATERIALS
- A. Nonmetallic, Non-shrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, Portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107 of consistency suitable for application within a 30-minute working time.
- 2.8 THIN MASONRY UNITS AND ACCESSORIES
- A. Thin Brick Units: ASTM C 216, Type FBX or ASTM C 1088, Grade Exterior, Type TBX, not less than 1/2 in (12 mm) at the narrowest point, with a tolerance of plus or minus 1/16 in (1.6 mm).
 - 1. Special Shapes: Include corners, edge corners, and end edge corners.
 - 2. Back Surface Texture: Scored, combed, wire roughened, ribbed, keybacked, or dovetailed.
 - 3. Initial Rate of Absorption: Less than 30 g/30 sq. in. (30 g/194 sq. cm) per minute; ASTM C 67.
 - 4. Efflorescence: Tested according to ASTM C 67 and rated "not effloresced."
 - 5. Surface Coating: Thin brick with colors or textures applied as coatings shall withstand 50 cycles of freezing and thawing; ASTM C 67 with no observable difference in applied finish when viewed from 10 ft (3 m).
 - B. Thin Brick Facing Units - Basis of Design: As scheduled or as indicated in Design Selections.
 - C. Thin Calcium Silicate Facing Units - Basis of Design: As scheduled or as indicated in Design Selections.
 - D. Stone Facing - Basis of Design: As specified in Division 04 Section "Exterior Stone Cladding".
 - E. Anchors: Stainless steel, ASTM A 666, Type 304, of temper and diameter required to support loads without exceeding allowable design stresses.

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1. Fit each anchor leg with neoprene grommet collar of width at least twice the diameter and of length at least five times the diameter of anchor.
- F. Sealant for Flexible Filler: ASTM C 920, low-modulus, neutral-curing silicone sealant complying with requirements in Division 07 Section "Joint Sealants" and that is nonstaining to stone substrate.
- G. Epoxy for Rigid Filler: ASTM C 881/C 881M, 100 percent solids, sand-filled nonshrinking, nonstaining of type, class, and grade to suit application.
 1. Elastomeric Anchor Sleeve: **1/2 in (12 mm)** long, Type A durometer hardness of 60, ASTM D 2240.
- H. Bond Breaker: One of the following:
 1. Polyethylene sheet, ASTM D 4397, **6 to 10 mils (0.15 to 0.25 mm)** thick.
 2. Preformed, compressible, resilient, nonstaining, nonwaxing, closed-cell polyethylene foam pad, nonabsorbent to liquid and gas, **1/8 in (3.2 mm)** thick

2.9 INSULATED PANEL ACCESSORIES

- A. Polyisocyanurate Board Insulation: Rigid, cellular polyisocyanurate thermal insulation complying with ASTM C 591, square edged.
 1. Thickness: **2 in (50 mm)** with R-Value of 10.
 2. Density: Capable of withstanding design loads within limits and under conditions indicated.
- B. Extruded Polystyrene Board Insulation: Rigid, cellular polystyrene thermal insulation complying with ASTM C 578, square edged.
 1. Thickness: **2 in (50 mm)** with R-Value of 10.
 2. Density: Capable of withstanding design loads within limits and under conditions indicated.
- C. Wythe Connectors: Manufactured to connect wythes of precast concrete panels and configured for insulation thickness.
 1. Provide corrosion and alkali resistant glass-fiber and vinyl-ester polymer connectors, stainless steel pin connectors or epoxy coated carbon fiber mesh.
 2. Proven Accelerated Aging Testing: Provide reports indicating compliance with accelerated aging equivalent to 100 years of service in concrete.

2.10 GUTTER DRAINAGE SYSTEM

- A. Gutter drainage system at back of units may be either prefabricated silicone system or fabricated galvanized sheet steel system as indicated on the Drawings.
- B. Prefabricated Silicone Gutter Drainage System: Flame-resistant extruded silicone collection channel system used to collect moisture or condensation on the back side of the units. Include accessories such as end dams, weep baffles and silicone weeps as necessary to drain collected moisture to the exterior of the building.
 1. Available Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, manufacturers offering products that may be incorporated into the Work include but are not limited to those listed below:
 - a. Basis of Design: 2DS; "Secondary Drainage Systems - Precast".

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- C. Fabricated Galvanized Sheet Steel Gutter Drainage System: Galvanized sheet steel collection channel system used to collect moisture or condensation on the back side of the units. Include accessories such as end dams, weep baffles, and silicone weeps as necessary to drain collected moisture to the exterior of the building.
 - 1. Zinc-Coated (Galvanized) Sheet Steel: ASTM A 653, G90 coating designation; structural quality, not less than 0.0312 in (0.79 mm) (20 gage) unless otherwise indicated.
 - 2. Solder for Galvanized Sheet Steel: ASTM B 32, 60 percent lead and 40 percent tin with low antimony, as recommended by manufacturer.
 - 3. Fabricate gutter drainage system to cross section indicated with clips and accessories required for secure watertight installation. Meet recommendations of SMACNA for fabrication details and metal thicknesses.
- D. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing per ASTM E 1190, conducted by a qualified testing and inspecting agency.
- E. Joint Sealant: Silicone construction sealant as specified in Division 07 Section "Joint Sealants".

2.11 CONCRETE MIXTURES

- A. Mix Designs: Prepare design mixtures for each type of precast concrete required.
 - 1. Limit use of fly ash and silica fume to 20 percent of Portland cement by weight; limit metakaolin and silica fume to 10 percent of Portland cement by weight. Not allowed in face of unit mix.
- B. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at architectural precast concrete fabricator's option.
- C. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 (ACI 318M) or PCI MNL 117 when tested according to ASTM C 1218/C 1218M.
- D. Normal-Weight Concrete Mixtures: Proportion face and backup mixtures by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:
 - 1. Compressive Strength: 5000 psi (34.5 MPa) minimum at 28 days.
 - 2. Maximum Water-Cementitious Materials Ratio: 0.45.
- E. Water Absorption: 6 percent by weight or 14 percent by volume according to PCI MNL 117.
- F. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 117.
- G. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.

2.12 MOLD FABRICATION

- A. Molds: Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete-placement operations and temperature changes and for prestressing and detensioning operations. Coat contact surfaces of molds with release agent before reinforcement is placed. Avoid contamination of reinforcement and prestressing tendons by release agent.

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1. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and supports to maintain stability of liners during concrete placement. Coat form liner with form-release agent.
 - B. Maintain molds to provide completed units of shapes, lines, and dimensions indicated, within fabrication tolerances specified.
 1. Form joints are not permitted on faces exposed to view in the finished Work.
 2. Edges and corners shall be uniformly chamfered or radius as indicated on the Drawings.
- 2.13 THIN MASONRY FACINGS
- A. Form Liner Templates: Place accurately to provide grid for thin masonry facings. Provide solid backing and supports to maintain stability of liners while placing thin masonry and during concrete placement.
 - B. Thin Masonry Unit Placement: Securely place face down into form liner pockets and place concrete backing mixture.
 - C. Clean faces and joints of brick facing.
- 2.14 STONE FACINGS
- A. Preparation: Before placing, clean stone surfaces to remove soil, stains, and foreign materials. Thoroughly scrub stones with fiber brushes and thoroughly drench with clear water. Use only mild cleaning compounds that contain no caustic or harsh filler or abrasives.
 - B. Stone Placement:
 1. Accurately position stone facings to comply with requirements and in locations indicated.
 2. Install anchors, supports, and other attachments indicated or necessary to secure stone in place.
 3. Keep concrete reinforcement a minimum of **3/4 in (19 mm)** from back surface of stone.
 4. Use continuous spacers to obtain uniform joints of widths indicated and with edges and faces aligned according to established relationships and indicated tolerances.
 - C. Stone to Precast Anchorages: Fill anchor holes with sealant filler and install anchors in numbers, types and locations required to satisfy specified performance criteria:
 1. Not less than 2 anchors per stone unit of less than **2 sq ft (0.19 sq m)** in area.
 2. Not less than 4 anchors per stone unit of less than **12 sq ft (1.1 sq m)** in area.
 3. Anchors spaced not more than **24 in (600 mm)** on centers horizontally and vertically for stone units larger than **12 sq ft (1.1 sq m)** in area.
 4. Locate anchors minimum **6 in (150 mm)** from stone edge.
 - D. Fill anchor holes with sealant filler and install anchors. Provide one of the following:
 1. Install polyethylene sheet to prevent bond between back of stone facing and concrete substrate and to ensure no passage of precast matrix to stone surface.
 2. Install **1/8 in (3 mm)** polyethylene-foam bond breaker to prevent bond between back of stone facing and concrete substrate and to ensure no passage of precast matrix to stone surface. Maintain minimum projection requirements of stone anchors into concrete substrate.
- 2.15 FABRICATION
- A. Fabrication Quality Standards: In addition to standards listed elsewhere, comply with following, unless otherwise specified in this Section:
 1. PCI MNL 117.

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2. Accepted submittals.
 3. Contract Documents.
- B. General: Fabricate units straight and true to size and shape with exposed edges and corners precise and true so each finished unit complies with fabrication quality standard, product tolerances, and position tolerances for cast-in items.
- C. Connection Hardware:
1. Fabricate cast-in anchors, inserts, plates, angles, and other anchorage hardware with sufficient anchorage and embedment to comply with delegated engineering.
 2. Accurately position for attachment of loose hardware, and secure in place during precasting operations.
 3. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.
 4. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing architectural precast concrete units to supporting and adjacent construction.
- D. Cast-in reglets, slots, holes, and other accessories in architectural precast concrete.
- E. Cast-in openings larger than 10 in (250 mm) in any dimension. Do not drill or cut openings without Architect's approval.
- F. Reinforcement: Comply with recommendations in PCI MNL 117 for fabricating, placing, and supporting reinforcement:
1. Clean reinforcement of loose rust and mill scale and other materials that reduce or destroy bond with concrete.
 2. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Completely conceal support devices to prevent exposure on finished surfaces.
 3. Place reinforcement to maintain at least 3/4 in (19 mm) minimum coverage. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.
 4. Place reinforcing steel to maintain at least 3/4 in (19 mm) minimum concrete cover. Increase cover requirements for reinforcing steel to 1-1/2 in (38 mm) when units are exposed to corrosive environment or severe exposure conditions. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.
 5. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh spacing and wire tie laps, where required by delegated engineering. Offset laps of adjoining widths to prevent continuous laps in either direction.
- G. Reinforce architectural precast concrete units to resist handling, transportation, and erection stresses.
- H. Placing Concrete:
1. Comply with requirements in PCI MNL 117 and requirements in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.
 2. Place face mixture to a minimum thickness after consolidation of greater of 1 in (25 mm) or 1.5 times maximum aggregate size, but not less than minimum reinforcing cover specified.
 3. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in units.

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4. Place backup concrete mixture to ensure bond with face-mixture concrete.
 5. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air on surfaces. Use equipment and procedures complying with PCI MNL 117.
- I. Hot and Cold Weather Concrete Placement: Comply with PCI MNL or ACI 306.1 procedures for cold weather concrete placement and ACI 305R recommendations for hot weather concrete placement.
 - J. Handling Units: Identify pickup points of architectural precast concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each architectural precast concrete unit on a surface that will not show in finished structure.
 - K. Curing: Cure concrete, according to PCI MNL 117, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture.
 - L. Defective Units: Discard and replace units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 117 and Architect's and Owner's approval.
- 2.16 FABRICATION TOLERANCES
- A. Fabricate architectural precast concrete units straight and true to size and shape with exposed edges and corners precise and true so each finished unit complies with PCI MNL 117 product tolerances as well as position tolerances for cast-in items.
 - B. Brick-Faced Architectural Precast Concrete Units: Restrict the following misalignments to 2 percent of number of bricks in a unit.
 1. Alignment of Mortar Joints:
 - a. Jog in Alignment: 1/8 in (3 mm).
 - b. Alignment with Panel Centerline: Plus or minus 1/8 in (3 mm).
 2. Variation in Width of Exposed Mortar Joints: Plus or minus 1/8 in (3 mm).
 3. Tipping of Individual Bricks from the Panel Plane of Exposed Brick Surface: Plus 1/16 in (1.5 mm); minus 1/4 in (6 mm) less than or equal to depth of form liner joint.
 4. Exposed Brick Surface Parallel to Primary Control Surface of Panel: Plus 1/4 in (6 mm); minus 1/8 in (3 mm).
 5. Individual Brick Step in Face from Panel Plane of Exposed Brick Surface: Plus 1/16 in (1.5 mm); minus 1/4 in (6 mm) less than or equal to depth of form liner joint.
 - C. Stone Veneer-Faced (Smooth Finish) Architectural Precast Concrete Units:
 1. Variation in Cross-Sectional Dimensions: For thickness of walls from dimensions indicated: Plus or minus 1/4 in (6 mm).
 2. Variation in Joint Width: 1/8 in in 36 in (3 mm in 900 mm) or a quarter of nominal joint width, whichever is less.
 3. Variation in Plane between Adjacent Stone Units (Lipping): 1/16 in (1.5 mm) difference between planes of adjacent units.
- 2.17 CONCRETE-FACED UNIT FINISHES
- A. Finishes, General: Exposed faces shall be free of joint marks, grain, and other obvious defects. Corners, including false joints shall be uniform, straight, and sharp. Finish exposed-face surfaces of architectural precast concrete units to match approved design reference sample, sample panels, mockups and as follows:

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1. Finish Selections: As scheduled or as indicated in Design Selections; match approved sample units for aesthetic purposes.
 2. Design Reference Sample: <Insert description and identify fabricator and code number of sample>.
 3. As-Cast-Surface Finish: Provide surfaces to match approved sample for acceptable surface, air voids, sand streaks, and honeycomb, with uniform color and texture.
 4. Textured-Surface Finish: Impart by form liners.
 5. Exposed-Aggregate Finish: Use chemical-retarding agents applied to concrete forms and washing and brushing procedures to expose aggregate and surrounding matrix surfaces after form removal.
 6. Sand- or Abrasive-Blast Finish: Use abrasive grit, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces.
 7. Acid-Etched Finish: Use acid and hot-water solution equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces.
- B. Exposed Top, Bottom, and Sides Surfaces: Finish exposed surfaces to match face surface finish.
- C. Exposed Back Surfaces: Finish exposed back surfaces with smooth, steel-trowel finish.
- D. Unexposed Surfaces: Finish unexposed surfaces with float finish.
- 2.18 SOURCE QUALITY CONTROL
- A. Owner Testing Agency: Owner may employ an independent testing agency to evaluate architectural precast concrete fabricator's quality-control and testing methods.
1. Allow Owner's testing agency access to material storage areas, concrete production equipment, concrete placement, and curing facilities. Cooperate with Owner's testing agency and provide samples of materials and concrete mixtures as may be requested for additional testing and evaluation.
- B. Contractor Quality-Control Testing: Establish and maintain a quality-control program for manufacturing architectural precast concrete panels in accordance with PCI MNL 117.
1. Strength of precast concrete units will be considered deficient if units fail to comply with **ACI 318 (ACI 318M)** requirements for concrete strength.
 2. Quality Control Testing: If there is evidence that strength of precast concrete units may be deficient or may not comply with **ACI 318 (ACI 318M)** requirements, precaster will employ an independent testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C 42/C 42M.
 - a. A minimum of three representative cores will be taken from units of suspect strength, from locations directed by Architect.
 - b. Cores will be tested in an air-dry condition.
 - c. Strength of concrete for each series of 3 cores will be considered satisfactory if average compressive strength is equal to at least 85 percent of 28-day design compressive strength and no single core is less than 75 percent of 28-day design compressive strength.
 - d. Test results will be made in writing on same day that tests are performed, with copies to Architect, Contractor, and precast concrete fabricator. Test reports will include the following:
 - 1) Project identification name and number.
 - 2) Date when tests were performed.
 - 3) Name of precast concrete fabricator.

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- 4) Name of concrete testing agency.
 - 5) Identification letter, name, and type of precast concrete unit(s) represented by core tests; design compressive strength; type of break; compressive strength at breaks, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.
3. Patching: If core test results are satisfactory and precast concrete units comply with requirements, clean and dampen core holes and solidly fill with precast concrete mixture that has no coarse aggregate, and finish to match adjacent precast concrete surfaces.
 4. Defective Units: Discard and replace recast architectural concrete units that do not comply with acceptability requirements in PCI MNL 117, including concrete strength, manufacturing tolerances, and color and texture range. Chipped, spalled, or cracked units may be repaired, subject to Architect's approval. Architect reserves the right to reject precast units that do not match approved samples, sample panels, and mockups. Replace unacceptable units with precast concrete units that comply with requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.
- B. Acceptance of Building Structural Frame: Do not install units until supporting cast-in-place concrete building structural framing has attained minimum allowable design compressive strength, supporting structural steel framing, or other structure is complete.

3.2 INSTALLATION, GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
 1. PCI MNL 127 Standards and Guidelines for the Erection of Precast Concrete Products.
 2. Respective manufacturer/fabricator's written installation instructions.
 3. Accepted submittals.
 4. Contract Documents.

3.3 PREPARATION

- A. General: Comply with manufacturer/fabricator's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.

3.4 ERECTION

- A. Erection: Install units level, plumb, in alignment, and square within specified allowable tolerances.
 1. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
 2. Remove projecting lifting devices and use sand-cement grout to fill voids within recessed lifting devices flush with surface of concrete.
 3. Unless otherwise indicated, maintain uniform joint widths of 3/4 in (19 mm).

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- B. Attachments, General: Connect units in position by bolting, welding, or grouting.
- C. Bolted Connections: Use lock washers, lock nuts, or other acceptable means to prevent loosening of bolted connections.
- D. Welding: Perform welding in compliance with AWS D1.1/D1.1M and AWS D1.4 with qualified welders.
 - 1. Protect units from damage by field welding or cutting operations, and provide noncombustible shields as required.
 - 2. Repair damaged galvanized steel surfaces by cleaning and applying a coat of galvanizing repair paint to galvanized surfaces.
 - 3. Repair prime painted steel by cleaning and re-priming damaged painted surfaces.
- E. Grouting Connections:
 - 1. Grout connection block-outs after final adjustment.
 - 2. Retain grout in place until hard enough to support itself.
 - 3. Pack spaces with stiff grout material, tamping until voids are completely filled.
 - 4. Place grout to finish smooth, level, and plumb with adjacent concrete surfaces.
 - 5. Keep grouted joints damp for not less than 24 hours after initial set.
 - 6. Promptly remove grout material from exposed surfaces before it affects finishes or hardens.

3.5 ERECTION TOLERANCES

- A. Erect architectural precast concrete units level, plumb, square, true, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 117, Appendix I.
- B. Gutter Drainage System: Securely attach gutter drainage system to back of units using powder actuated fasteners as indicated on the Drawings. Seal joints with silicone joint sealant as specified in Division 07 Section "Joint Sealants". Slope system to positive drain to weeps.

3.6 FIELD QUALITY CONTROL

- A. Owner Testing Agency: The Owner may employ and pay a qualified independent testing agency to perform field quality control.
 - 1. Refer to Division 01 Section Field Test for Air and Water Leakage.
 - 2. Refer to Owner's Building Enclosure Commissioning Plan for Field Observations and Performance Testing Activities.
- B. Special Inspections: Owner will engage a qualified special inspector to perform special inspections and prepare reports:
 - 1. Erection of architectural precast concrete.
 - 2. Testing agency will report test results promptly and in writing to Contractor and Architect.
- C. Tests and Inspections, General: Tests and inspections shall take place as installation proceeds to determine compliance with specified performance requirements.
 - 1. Correction of Deficiencies:
 - a. Materials and installation will be considered defective if they do not meet specified requirements.
 - b. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.
 - c. Perform additional tests and inspections, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.

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2. Prepare test and inspection reports.

3.7 REPAIRS

- A. Repair exposed surfaces of units to match color, texture, and uniformity of surrounding precast architectural concrete if permitted by Architect and Owner. Architect and Owner reserves right to reject repaired units that do not comply with requirements.
- B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired Work, when viewed in typical daylight illumination from a distance of 20 ft (6 m).
- C. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A 780.
- D. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.
- E. Remove and replace damaged units if repairs do not comply with requirements.

3.8 CLEANING

- A. Clean surfaces of precast concrete units exposed to view.
- B. Cleaning: After erection and completion of joint treatment, clean exposed surfaces of units to remove weld marks, other markings, dirt, and stains.
 - 1. Perform cleaning procedures, if necessary, according to manufacturer/fabricator's written recommendations.
 - 2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

3.9 FINISH SCHEDULE

- A. PCXX - Exposed Face Surfaces:
 - 1. Exposed Aggregate:
 - 2. Sandblast: [Light] [Medium] [Heavy]
 - 3. Color Additive:
 - 4. Cement Color:
- B. PCXX - Thin Brick Facing Units:
 - 1. Manufacturer:
 - 2. Product Series:
 - 3. Color Name and Number:
 - 4. Face Style:
 - 5. Color Selection:
 - 6. Face Size:
- C. PCXX - Thin Calcium Silicate Facing Units:
 - 1. Manufacturer:
 - 2. Product Series:
 - 3. Color Name and Number:
 - 4. Face Style:
 - 5. Color Selection:
 - 6. Face Size:

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D. PCXX - Stone Facing Units:

1. Stone Facing:
2. Cement Color:

END OF SECTION

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SECTION 035416
HYDRAULIC CEMENT UNDERLAYMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes hydraulic-cement-based, polymer-modified, self-leveling underlayment for application below interior floor coverings.
- B. Related Sections:
 - 1. Division 09 Sections for patching and leveling compounds applied with floor coverings.

1.2 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
 - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
- B. Shop Drawings: Show details of installation, including plans indicating substrates, locations, and average depths of underlayment based on survey of substrate conditions.

1.3 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Project Acceptance Document: Certification by the manufacturer that its product(s) are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required.
 - 1. Product Certificates: Signed by manufacturers of underlayment and floor-covering systems certifying that products are compatible.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Experience: Installer's personnel with not less than 5 years of experience in the successful performance of Work similar to scope of this Project.
 - 2. Supervision: Installer shall maintain a competent supervisor at Project while the Work is in progress, and who has not less than 5 years of experience installing products and systems similar to scope of this Project.
- B. Product Compatibility: Manufacturers of underlayment and floor-covering systems certify in writing that products are compatible.

1.5 PRE-INSTALLATION CONFERENCE

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to comply with manufacturer's written instructions to prevent deterioration from moisture or other detrimental effects.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ventilation, ambient temperature and humidity, and other conditions affecting underlayment performance.

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1. Place hydraulic-cement-based underlayments only when ambient temperature and temperature of substrates are between 50 and 80 deg F (10 and 27 deg C).

1.8 COORDINATION

- A. Coordinate application of underlayment with requirements of floor-covering products and adhesives, specified in Division 09 Sections, to ensure compatibility of products.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND PRODUCTS

- A. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section Substitution Procedures.

2.2 HYDRAULIC-CEMENT-BASED UNDERLAYMENTS

- A. Underlayment: Hydraulic-cement-based, polymer-modified, self-leveling product that can be applied in minimum uniform thickness of 1/4 inch (6 mm) and that can be feathered at edges to match adjacent floor elevations.
 1. Manufacturers and Products:
 - a. ARDEX Engineered Cements; K-15 Self-Leveling Underlayment Concrete.
 - b. Euclid Chemical Company (The); Super Flo-Top.
 - c. Sika Corp.; SikaLevel 110SL.
 2. Cement Binder: ASTM C 150, Portland cement, or hydraulic or blended hydraulic cement as defined by ASTM C 219.
 3. Compressive Strength: Not less than 4000 psi (27.6 MPa) at 28 days when tested according to ASTM C 109/C 109M.
 4. Underlayment Additive: Resilient-emulsion product of underlayment manufacturer, formulated for use with underlayment when applied to substrate and conditions indicated.
- B. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3 to 6 mm); or coarse sand as recommended by underlayment manufacturer.
 1. Provide aggregate when recommended in writing by underlayment manufacturer for underlayment thickness required.
- C. Water: Potable and at a temperature of not more than 70 deg F (21 deg C).
- D. Primer: Product of underlayment manufacturer recommended in writing for substrate, conditions, and application indicated.
- E. Corrosion-Resistant Coating for Metal Substrates: Recommended in writing by underlayment manufacturer for metal substrates.
- F. Reinforcement for Wood Substrates: For underlayment applied to wood substrates, provide galvanized metal lath or other corrosion-resistant reinforcement recommended in writing by underlayment manufacturer.

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PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

3.2 INSTALLATION, GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
 - 1. Respective manufacturer/fabricator's written installation instructions.
 - 2. Accepted submittals.
 - 3. Contract Documents.

3.3 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.
 - 1. Treat nonmoving substrate cracks according to manufacturer's written instructions to prevent cracks from telegraphing (reflecting) through underlayment.
 - 2. Fill substrate voids to prevent underlayment from leaking.
- B. Concrete Substrates: Mechanically remove, according to manufacturer's written instructions, laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants that might impair underlayment bond.
- C. Nonporous Substrates: For ceramic tile, quarry tile, and terrazzo substrates, remove waxes, sealants, and other contaminants that might impair underlayment bond, and prepare surfaces according to manufacturer's written instructions.
- D. Wood Substrates: Mechanically fasten loose boards and panels to eliminate substrate movement and squeaks. Sand to remove coatings that might impair underlayment bond and remove sanding dust.
 - 1. Install underlayment reinforcement recommended in writing by manufacturer.
- E. Metal Substrates: Mechanically remove, according to manufacturer's written instructions, rust, foreign matter, and other contaminants that might impair underlayment bond. Apply corrosion-resistant coating compatible with underlayment if recommended in writing by underlayment manufacturer.
- F. Adhesion Tests: After substrate preparation, test substrate for adhesion with underlayment according to manufacturer's written instructions.

3.4 APPLICATION

- A. General: Mix and apply underlayment components according to manufacturer's written instructions.
 - 1. Close areas to traffic during underlayment application and for time period after application recommended in writing by manufacturer.

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2. Coordinate application of components to provide optimum underlayment-to-substrate and intercoat adhesion.
 3. At substrate expansion, isolation, and other moving joints, allow joint of same width to continue through underlayment.
- B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.
- C. Apply underlayment to produce uniform, level surface.
1. Apply a final layer without aggregate to product surface.
 2. Feather edges to match adjacent floor elevations.
- D. Cure underlayment according to manufacturer's written instructions. Prevent contamination during application and curing processes.
- E. Do not install floor coverings over underlayment until after time period recommended in writing by underlayment manufacturer.
- F. Remove and replace underlayment areas that evidence lack of bond with substrate, including areas that emit a "hollow" sound when tapped.
- 3.5 PROTECTION
- A. Protect underlayment from concentrated and rolling loads for remainder of construction period.

END OF SECTION

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SECTION 04 05 23 – THROUGH-WALL AND WALL SUBSTRATE FLASHING SYSTEM

PART 1 - GENERAL

1.1 GENERAL

- A. Contractor shall review American Concrete Institute 530.1 mandatory specification checklist for additional requirements necessary for specific project.
- B. Flashing system shall be provided and installed by a qualified waterproofing contractor.
- C. It is the intent of this specification that the new work will provide a watertight facility (restricted to the location where work is to be performed). The attached specifications describe the minimum acceptable standards of construction and finish.
- D. Contractor shall water test all through-wall flashings once veneer is twelve inches (12") above installed flashing. Coordinate test with Architect and Consultant.
- E. Manufacturer of cloak flashing shall have a representative inspect the installed work a minimum of two times per week. The representative shall not be the installer.
- F. All vertical flashing to be installed full height of the vertical surface in shingle fashion.
- G. Refer to all aluminum window, curtain wall and storefront specifications for flashing to window coordination.
- H. The basis of design intent is to have windows installed, flashed, and water tested prior to veneer installation.
- I. Refer to Specification Section 01 43 39 Mock Up Wall Construction for Further information.
- J. Provide and maintain a photo manifest of all flashing installed throughout the project showing the floor plan locations where the flashing has been installed. Keep on file in the job trailer at all times for reference.

1.2 QUALITY ASSURANCE

- A. At a scheduled pre-construction meeting with all trades, contractor shall review flashing for the project and how the flashing shall be sequenced with the following: below grade waterproofing, air and vapor system, window installation, sealant installation, relief angles and roofing.
- B. Material Manufacturer's Inspection Paid for By Contractor: Minimum of one inspection per week during installation, shall be made during Project schedule by authorized representative of product system manufacturer to ensure that said Project is installed in accordance with manufacturer's requirements. Manufacturer shall provide a written report to the Owner's representative within five days of each inspection stating acceptance of Contractor procedures and outlining items of non-compliance with manufacturer's requirements.
- C. Contractor shall provide a photo manifest of through-wall installation, including all starts, stops, and transitions in plane. Photos shall be documented and located on a floor plan for reference.

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1.3 SUBMITTALS

- A. Shop Drawings: Contractor shall provide from the manufacturer a review of the flashing design for the project and location of preformed shapes on reduced floor plan.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original, unopened containers and rolls with all labels intact and legible including labels indicating appropriate warnings, storage conditions, lot numbers, and usage instructions. Materials damaged in shipping or storage shall not be used.
- B. Manufacturer's packaging and/or roll plastic is not acceptable for exterior storage. Tarpaulin with grommets shall be minimum acceptable for exterior coverings. All materials stored as above shall be a minimum of four inches (4") off the substrate, and the tarpaulin tied off with rope.
- C. Deliver materials in sufficient quantity to allow continuity of work.
- D. Handle and store material in such a manner as to avoid damage.
- E. Protect materials against damage by construction traffic.
- F. Storage: All materials should be stored under cover to avoid site damage. During cool weather construction, store materials inside at 50° F or higher.
- G. The proper storage of materials is the sole responsibility of the contractor and damaged materials shall be discarded, removed from the project site, and replaced prior to application.

1.5 SITE CONDITIONS

- A. Job Condition Requirements: Coordinate the work of the contractor with the work to be performed by the Owner's personnel, to ensure proper sequencing of the entire work. The contractor shall follow local, state, and federal regulations, safety standards, and codes. When a conflict exists, use the stricter document.
- B. Protection of Work and Property:
 - 1. Work: The contractor shall maintain adequate protection of all his work from damage and shall protect the Owner's and adjacent property from injury or loss arising from this contract. He shall provide and maintain at all times any OSHA required danger signs, guards, and/or obstructions necessary to protect the public and his workmen from any dangers inherent with or created by the work in progress. All federal, state, and city rules and requirements pertaining to safety and all EPA standards, OSHA standards, NESHAP regulations shall be fulfilled by the contractor as part of his proposal.
 - 2. Property: Protect existing planting and landscaping as necessary or required to provide and maintain clearance and access to the work of this contract. Examples of two categories or degrees of protection are generally as follows: a) removal, protection, preservation, or replacement and replanting of plant materials; b) protection of plant materials in place, and replacement of any damage resulting from the contractor's operations.

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- C. Damage to Work of Others: The contractor shall repair, refinish, and make good any damage to the building or landscaping resulting from any of his operation. This shall include, but is not limited to, any damage to plaster, tile work, wall covering, paint, ceilings, floors, or any other finished work. Damage done to the building, equipment, or grounds shall be repaired at the successful contractor's expense holding the Owner harmless from any other claims for property damage and/or personal injury.
- D. Measurements: It will be the contractor's responsibility to obtain and/or verify any necessary dimensions by visiting the job site, and the contractor shall be responsible for the correctness of same. Any drawings supplied are for reference only.
- E. Cleaning and Disposal of Materials:
 - 1. Contractor shall keep the job clean and free from all loose materials and foreign matter. Contractor shall take necessary precautions to keep outside walls clean.
 - 2. All waste materials, rubbish, etc., shall be removed from the Owner's premises as accumulated. Rubbish shall be carefully handled to reduce the spread of dust. At completion, all work areas shall be left clean and all contractor's equipment and materials removed from the site.
 - 3. Debris shall be deposited at an approved disposal site.

1.6 WARRANTY

- A. Flashing Manufacturer: Project shall be installed in such a manner that the flashing material manufacturer will furnish a written ten (10) year materials warranty from the date of substantial completion of the completed project.

PART 2 – PRODUCTS

2.1 BUILT-IN FLASHING MEMBRANE

- A. The built-in flashing membrane shall be 40 mil flexible sheet material, consisting of a blend of elastomeric and thermal plastic polymers, The membrane shall be reinforced with synthetic fibers, calendared into sheet form, rolled and cut to width.
- B. The built-in flashing membrane shall be 25 mil flexible sheet material, consisting of a blend of elastomeric and thermal plastic polymers, The membrane shall be reinforced with synthetic fibers, calendared into sheet form, rolled and cut to width. To be installed at all vertical wall and opening applications only.
- C. Flashing Cloaks shall be pre-formed, three dimensional flexible units used for all exterior, interior corners, level changes, stop ends, and special applications.

Physical Properties

Elongation	175%	ASTM D412
Tensile Strength	650 psi	ASTM D412
Tear Strength	280 psi	ASTM D624
Low Temperature Flexibility	-25° F Pass	ASTM D146
Water Absorption	Less than 0.1%	ASTM D471

- D. Flashing color shall be as selected by Architect and/or shall match mortar color. Reference manufacturer's list of colors for selection.

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2.2 RELATED MATERIALS FOR BUILT-IN FLASHING MEMBRANE

- A. Flashing Membrane Adhesive: Flashing adhesive exceeds the requirements of TTS00230C Type II, Class B, ASTM C 92094. The product shall be terra cotta (dull red) in color.

Physical Properties

Hardness Shore A	24 ± 3	ASTM C 661
Shear Strength	75 psi	ASTM D 1002
Tack Free Time	25 minutes	ASTM C 679
Slump (sag)	Zero slump	ASTM C 697
Shrinkage	No measurable shrinkage after 14 days	
Low Temperature Flexibility	-20° F pass 1/4 inch mandrel	
Service Temperature	-40° F to 200° F continuous service	
Shelf Life	One year	

2.3 RELATED MATERIALS FOR SURFACE ADHERED FLASHING MEMBRANE

- A. Asphalt Primer: Shall be a two-sided, self-adhering tape used to seal the top of cloaks against the back-up wythe. Adhesive may be used as an alternative.

- B. Substrate Primer:

Physical Properties

Solids by Weight	68%	
Viscosity	758 cps	
Weight per Gallon	9.3 lbs.	
Elongation	>656% no Breakage, Exceeded Travel of Instron	ASTM D 2370
Tensile Strength	85.1 psi	ASTM D 2370
pH	10	
Hardness Shore A	59	
Peel Strength	Aluminum No Fail at 4.60 pli	
	Concrete No Fail at 3.86 pli	

- C. Mastic: Shall be used at all laps and joints, and top terminations.

2.4 WALL DRAINAGE SYSTEM FOR FLASHING INSTALLATION INTO EXISTING WALL

- A. Collection device shall be a dovetail shaped material to place in the cavity of brick masonry walls for collecting mortar droppings above the level of the weep holes and flashing. The 90% open weave construction material shall be High Density Polyethylene (HDPE) mesh for thickness of 0.4 – 1.0 inch, or recycled polyester mesh for 2.0 inch thickness.
- B. Material shall not oxidize, rot, promote mold or fungus, or react with other common building materials such as mortar, cement, asphalt, modified bitumen, PVC, copper, or galvanized metal; shall be Mortar Net, or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions for compliance with requirements for installation tolerances and other specific conditions.

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3.2 GENERAL

- A. Laying Masonry Walls: Use an inverted lintel CMU or fully grouted hollow CMU as a base for flashing at sills, floor joints, and other similar conditions.
- B. Preparation: All sharp protrusions and mortar droppings must be removed from the substrate, and the surface must be clean and dry.
- C. Where brick work occurs above the roof elevation, provide solid protection of the existing roof system until work is complete.
- D. Flashing shall be fully supported when crossing the cavity except at sill and coping locations.
- E. Flashing shall be fully adhered around all wall penetrations prior to veneer installation.
- F. Grout Cant strip shall be installed at back of brick ledge to provide positive slope for new membrane flashing.
- G. Taper Cant down where preformed pieces are to be installed.

3.3 INSTALLATION OF BUILT-IN FLASHING MEMBRANE

- A. Flashing membrane and flashing cloaks shall be installed in a bed of fresh mortar and should stop three eighths of an inch from front face of masonry.
- B. Weep holes shall be provided immediately above all flashing at 24-inch centers. A minimum of two weeps shall be installed above any wall opening. Weeps shall be seated on flashing, NOT on mortar bed.
- C. All joints in the flashing membrane shall be lapped a minimum of four inches (4") using flashing membrane adhesive.
- D. Flashing membrane shall be installed and extend up eight inches (8") above finished grade level.
- E. Flashing Cloaks and end dams shall be installed at all window and door heads and sills and at all elevation transitions.
- F. Vertical flashing at wall openings shall extend into the wall opening four inches (4"). The door/window frame shall be installed with the flashing extending onto the back of the frame a minimum of two inches (2").
- G. Cleaning: Flashing membrane shall not be damaged by cavity cleaning after installation. Precautions to be taken during subsequent work are:
 - 1. Use of cavity battens to prevent mortar droppings;
 - 2. Removal of droppings before they harden;
 - 3. Never use implements such as steel rods for cleaning the cavity; and
 - 4. Inspection of cavity flashing for damage as the work proceeds.

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3.4 FLASHING MEMBRANE ADHESIVE

- A. Application:
1. Flashing adhesive shall be applied to clean, dry and relatively smooth surfaces.
 2. When joint two (2) pieces of flashing membrane, or joining flashing membrane to Cloaks:
 - a) Apply two (2) one-fourth inch (1/4") beads of adhesive approximately one-half inch (1/2") and one and one-half inch (1-1/2"), respectively, from the edge of the bottom membrane along the entire width of the bottom membrane. Overlap the top membrane over the bottom membrane two inches (2") and roll lap with steel hand roller, causing excess to extrude the entire length of the overlap.
 3. Do not remove excess adhesive.
- B. Safety, Storage and Handling: Keep container tightly closed when not in use. Store at room temperature. Clean up tools and hands with waterless hand cleaner.

3.5 SUBSTRATE PRIMER

- A. Surface Preparation: Areas to be primed should be dry.
- B. Application: Substrate primer may be applied using a soft roller or brush. It can be removed from masonry with soapy water while wet and a solvent-based cleaner if dry (mineral spirits or citrus cleaner).
- C. Coverage: Depending on the condition of the surface, coverage may vary from as little as 150 square feet to 200 square feet per gallon.
- D. Caution:
1. Substrate primer should not be applied when temperatures are below 40° F or when rain is imminent.
 2. Keep substrate primer from freezing.
 3. During hot weather, the product should be stored in a cool shaded area.
 4. Do not thin this product.
 5. Curing rates will vary depending on the ambient temperature relative humidity, wind speed, sky condition and the proper rate of application. Generally speaking, Substrate primer will dry within 15 to 30 minutes when applied at 70° F or above. At 50° F, on a cloudy day, cure time may be extended to as much as one hour.
 6. Check several places on primed area for dryness prior to proceeding with the flashing application.

END OF SECTION 04 05 23

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SECTION 042100
MASONRY VENEER

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Exterior, non-load bearing masonry veneer units and supplementary items necessary for installation.

1.2 DEFINITIONS

- A. Masonry Veneer Terminology: Refer to BIA 2 and other referenced quality standards.

1.3 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each type of product and system indicated.
 - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
 - a. Kind, size, and color of masonry unit.
 - b. Manufactured accessory product.
 - c. Cleaning products, including application procedures.
- B. Shop Drawings: Show details of construction and installation, including plans, elevations, sections, details of components and attachments to other work. Distinguish between shop and field-assembled work. Including, but not limited to, the following:
 - 1. Flashing: Large-scale details for each element of flashing system showing layout, profiles, methods of joining, and anchorage details; including lintel units, shelf units, corner units, end dam units, conditions showing interface and relationship to adjacent materials, and other special applications.
 - 2. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
- C. Samples for Verification Purposes: Submit samples for each item listed below of size and construction indicated. Where products involve normal color and texture variations, include sample sets showing the full range of variations expected.
 - 1. Masonry Veneer: Full-size samples for each different unit indicated.
 - 2. Pigmented and Color Aggregate Mortar: Make samples using same sand and mortar ingredients to be used on Project; label samples to indicate type and amount of pigments used.
 - 3. Accessories: Samples of manufactured products, including anchors, ties, cavity drainage material, flashing materials, weeps, vents, and other accessories.
 - 4. Flashing: Samples of each shape, profile, intersection and transition required, not less than 12 in (300 mm) long, including end dam, and splice/lap joint for lintel and shelf angle flashing; demonstrate soldering quality.

1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturer Project Acceptance Document: Certification by the manufacturer that its product(s) are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required.
- B. Material Certificates: For each type and size of the following:
 - 1. Masonry units.
 - a. Include material test reports substantiating compliance with requirements.

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- b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
 - c. For exposed brick, include test report for efflorescence according to ASTM C67.
 - 2. Integral water repellant used in decorative CMU.
 - 3. Cementitious materials. Include name of manufacturer, brand name, and type.
 - 4. Mortar admixtures, if any.
 - 5. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
 - 6. Anchors, ties, and metal accessories.
 - C. Mix Designs: For each type of mortar. Include description of type and proportions of ingredients.
 - 1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C109/C109M for compressive strength, ASTM C1506 for water retention.
 - D. Field Quality Control Reports: Written report of testing and inspection required by Field Quality Control.
- 1.5 QUALITY ASSURANCE
- A. Quality Standards: In addition to specified requirements, comply with TMS 402/602 and local building code, whichever is more stringent.
 - B. Installer Qualifications:
 - 1. Experience: Installer personnel with not less than 10 years of experience in the successful performance of Work similar to scope of this Project.
 - 2. Supervision: Installer shall maintain a competent supervisor at Project while the Work is in progress, and who has not less than 10 years of experience installing products and systems similar to scope of this Project.
 - C. Hot and Cold Weather Work Plan: Written plan detailing methods, materials and equipment to be used to comply with weather requirements.
 - D. Masonry Veneer Cleaning Plan: Based on technical information provided by respective manufacturer for each masonry veneer unit to be cleaned, prepare written plan for cleaning exposed masonry veneer surfaces, prepared by commercial cleaning compound manufacturer, with signature of installer indicating acceptance and include following information:
 - 1. Qualifications of applicators.
 - 2. Products to be used and application procedures.
 - 3. Masonry veneer surfaces to be cleaned and required preparations.
 - 4. Environmental requirements by authorities having jurisdiction for use and discharge of cleaning effluents.
 - 5. Protection of surrounding areas, landscaping, and building surfaces adjacent to area of cleaning.
 - E. Sample Panels: Prior to installing masonry, build as many sample panels as required to verify selections made under submittals and to demonstrate aesthetic effects using specified materials:
 - 1. Build approximately 48 in (1200 mm) square for each type of exposed masonry units.
 - 2. Locate at locations indicated or, if not indicated, as directed by Architect.
 - 3. Clean exposed faces with masonry cleaner specified.
 - 4. Where masonry is to match existing masonry, erect panels adjacent and parallel to an existing, south-facing wall.
 - 5. Notify Architect 7 days in advance of the dates and times when panels will be constructed.

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6. Protect accepted approved sample panels with weather-resistant membrane.
7. Maintain during construction in an undisturbed condition as a standard for judging completed Work.
8. Acceptance Approval of panels is for following aesthetic qualities; acceptance approval does not constitute acceptance approval of deviations from Contract Documents, unless specifically accepted approved by Architect in writing:
 - a. Color, texture, and blending of masonry units.
 - b. Color and blending of mortar.
 - c. Relationship of mortar and sealant colors to masonry unit colors.
 - d. Tooling of joints.
 - e. Effectiveness of masonry cleaner.
 - f. Other aesthetic qualities as determined by the Architect.

9. When directed, demolish and remove mock-up from Project site, including foundations.

F. Mock-ups: Prior to fabrication and installation, build mock-up for each form of construction and finish required to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mock-up using materials indicated for the completed Work.

1. Build mock-up in the location and of the size indicated or, if not indicated, as directed by Architect. Contractor shall provide structural support framework.
 - a. Show typical components, attachments to building structure, and requirements of installation.
 - b. Include control joints and through wall flashing with drip edge.
2. Notify Architect seven days in advance of the dates and times when mock-up will be installed.
3. Obtain Architect's acceptance of mock-ups before starting fabrication or installation.
4. Acceptance of mock-ups does not constitute acceptance of deviations from the Contract Documents contained in mock-ups unless such deviations are specifically noted by Contractor and accepted by Architect in writing.
5. Demolish and remove mock-ups when directed by Architect unless accepted to become part of the completed Work.

1.6 PRE-INSTALLATION CONFERENCE

A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.

1. Participants:
 - a. Architect.
 - b. Contractor, including superintendent.
 - c. Installer, including project manager and supervisor.
 - d. If requested, Manufacturer's qualified technical representative.
 - e. Installers of other construction interfaced with Work.
2. Minimum Agenda: Installer shall demonstrate understanding of the Work required by describing detailed procedures for preparing, installing, and cleaning the Work. Demonstration shall include, but not be limited to, following topics:
 - a. Tour representative areas of Work, inspect and discuss condition of substrate, and other preparatory work performed by other trades.
 - b. Review Contract Document requirements.
 - c. Review approved submittals.
 - d. Review inspection and testing requirements.

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- e. Review environmental conditions and procedures for coping with unfavorable conditions.
 - f. Resolve deviations or differences between Contract Documents and the manufacturer's specifications.
 - 3. Record discussions, including decisions and agreements, and prepare report.
- 1.7 DELIVERY, STORAGE, AND HANDLING
- A. Delivery: Label pallets of masonry veneer units with manufacturers name, product name, and information required to identify products.
 - B. Storage:
 - 1. Masonry Veneer Units: Store on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
 - 2. Cementitious Materials: Store on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
 - 3. Aggregates: Store where grading and other required characteristics can be maintained and contamination avoided.
 - 4. Accessories: Store to prevent corrosion and accumulation of dirt and oil.
- 1.8 PROJECT CONDITIONS
- A. Protection during Work: Prevent excess moisture from entering Work in progress.
 - 1. Cover tops of walls, projections, and sills with water-repellent tarps or heavy plastic sheets at end of each day's Work.
 - 2. Cover partially completed masonry veneer when construction is not in progress.
 - 3. Extend cover minimum of 24 in (600 mm) down both sides and hold cover securely in place.
 - 4. Protect door and window frames from damage.
 - B. Stain Prevention: Prevent mortar and soil from staining exposed masonry veneer. Immediately remove mortar and soil from exposed masonry veneer.
 - 1. Protect base of walls from rain-splashed mud and mortar splatter.
 - 2. Protect sills, ledges, and projections from mortar droppings.
 - 3. Protect surfaces of window and door frames, and other adjacent with painted and integral finishes from mortar droppings.
 - 4. Turn scaffolding planks near Work on edge at end of each day to prevent rain from splashing mortar droppings or dirt onto face of exposed masonry veneer.
 - C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 402/602.
 - 1. Do not apply when ambient temperature is less than 32 deg F (0 deg C) or when 40 deg F (4.4 deg C) or less and falling.
 - 2. Provide heat and protection (temporary or permanent) as required to protect Work from freezing for not less than 48 hours after application.
 - 3. Distribute heat uniformly to prevent concentration of heat near sources; provide deflection or protective screens.
 - 4. Use liquid cleaning methods only when air temperature is 40 deg F (4.4 deg C) and above and will remain so until masonry veneer has dried, but not less than 7 days after completing cleaning.

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- D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 402/602.
 - 1. Protect Work against uneven and excessive evaporation and from strong flows of dry air, both natural and artificial.
 - 2. Apply and cure work as required by climatic and job conditions to prevent dryout during cure period.
 - 3. Provide suitable coverings, moist curing, barriers to deflect sunlight and wind, or combinations of these, as required.

1.9 COORDINATION

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND PRODUCTS

- A. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section Substitution Procedures.
- B. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other available manufacturers offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.

2.2 MATERIALS, GENERAL

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.
- B. Masonry Units: Obtain exposed masonry veneer units of a uniform texture and color, or a uniform blend within ranges accepted for these characteristics.
- C. Cementitious Materials: Obtain cementitious ingredients of a uniform quality, including color, for each component.

2.3 MASONRY UNITS, GENERAL

- A. Masonry Standard: Comply with TMS 602, except as modified by requirements in the Contract Documents.
- B. Defective Units: Referenced standards may allow a certain percentage of units to exceed tolerances and to contain chips, cracks, or other defects exceeding limits stated in standard. Do not install units where defects, including dimensions that vary from specified dimensions by more than stated tolerances, will be exposed in completed Work or will impair quality of completed masonry veneer.
- C. Special Shapes: Provide shapes indicated and as follows for each form of masonry unit required:
 - 1. For applications requiring units of form, color, texture, and size on exposed surfaces that cannot be produced by sawing standard unit sizes.
 - 2. For applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
 - 3. For applications where stretcher units cannot accommodate special conditions including those at corners, movement joints, bond beams, sashes, and lintels.

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4. For units without cores or frogs and with exposed surfaces finished for ends of sills, caps, and similar applications that would otherwise expose unfinished unit surfaces.

D. Match Existing Masonry Veneer: Wherever "match existing" indicated, provide masonry veneer unit of matching color, texture, and size as existing adjacent masonry veneer work.

2.4 FACE BRICK MASONRY UNITS

A. Product Quality Standard: ASTM C 216 or ASTM C 652, Grade SW, Type FBS.

1. Unit Compressive Strength: Minimum **3000 psi (20.7 MPa)** for average of 5 bricks, and **2500 psi (17.2 MPa)** for individual brick, gross area, according to ASTM C 67, Section 7.
2. Hot and Cold Water Testing:
 - a. Water Absorption: Maximum 17.0 percent for average of 5 bricks, and 20.0 percent for individual brick, according to ASTM C 67, Section 8 for 5 hour boiling test.
 - b. Saturation Coefficient: Maximum 0.78 for average of 5 brick, and 0.80 for individual brick.
 - c. Requirement Waivers:
 - 1) Absorption: Saturation coefficient requirement may be waived if there is maximum 8.0 percent absorption of random sampling of 5 bricks according to ASTM C 67, Section 8 for 24 hour submersion test.
 - 2) Freezing and Thawing: Water absorption and saturation coefficient requirements may both be waived if there is maximum 0.5 percent loss in dry weight of any individual brick according to ASTM C 67, Section 9, for 50 cycles of freezing and thawing.
3. Initial Rate of Absorption: Between 5 and 25 g/m per **30 sq in (0.02 sq m)** according to ASTM C 67, Section 10. Use of coating to establish initial rate of absorption is not permitted and will not be allowed.
4. Efflorescence: Rated "not effloresced" according to ASTM C 67, Section 11.
5. Surface Coloring: Brick with surface coloring, other than flashed or sand-finished brick, shall withstand 50 cycles of freezing and thawing according to ASTM C 67, Section 8, with no observable difference in applied finish when viewed from **10 ft (3 m)** under an minimum illumination of **50 foot-candles (538 lumen/square meter)**.

B. Basis of Design: As scheduled or as indicated in Design Selections.

2.5 CALCIUM SILICATE MASONRY UNITS

A. Product Quality Standard: ASTM C 73, Grade SW.

1. Compressive Strength: Minimum **6600 psi (45.5 MPa)** according to ASTM C 170.
2. Absorption: Maximum 8.8 percent according to ASTM C 97.
3. Density: Minimum **129 pcf (2066 kg/cu m)** according to ASTM C 97.
4. Modulus of Rupture: Minimum **770 psi (5.3 MPa)** according to ASTM C 99.
5. Freeze-Thaw Durability: No observable distress.

B. Basis of Design: As scheduled or as indicated in Design Selections.

2.6 DECORATIVE CONCRETE MASONRY UNITS

A. Product Quality Standard: ASTM C 90.

1. Unit Compressive Strength: Minimum average net area compressive strength of **1900 psi (13.1 MPa)** for 3 units, and minimum **1700 psi (11.7 MPa)** for individual unit.
2. Weight Classification: Medium weight.

B. Integral Water Repellent: Provide units made with integral water repellent.

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1. Description: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive according to ASTM E 514, with test period extended to 24 hours, show no visible water or leaks on back of test specimen.
2. Manufacturers and Products:
 - a. Addiment Inc.; Block Plus W-10.
 - b. Grace Construction Products; Dry-Block.

C. Basis of Design: As scheduled or as indicated in Design Selections.

2.7 PRE-FACED CONCRETE MASONRY UNITS

- A. Product Quality Standard: ASTM C 90, with manufacturer's standard smooth resinous facing complying with ASTM C 744.
 1. Unit Compressive Strength: Units with minimum average net-area compressive strength of **1900 psi (13.1 MPa)** for 3 units, and minimum **1700 psi (11.7 MPa)** for individual unit.
 2. Weight Classification: Lightweight.
- B. Basis of Design: As scheduled or as indicated in Design Selections.

2.8 SHELF ANGLES AND LINTELS

- A. Steel Angle Lintels: Materials complying with Division 05 Section Metal Fabrications for loose masonry lintels (Designation MF), with schedule as shown on the Drawings.
- B. Cast-in-Place Concrete Lintels: Concrete materials complying with Division 03 Section Cast-in-Place Concrete for color, texture, and compressive strength indicated or required, and with reinforcing bars to support loads indicated.
- C. Precast Concrete Lintels: As specified in Division 03 Section Architectural Precast Concrete.
- D. Masonry Lintels: Prefabricated or built-in-place masonry lintels as shown of the Drawings made from masonry units with reinforcing bars placed as indicated and filled with coarse grout. Cure prefabricated lintels before handling and installing.

2.9 MORTAR MATERIALS

- A. Portland Cement:
 1. Material Quality Standard: ASTM C 150, Type I; except Type III may be used for cold-weather construction.
 2. Color: Natural gray color or white cement as required to produce mortar color required.
 3. Manufacturers:
 - a. LafargeHolcim.
 - b. Lehigh Cement Co.
 - c. Lone Star Industries, Inc.
 - d. Rinker Materials.
 - e. Royal White Cement.
 4. Types of Cements Not permitted:
 - a. Masonry Cement: ASTM C 91.
 - b. Mortar Cement: ASTM C 1329.
- B. Hydrated Lime:
 1. Material Quality Standard: ASTM C 207, Type S.
 2. Manufacturers:

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- a. Graymont Dolime (OH) Inc.
 - b. Rockwell Lime Co.
- C. Portland Cement-Lime Mix: Packaged blend of Portland cement and hydrated lime containing no other ingredients.
 - 1. Product Quality Standard: ASTM C 144.
 - 2. Mortar Exposed to View: Use washed aggregate consisting of natural sand or crushed stone.
 - 3. Joints Less Than $\frac{1}{4}$ in (6 mm) Thick: Use aggregate graded with 100 percent passing No. 16 sieve.
- D. Aggregate for White Mortar: Natural white sand or ground white stone, as required to match approved sample.
- E. Aggregate for Colored Mortar: Natural sand or ground marble, granite, or other sound stone, as required to match approved sample.
- F. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979. Use only pigments with a record of satisfactory performance in masonry mortar.
 - 1. Quantity Limitations: Pigments shall not exceed 10 percent of Portland cement by weight for mineral oxides or 2 percent for carbon black.
 - 2. Manufacturers and Products:
 - a. Bayer Corp., Industrial Chemicals Div.; Bayferrox Iron Oxide Pigments.
 - b. Davis Colors; True Tone Mortar Colors.
 - c. Solomon Grind-Chem Service, Inc.; SGS Mortar Colors.
- G. Colored Portland Cement-Lime Mix: Packaged blend made from Portland cement and hydrated lime and mortar pigments, all complying with specified requirements, and containing no other ingredients.
 - 1. Quantity Limitations: Pigments shall not exceed 10 percent of Portland cement by weight or 2 percent for carbon black.
 - 2. Manufacturers and Products:
 - a. Capital Materials Corp.; Riverton Portland Cement Lime Custom Color.
 - b. Holcim (US) Inc.; Rainbow Mortamix Custom Color Cement/Lime.
 - c. LafargeHolcim; Eaglebond.
 - d. Lehigh Cement Company; Lehigh Custom Color Portland/Lime Cement.
- H. Water-Repellent Mortar Admixture for Decorative Concrete Masonry Units:
 - 1. Description: Liquid water-repellent mortar admixture intended for use with concrete masonry veneer units, containing integral water repellent by same manufacturer.
 - 2. Manufacturers and Products:
 - a. Addiment Inc.; Mortar Tite.
 - b. Grace Construction Products; Dry-Block Mortar Admixture.
 - c. Master Builders, Inc.; Color Cure Mortar Admix or Rheomix Rheopel.
- I. Water: Potable, clean and free of amounts of oils, acids, alkalies, salts, organic materials, or other substances that are deleterious to mortar or any metal within the wall.

2.10 REINFORCEMENT

- A. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.

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- B. Masonry Joint Reinforcement for Multi-wythe Masonry: As specified in Division 04 Section Concrete Unit Masonry.

2.11 VENEER ANCHORS AND TIES

- A. General: For attaching masonry veneer to a back-up structure, use two-piece assemblies that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall; suitable for attachment conditions indicated.
1. Corrugated ties are not permitted.
- B. Structural Performance Characteristics: Capable of withstanding a 100-lbf (445-N) load in both tension and compression without deforming or developing play in excess of 0.05 in (1.3 mm).
- C. Materials for Adjustable Masonry Veneer Anchors: Use one of the following. Mill-galvanized ties are not permitted.
1. Hot-Dip Galvanized Carbon-Steel Wire: ASTM A 82 / A 82M with ASTM A 153 / A 153M, Class B-2 coating.
 2. Steel Sheet, Galvanized after Fabrication: ASTM A 1008 / A 1008M, commercial sheet, hot-dip galvanized after fabrication to comply with ASTM A 153 / A 153M, Class B coating.
 3. Stainless Steel Wire: ASTM A 580 / A 580M, AISI Type 304.
 4. Stainless Steel Sheet: ASTM A 167, A 240, or A 666, AISI Type 304.
 5. Stainless-Steel Bars and Shapes for Stone Trim: ASTM A 276 or ASTM A 666, Type 304.
- D. Adjustable Anchors for Connecting to Concrete, CMU or Structural Steel:
1. Description: Two-piece adjustable veneer anchoring system.
 - a. Anchors: Zinc alloy barrel, flanged head, screw and eye, with drilling threads suitable for structural substrate.
 - b. Ties: Hot-dip galvanized, carbon-steel wire, 3/16 in (5 mm) pre-coated diameter, triangular shaped ties, size as required to provide maximum bond, not less than 2 in (50 mm).
 2. Basis of Design:
 - a. Heckmann Building Products, Inc.; POS-I-TIE Masonry Veneer Anchor System with Triangle Tie (with ThermalGrip CI Washers at Cavity Insulation).
 - b. Hohmann & Bernard, Inc.; Thermal Concrete 2-Seal Wing Nut Adjustable Thermal Veneer Anchor (with Wing Nut Anchor at Cavity Insulation).
 3. Basis of Design:
 - a. Heckmann Building Products, Inc.; POS-I-TIE Masonry Veneer Anchor System with Seismic Triangle Wire Tie (with ThermalGrip CI Washers at Cavity Insulation).
 - b. Hohmann & Bernard, Inc.; Thermal Concrete 2-Seal Wing Nut Adjustable Thermal Veneer Anchor with Seismic Hook to Accept Continuous Wire (with Wing Nut Anchor at Cavity Insulation).
- E. Adjustable Masonry Veneer Anchors for Sheathed Steel Studs Walls:
1. Anchor Plate: Minimum 0.0713 in (14 gage) (1.81 mm) uncoated base metal thickness, with raised strap stamped vertically into center to provide a slot between strap and plate for interlocking wire tie, with one screw hole at top and one at bottom; with rubberized asphalt flexible flashing material either adhered to back of plate, or loose for separate mounting.

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2. Wire Tie: Minimum **3/16 in (5 mm)** diameter, bent into triangle shaped tie; length as required to extend at least halfway through masonry veneer but with minimum **5/8 in (15 mm)** cover on outside face of masonry veneer.
 3. Manufacturers and Products:
 - a. Heckmann Building Products, Inc.; 315D Screw-On Anchor Plate with 316 Triangle Wire Ties.
 - b. Hohmann & Barnard, Inc.; DW-10HS Veneer Anchor with Vee Byne-Tie.
 - c. Prosoco; Masonry Veneer Tie (Anchor Plate and Wire Tie).
 - d. Wire-Bond; Type III Screw-On Anchor 1004 with 1100 Series Triangular Wire Tie.
- F. Adjustable Masonry Veneer Anchors for Sheathed Steel Studs Walls with Insulation in Cavity:
1. Anchor Plate: Minimum **0.0713 in (14 gage) (1.81 mm)** uncoated base metal thickness, with projecting horizontal tabs of length to allow for insulation thickness, with holes or slots to receive pintel legs, with two screw holes; with rubberized asphalt flexible flashing material either adhered to back of plate, or loose for separate mounting.
 2. Insulation Retainer: Manufacturer's standard designed to hold cavity insulation in place.
 3. Wire Pintel: Minimum **3/16 in (5 mm)** diameter, bent into open-end rectangle box shaped tie with 2 legs bent down to slip into anchor slot; length as required to extend at least halfway through masonry veneer but with minimum **5/8 in (15 mm)** cover on outside face of masonry veneer.
 4. Manufacturers and Products:
 - a. Hohmann & Barnard, Inc.; HB-213-2X Adjustable Veneer Anchor (Anchor Plate, Insulation Retainer and Wire Pintel).
 - b. Prosoco; Masonry Veneer Tie (Anchor Plate, Insulation Retainer and Wire Tie).
 - c. Wire-Bond; RJ-711 Adjustable Veneer Anchor (2401 Anchor Plate, Insulation Retainer and 2402 Wire Pintel).
- G. Stack Bond Adjustable Masonry Veneer Anchors for Sheathed Steel Studs Walls:
1. Anchor Plate: Minimum **0.1017 in (12 gage) (2.58 mm)** uncoated base metal thickness, with projecting horizontal tabs, with holes or slots to receive pintel legs, with two screw holes; with rubberized asphalt flexible flashing material either adhered to back of plate, or loose for separate mounting.
 2. Plate Pintel: Minimum **0.1017 in (12 gage) (2.58 mm)** uncoated base metal thickness, with down-turned leg to slip into anchor slot; with punched shear lugs for holding pencil rod.
 3. Pencil Rod: Deformed wire, **3/16 in (5 mm)** in diameter.
 4. Manufacturers and Products:
 - a. Hohmann & Barnard, Inc.; HB-213-2X SIS Seismic Veneer Anchor (HB-213 Adjustable Veneer Anchor, Wire Pintel with Seismicclip Interlock System).
 - b. Wire-Bond; RJ-721 Anchoring System (2421 Slotted Anchor Plate and 2422 Seismic Plate Pintel with Continuous Seismic Wire).
- H. Stack Bond Adjustable Masonry Veneer Anchors for Sheathed Steel Studs Walls with Insulation in Cavity:
1. Anchor Plate: Minimum **0.1017 in (12 gage) (2.58 mm)** uncoated base metal thickness, with projecting horizontal tabs of length to allow for insulation thickness, with holes or slots to receive pintel legs, with two screw holes; with rubberized asphalt flexible flashing material either adhered to back of plate, or loose for separate mounting.
 2. Insulation Retainer: Manufacturer's standard designed to hold cavity insulation in place.
 3. Plate Pintel: Minimum **0.1017 in (12 gage) (2.58 mm)** uncoated base metal thickness, with down-turned leg to slip into anchor slot; with punched shear lugs for holding pencil rod.

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4. Pencil Rod: Deformed wire, 3/16 in (5 mm) in diameter.
5. Manufacturers and Products:
 - a. Hohmann & Barnard, Inc.; HB-213-2X SIS Seismic Veneer Anchor (HB-213 Adjustable Veneer Anchor, Insulation Retainer, Wire Pintel with Seismicclip Interlock System).
 - b. Wire-Bond; RJ-721 Anchoring System (2421 Slotted Anchor Plate, Insulation Retainer and 2422 Seismic Plate Pintel with Continuous Seismic Wire).

I. Irregular Bond/Coursing Adjustable Masonry Veneer Anchors for Walls with Insulation in Cavity:

1. Description: Two-piece adjustable veneer anchoring system.
 - a. Anchors: Zinc alloy barrel, flanged head, screw and eye, with drilling threads suitable for structural substrate.
 - b. Insulation Retainer: Manufacturer's standard designed to hold cavity insulation in place.
 - c. Ties: Hot-dip galvanized, carbon-steel wire, 3/16 in (5 mm) pre-coated diameter, triangular shaped ties, size as required to provide maximum bond, not less than 2 in (50 mm).
2. Basis of Design:
 - a. Heckmann Building Products, Inc.; POS-I-TIE Masonry Veneer Anchor System (with ThermalGrip CI Washers).
 - b. Hohmann & Barnard, Inc.; Thermal Concrete 2-Seal Wing Nut Adjustable Thermal Veneer Anchor (with Wing Nut Anchor at Cavity Insulation).

J. Polymer-Coated Steel Drill Screws for Steel Studs:

1. Material Quality Standard: ASTM C 954.
2. Description: Self-drilling, hex washer head with bonded EPDM washer, screw of size and length required to penetrate steel stud flange by not less than 3 exposed threads; corrosion protective organic polymer coating with salt-spray resistance to red rust of more than 800 hours per ASTM B 117.
3. Manufacturers and Products:
 - a. Elco Construction Products; Dril-Flex with Stalgard finish.
 - b. ITW Buildex; Teks Maxiseal with Climaseal finish.

2.12 MISCELLANEOUS ANCHORS

- A. Dovetail Slots in Concrete for Shelf Angles: As specified in Division 03 Section Concrete Accessories unless indicated otherwise.

2.13 EMBEDDED FLASHING MATERIALS

- A. Sheet Metal Flashing: Metal flashing to comply with SMACNA's Architectural Sheet Metal Manual and as follows:

1. Material:
 - a. Quality Standard: ASTM A 240 / A 240M or A 666, Type 304.
 - b. Quality Standard: ASTM A 240 / A 240M or A 666, Type 316.
 - c. Description: Stainless steel, 2D annealed finish, not less than 0.0250 in (24 ga) (0.64 mm) thick, unless noted otherwise.
2. Solder:
 - a. Material Quality Standard: ASTM B 32, Grade Sn60.

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- b. Description: Solder with acid flux of type recommended by stainless steel sheet manufacturer; use a noncorrosive rosin flux over tinned surfaces.
- B. Sealant for Sheet Metal Flashing: Exterior non-sag silicone sealant, Class 100/50, as specified in Division 07 Section Joint Sealants.
- C. Sealant for Use at Concealed Joints: Contractor's option, one of the following:
 - 1. Butyl: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.
 - 2. Silicone: ASTM C 920, single-component, neutral cure silicone sealant.
 - a. Basis of Design: Dow; Dowsil 758 Silicone Weather Barrier Sealant.
- D. Rubberized-Asphalt Flexible Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.040 inch (1.02 mm).
 - 1. Manufacturers and Products:
 - a. Carlisle Coatings & Waterproofing; CCW-705-TWF Thru-Wall Flashing.
 - b. Dayton Superior Corporation, Dur-O-Wal Division; Dur-O-Barrier Thru-Wall Flashing.
 - c. GCP Applied Technologies; Perm-A-Barrier Wall Flashing.
 - d. Heckmann Building Products Inc.; No. 82 Rubberized-Asphalt Thru-Wall Flashing.
 - e. Hohmann & Barnard, Inc.; Textroflash.
 - f. W. R. Meadows, Inc.; Air-Shield Thru-Wall Flashing.
 - g. Polyguard Products, Inc.; Polyguard 400.
 - 2. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
 - 3. Compatibility: Flexible flashing shall be compatible with air and water barrier and approved by air and water barrier manufacturer in writing.
- E. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.14 ACCESSORIES

- A. Weeps and Vents: Provide one of the following:
 - 1. Plastic Weep and Vent:
 - a. Description: One-piece flexible extrusion made from ultraviolet light resistant polypropylene copolymer, consisting of honeycomb matrix of multiple cells, designed to fill head joint with outside face held back **1/8 in (3 mm)** from exterior face of masonry veneer.
 - b. Color: As selected by Architect from manufacturer's standard colors available.
 - c. Manufacturers and Products:
 - 1) Advanced Building Products, Inc.; Mortar Maze Weep Vents.
 - 2) Heckmann Building Products, Inc.; No. 85 Cell Vent.
 - 3) Hohmann & Barnard, Inc.; QV - Quadro-Vent.
 - 4) Wire-Bond; Cell Vent
 - 2. Mesh Weep and Vent:
 - a. Description: Compressed, 200 denier polyester with 90 percent open mesh and bonded with flame retardant adhesive.
 - b. Color: As selected by Architect from manufacturer's standard colors available.

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- c. Basis of Design: Mortar Net USA, Ltd.; Mortar Net Weep Vents.
 - B. Cavity Drainage Material:
 - 1. Description: Composed of either reticulated, nonabsorbent mesh made from polyethylene strands, or, polymer core geomatrix composed of woven nylon strands, molded and shaped in open weave configuration to maintain drainage at weeps without being clogged by mortar droppings, size as required to extend across entire width of cavity.
 - 2. Manufacturers and Products:
 - a. Advanced Building Products, Inc.; Mortar Break II.
 - b. Heckmann Building Products, Inc.; No. 84 Weep-Thru Mortar Deflector.
 - c. Mortar Net USA, Ltd.; Mortar Net.
 - d. Polyguard Products, Inc.; Termi-Net.
 - e. Wire-Bond; Cavity Net II.
 - C. Bond Breaker Strips:
 - 1. Material Quality Standard: ASTM D 226, Type I.
 - 2. Description: Asphalt-saturated organic roofing felt (No. 15 asphalt felt).
 - D. Termination Bars: ASTM A 666, Type 304 formed stainless steel flat bars; 1 in by 1/8 in (25 mm by 3 mm) thick; predrilled at 8 in (200 mm) centers. No aluminum or plastic bars allowed.
 - 1. Anchors: Same type screws as used to attach veneer wall ties.
 - E. Cavity Wall Insulation: As specified in Division 07 Section Thermal Insulation.
 - F. Barrier Sealing Tape: Air and water barrier sheet material laminated to adhesive coated rubberized asphalt or butyl. Refer to Division 07 Section Air and Water Barriers.
 - G. Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, trowel grade or low viscosity provided by waterproofing manufacturer.
 - H. Asphalt Mastic Dampproofing: Water-based, cold-applied, non-flammable, asphalt mastic emulsion with refined asphalt, non-asbestos mineral fibers, and clay fillers complying with ASTM D 1227, Type II, Class 1. Brush, roller, or trowel grade allowed. Include primer and accessories as required.
- 2.15 MASONRY VENEER CLEANERS
- A. Commercial Cleaning Compounds: Products as recommended and approved by masonry veneer and mortar manufacturers.
 - 1. Description: Manufacturer formulated, general purpose cleaner for removing mortar stains, efflorescence, and other construction related stains from new masonry veneer surfaces, with following suitability requirements:
 - a. Suitable for masonry veneer units and mortar installed, without discoloring or damaging masonry veneer materials.
 - b. Suitable for conditions at project site, including, but not limited to, windows, doors, other exterior wall elements, and adjacent walks or landscaping.
 - 2. Manufacturers:
 - a. Diedrich Technologies, Inc.
 - b. EaCoChem.
 - c. Prosoco, Inc.
 - B. Cleaning Restrictions: Following methods are not permitted nor will they be allowed:

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1. Hydrochloric acid.
2. Muratic acid.
3. Pressurized water blasting.
4. Abrasive blasting.

2.16 METAL FLASHING FABRICATION

- A. Field Measurements: Where metal flashing is to fit, cope, or be tailored to other construction, check actual dimensions of other construction by accurate field measurements before fabrication of metal flashing.
- B. Fabrication Procedures: Fabricate continuous flashings in sections 8 ft (2.4 m) long minimum, but not exceeding 12 ft (3.6 m). Provide splice plates at joints of formed, smooth metal flashing.
 1. Shop form flashing on a bending brake.
 2. Shape, trim and hand seam on bench as far as practical with proper tools.
 3. Form exposed metal Work without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated.
 4. Make angle bends and folds for interlocking metal with full regard for expansion and contraction to avoid buckling or fullness in metal after installation.
 5. Form materials to shape indicated with straight lines, sharp angles and smooth curves.
 6. Fold and hem exposed edges of flashings.
- C. Flashing Joinery: Fabricate interior and exterior corners, intersections, and complex flashing conditions in shop, rather than in field, with properly folded, constructed and continuous soldered joints. Field fabricated units are not permitted and will not be allowed.

2.17 MORTAR MIX

- A. General: Mix cementitious materials in a mechanical batch mixer with a sufficient amount of water to produce a workable consistency for minimum 3 minutes to 5 minutes; do not hand mix.
 1. Admixture Limitation: Do not use admixtures including air-entraining agents, accelerators, retarders, water repellent agents, antifreeze compounds, calcium chloride or other admixtures, unless otherwise indicated.
 - a. Decorative Concrete Masonry Units: Use water-repellent admixture in the mortar for decorative concrete masonry units only.
 2. Cementitious Limitation: Limit cementitious materials in mortar to Portland cement and lime.
 3. Ingredient Measurement: Measure in a one cubic foot batching box before mixing for component materials not pre-blended, prepackaged or containerized.
 4. Aggregate Moisture Content: Monitor moisture content of aggregates and exercise caution when mixing to avoid over or under-sanding of mortar.
- B. Pre-blended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a pre-blended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project.
- C. Mortar Mix:
 1. Mix Quality Standard: ASTM C 270, Proportion Specification for Portland cement-lime mortars, Type N.
 2. Mortar Color: Standard gray, unless indicated otherwise.
 3. Colored Pigmented Mortar: Select and proportion pigments with other ingredients to produce color required; limit mineral oxide pigments to maximum 10 percent of cement content by weight, and maximum 2 percent for carbon black pigment.

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4. Colored Aggregate Mortar: Produce mortar of color required by use of colored aggregates in combination with selected cementitious materials.
5. Match Existing Mortar: Wherever "match existing" indicated, provide masonry mortar of matching color and texture as existing adjacent masonry veneer work.
6. Basis of Design: As scheduled or as indicated in Design Selections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

3.2 INSTALLATION, GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
 1. Applicable portions of BIA Technical Notes on Brick Construction, if no other installation quality standard applies to condition.
 2. TMS 602 and local building code requirements.
 3. Respective manufacturer's written installation instructions.
 4. Accepted submittals.
 5. Contract Documents.

3.3 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.

3.4 INSTALLATION OF MASONRY VENEER

- A. Installation Performance Requirements: Ensure masonry cavity is properly isolated from building interior to prevent water infiltration from infiltrating out of masonry cavity into other components of building such as window and door jambs and building interiors.
- B. Openings: Leave for equipment to be installed before completion of masonry veneer; after installation of equipment, complete masonry veneer to match construction immediately adjacent to opening.
- C. Cutting: Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, un-chipped edges. Install cut units with cut surfaces and, where possible, cut edges concealed.
- D. Blending of Masonry Veneer Units: Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed. If color blending is a critical aspect of Work, manufacturer shall provide instructions for blending.
- E. Mortar Workability: Maintain by remixing or retempering; mortar with added color pigments shall not be re-tempered. Discard mortar that has begun to stiffen or is not used within 2.5 hours after initial mixing.

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- F. Match Existing Masonry Veneer: Match coursing and bonding of existing masonry veneer.

3.5 SHELF ANGLES AND LINTELS

- A. Steel Shelf Angles: Erection as specified in Division 05 Section Metal Fabrications.
- B. Steel Loose Lintels: Set where indicated or required, with not less than 8 in (200 mm) of bearing at each jamb, unless otherwise indicated.
- C. Precast Concrete Lintels: Set where indicated, with not less than 8 in (200 mm) of bearing at each jamb, unless otherwise indicated.
- D. Masonry Lintels: Construct in place using formwork and shoring of sufficient strength to support Work, until strength has been achieved and assembly is cured.

3.6 LAYING MASONRY VENEER WALLS

- A. General: Lay out walls in advance for accurate spacing of surface bond patterns, uniform joint thicknesses, accurate location of openings, movement-type joints, returns, and offsets. Avoid using of less than half-size units at corners, jambs, and where possible at other locations.
- B. Bond Patterns:
1. Exposed Masonry Veneer: Match coursing of existing masonry, unless otherwise indicated.
 2. Exposed Masonry Veneer: One-half running bond or one-third running bond as indicated.
 3. Exposed Masonry Veneer: Stack bond as indicated.
 4. Concealed Masonry Veneer: Lay units in a wythe in running bond or bonded by lapping not less than 2 in (50 mm) lap.
 5. Corners: Bond and interlock each course of each wythe. Do not use units with less than nominal 4 in (100 mm) horizontal face dimensions at corners or jambs.
 6. Mitered corners are not allowed.
- C. Stopping and Resuming Work: In each course, rack back one-half unit length for one-half running bond pattern or one-third unit for one-third running bond pattern; do not tooth. When resuming Work, clean masonry veneer surfaces that are to receive mortar, remove loose masonry veneer units and mortar.
- D. Built-In Work:
1. As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry veneer around built-in items.
 2. Fill space between steel frames and masonry veneer solidly with mortar, unless otherwise indicated.

3.7 MORTAR BEDDING AND JOINTING

- A. General Procedures:
1. Do not disturb previously laid units.
 2. Spread mortar for bed joint only so far ahead of laying units that mortar will be plastic when units are laid.
 3. Butter end of unit with ample mortar so that head joint is completely filled with mortar when placed.
 4. Do not deeply furrow bed joints or slush head joints.
 5. Avoid over-plumbing and pounding of corners and jambs to fit stretcher unit after setting in place. Where adjustments must be made after initial setting, remove mortar and replace with fresh mortar.

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6. Rock closures into place with both head joints and closure space spread with ample mortar. Place against adjacent units so that both horizontal and vertical joints are completely filled.
 - B. Mortar Joint Thickness: Minimum 3/8 in (10 mm) wide for head and bed joints.
 - C. Hollow Masonry Veneer Units: Lay with face shells fully bedded in mortar and with head joints of depth equal to bed joints; with entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.
 - D. Solid Masonry Veneer Units: Lay with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and place into wall construction. Do not deeply furrow bed joints or slush head joints.
 - E. Joint Tooling: Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.
 1. Make mortar joints straight, clean, and uniform in thickness. Tool joints to produce dense surface well bonded to edges.
 2. Joints which are not tight at time of tooling shall be raked out, pointed, and then tooled.
 3. Tool when mortar is partially set but still sufficiently plastic to bond.
 4. Use a tool which compacts mortar, pressing excess mortar out of joint rather than dragging it out.
 5. Tool vertical joint first.
 - F. Stone and Cast-Stone Trim Units: Lay with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and place into wall construction. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with water.
 1. Rake out mortar joints for pointing with sealant.
 2. Prepare and apply sealant of type and at locations indicated to comply with applicable requirements in Division 7 Section Joint Sealants.
- 3.8 MASONRY CAVITIES, WEEPS, AND VENTS
- A. Cavity Cleaning: Keep cavity clean of mortar droppings and other materials. Strike joints facing cavity flush.
 - B. Mortar Protection: Install cavity drainage material at base of cavity to protect bottom of cavity from mortar droppings that would prevent weeps from draining infiltrated water.
 - C. Cavity Wall Insulation: As specified in Division 07 Section Thermal Insulation. In addition, install continuous strip of cavity insulation, minimum 3 in (75 mm) wide, at edges of cavities adjacent to jamb of through-wall openings.
 - D. Weeps: Install weeps at maximum 32 in (800 mm) on centers in head joints of first course of masonry veneer immediately above embedded flashings.
 - E. Vents: Install vents at maximum 32 in (800 mm) on centers in head joints of topmost course of masonry veneer immediately below shelf angles, and at top of each continuous cavity.
- 3.9 ANCHORING MASONRY VENEER
- A. Adjustable Anchors for Connecting to Concrete, CMU or Structural Steel: Anchor masonry veneer to structural members where masonry veneer abuts or faces structural members to comply with following, with anchors embedded in masonry veneer joints and attached to structure:

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1. Unless otherwise indicated, provide an open space not less than **1 in (25 mm)** in width between back of masonry veneer and structural member. Keep open space free of mortar or other rigid materials.
 2. Anchor masonry veneer to structural members with anchors embedded in masonry joints and attached to structure.
 3. Space anchors vertically and horizontally as required for coursing with one anchor for every **2 sq ft (1858 sq cm)** of masonry veneer; stagger alternating anchors in each row.
 4. Asphalt Mastic Dampproofing Substrate: Apply a coating of liquid membrane behind through-wall attachments that penetrate asphalt mastic dampproofing.
 5. Sheet Membrane Substrate: Apply a coating of liquid membrane behind through-wall attachments that penetrate sheet membrane.
- B. Adjustable Masonry Veneer Anchors for Sheathed Steel Studs Walls: Anchor masonry veneer to sheathed steel studs with proper anchors.
1. Unless otherwise indicated, provide an open space not less than **2 in (50 mm)** in width between back of masonry veneer and face of sheathing or **1 in (25 mm)** from face of cavity insulation.
 2. Keep open space free of mortar or other rigid materials.
 3. Locate anchor plate portion of wall tie to allow maximum vertical differential movement of tie up and down.
 4. Space anchors at **16 in (400 mm)** on center vertically and **16 in (400 mm)** on center horizontally as required for coursing.
 5. Install additional anchors within **12 in (300 mm)** of openings and at maximum **8 in (200 mm)** on center around perimeter.
 6. Attach each anchor through sheathing to steel studs with 2 metal fasteners each.
 - a. Air and Water Barrier: Install a strip of barrier flashing tape behind through-wall attachments that penetrate air and water barrier. Seal all penetrations with weather barrier sealant
 7. Embed wall tie, in proper orientation, at least halfway through masonry veneer but with at least **5/8 in (15 mm)** cover on outside face of masonry veneer.
 8. Seismic Anchors and Ties: Install pencil rod continuous horizontally.
 9. Stack Bond Anchors and Ties: Install pencil rod continuous horizontally.

3.10 EMBEDDED FLASHINGS

- A. General: Drawings may not necessarily indicate or describe full extent of Work required for completion of embedded flashing.
- B. Reglets and Nailers: Install for flashing and other related construction where they are shown to be built into masonry.
- C. Scheduled Locations: In addition to conditions shown on Drawings, install embedded flashings within masonry cavity at following locations to direct downward flow of infiltrated water within cavity to exterior:
 1. Shelf angles with end dams at through-wall openings; and with lap joints.
 2. Lintels with end dams or laps.
 3. Jambs at through-wall openings, full height from sill to head.
 4. Other obstructions.
- D. Preparation: Substrate surfaces shall be smooth and free from projections that could puncture flashing.

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- E. Flashing Installation: Provide continuous support for flashings and ensure positive drainage to exterior.
1. Install sheet metal flashing true to line and levels indicated; minimize quantity of lap joints by using longest units possible.
 2. Set shaped sheet metal units in proper locations with outside hemmed edges flush with building face location indicated; attach cavity side flanges to sheathed steel stud wall with screw fasteners driven into studs.
 3. At continuous shelf angles, terminate horizontal flashings at through-wall openings with properly folded and constructed sheet metal end dams with a depth equivalent to one masonry veneer course, with continuous soldered joints.
 4. At lintels, terminate horizontal flashings at end of lintel with properly folded and constructed sheet metal end dams with a depth equivalent to one masonry veneer course, with continuous soldered joints.
 5. At lap joints of horizontal flashings, form neat and aligned joints by interlocking splice plate within hemmed edge of sheet metal flashing profile; apply sealant and rubberized asphalt flashing as indicated to create water-resistant joint.
 6. Set shaped sheet metal units at jambs of through-wall openings and lap inside of end dams at horizontal flashings below; coordinate installation with rigid cavity insulation.
 7. Seal cavity edges of sheet metal flashings within masonry cavity to sheathing with continuous rubberized asphalt flashing.
- F. Examination and Repair: Immediately prior to laying masonry veneer, examine exposed surfaces of flashing and seal penetrations and damaged areas with rubberized asphalt flashing material before covering with masonry veneer.
- G. Asphalt Mastic Dampproofing Application: Apply continuous layer of product, without pinholes or holidays, at below grade masonry veneer locations and as indicated on drawings. Apply at coverage rate instructed by manufacturer.
1. Repair voids and damage. Patch with additional layer of asphalt mastic dampproofing extending **6 in (150 mm)** beyond repaired areas in all directions.

3.11 MASONRY VENEER EXPANSION JOINTS

- A. General: Install masonry veneer expansion joints materials as Work progresses. Do not allow materials to span masonry veneer expansion joints without provision to allow for in-plane wall or partition movement. Maintain joints free and clear of mortar.
- B. Vertical Expansion Joints:
1. Locate where indicated but not to exceed **25 ft (7.6 m)** on center, and within **10 ft (3 m)**, **4 ft (1.22 m)** preferred, of each side of outside corner. Keep vertical joints straight, true, and continuous from top to bottom of masonry veneer.
 2. Form open joint of width indicated for installation of sealant and backer rod specified in Division 07 Section "Joint Sealants".
- C. Horizontal Joints: Build in horizontal pressure-relieving joints below shelf angles and where indicated; construct of width required for installation of sealant and backer rod specified in Division 07 Section "Joint Sealants". Locate not less than **3/8 in (9 mm)** wide horizontal pressure-relieving joints beneath shelf angles supporting masonry veneer and attached to structure behind masonry veneer.

3.12 INSTALLATION TOLERANCES

- A. Conspicuous Lines:
1. Vertical: For such conditions as external corners, door and window jambs, reveals, and masonry veneer expansion joints, maximum variation of the following from plumb:

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- a. $\frac{1}{8}$ in (3 mm) in 10 ft (3 m).
 - b. $\frac{1}{4}$ in (6 mm) in 20 ft (6 m).
 - c. $\frac{1}{2}$ in (12 mm) overall.
 2. Horizontal: For such conditions as exposed lintels, sills, door and window heads, parapets, and reveals, maximum variation of the following from level:
 - a. $\frac{1}{8}$ in (3 mm) in 10 ft (3 m).
 - b. $\frac{1}{4}$ in (6 mm) in 20 ft (6 m).
 - c. $\frac{1}{2}$ in (12 mm) overall.
 - B. Exposed Head Joints:
 1. Vertical Alignment: Maximum variation of the following from plumb:
 - a. $\frac{1}{4}$ in (6 mm) in 10 ft (3 m).
 - b. $\frac{1}{2}$ in (12 mm) from plumb top to bottom of wall.
 2. Thickness: Maximum variation from width indicated of plus or minus $\frac{1}{8}$ in (3 mm); maximum variation from adjacent bed joint and head joint thicknesses $\frac{1}{8}$ in (3 mm).
 - C. Exposed Bed Joints: Maximum variation from width indicated of plus or minus $\frac{1}{8}$ in (3 mm), with a maximum thickness limited to $\frac{1}{2}$ in (12 mm); maximum variation from bed joint thickness of adjacent courses of $\frac{1}{8}$ in (3 mm).
 - D. Flush Alignment: Maximum variation of $\frac{1}{16}$ in (1.5 mm) except due to warpage of masonry veneer units with tolerances specified for warpage of units.
 - E. Stack Bond: For exposed head joints and bed joints, maximum variation from a straight line of $\frac{1}{16}$ in (1.5 mm) from one masonry veneer unit to next.
- 3.13 FIELD QUALITY CONTROL
- A. Special Inspections: Owner will engage a qualified special inspector to perform special inspections and prepare reports:
 1. Special inspections in accordance with TMS 402/602 and the Building Code.
 2. Testing agency will report test results promptly and in writing to Contractor and Architect.
 - B. Tests and Inspections, General: Tests and inspections shall take place as installation proceeds to determine compliance with specified performance requirements.
 1. Correction of Deficiencies:
 - a. Materials and installation will be considered defective if they do not meet specified requirements.
 - b. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.
 - c. Perform additional tests and inspections, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.
 2. Prepare test and inspection reports.
- 3.14 ADJUSTING
- A. Repairs for Damage: Remove and replace masonry veneer units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units and install fresh mortar, pointed to eliminate evidence of replacement.
 - B. Pointing: During tooling of joints, enlarge any voids or holes, except weeps and vents, and completely fill with mortar. Point up all joints including corners, openings, and adjacent

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construction, to provide a neat, uniform appearance. Prepare joints for application of sealants, where indicated.

3.15 CLEANING

- A. In-Progress Cleaning: As soon as practical, clean masonry veneer as Work progresses by dry brushing to remove mortar fins and smears prior to tooling joints.
- B. Protection: Prior to Final Cleaning, protect surrounding areas, landscaping, adjacent surfaces, and vehicles from contact with cleaning products.
- C. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry veneer as follows:
 - 1. Protect adjacent and nearby materials, especially windows and glass, to avoid damage.
 - 2. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 - 3. Test cleaning methods on mock-ups; leave one half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of permanent masonry veneer.
 - 4. Clean masonry veneer by means recommended by cleaning product manufacturer using masonry cleaner compound as recommended and approved by masonry veneer and mortar manufacturers.
 - 5. Avoid drifting of cleaning spray caused by wind.

END OF SECTION

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SECTION 047500
ADHERED MASONRY VENEER

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Adhered masonry veneer and supplementary items necessary for installation.
1. Exterior, Framed Construction: Thick set installation including building paper, metal lath, MVIS scratch coat mortar and veneer setting bond coat mortar.
 2. Exterior, CMU Construction: Thick set installation including metal lath, MVIS air and water barrier, scratch coat mortar and veneer setting bond coat mortar.
 3. Exterior, Framed Construction: Thin set installation including building paper, exterior cementitious backer units, MVIS air and water barrier and veneer setting bond coat mortar.
 4. Exterior, CMU or Concrete Construction: Thin set installation including MVIS air and water barrier and veneer setting bond coat mortar.
 5. Exterior, Framed Construction with Continuous Insulation: Thin set installation with continuous insulation including sub-framing system, continuous mineral wool cavity insulation and exterior cementitious backer units, MVIS air and water barrier and veneer setting bond coat mortar.
 6. Interior, Framed Construction: Thin set installation including exterior cementitious backer units, MVIS veneer setting bond coat mortar.
 7. Interior, CMU or Concrete Construction: Thin set installation including MVIS veneer setting bond coat mortar.
- B. Related Requirements:
1. Refer to Division 01 Section Field Test for Air and Water Leakage.

1.2 DELEGATED ENGINEERING REQUIREMENTS FOR INSTALLATIONS USING SUB-FRAMING SYSTEMS

- A. Delegated Engineering Responsibility: Contractor shall engage a qualified professional engineer to provide engineering for products and systems required to comply with the design intent of Contract Documents.
1. Contract Documents Design Intent: Drawings and Specifications indicate design intent for products and systems and do not necessarily indicate or specify total Work required. Contract Documents shall not be construed as an engineered design; furnish and install Work required for a complete installation.
 2. Delegated Engineer Professional Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated with a record of successful in-service performance. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.
 3. Submittals: Preparation of structural analysis data including engineering calculations, shop drawings and other submittals signed and sealed by the qualified professional engineer.
 4. Coordination of Work:

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- a. Product Variations: In the event of minor differences between products and systems of acceptable or available manufacturers, Contractor shall notify Architect of such differences and resolve conflicts in a timely manner. Failure of Contractor to provide notification shall be construed as acceptance of conditions indicated, and changes caused by minor differences between products and Contract Documents shall be included in the Work at no additional cost to Owner.
- b. Allowable Adjustments: Minor dimension and profile adjustments may be made in interest of fabrication or erection methods or techniques or ability to satisfy design intent, provided design intent is maintained as determined by Architect. Proposed deviations shall include a detailed analysis of impact to adjacent substrates or other building systems, including related design or construction cost impacts. If accepted by Architect, deviations causing changes in materials, constructability, substrates, or conditions shall be included in the Work at no additional cost to Owner.

1.3 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
 - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
 - a. Kind, size, and color of masonry unit.
 - b. Manufactured accessory product.
 - c. Setting and grout products.
 - d. Cleaning products, including application procedures.
 - 2. MVIS Membrane Air and Water Barrier:
 - a. Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of products.
 - b. Include data on air and water-vapor permanence based on testing according to referenced standards.
 - c. Include VOC content of each material, and applicable legal limit in the jurisdiction of the project.
- B. Shop Drawings: Show details of construction, including dimensioned drawings, plans, elevations, sections, and details of components to be incorporated into Work including, but not limited to, the following:
 - 1. Masonry Veneer Units: Show sizes, profiles, and coursing.
 - 2. Special Masonry Veneer Shapes: Submit large-scale details for each shape required or indicated.
 - 3. Wall panel assembly including sub-framing and attachments.
 - a. Shop drawings shall contain seal of a professional engineer currently registered in licensing jurisdiction of the project and a written statement that the framing system conforms to project requirements, applicable codes, and specified conditions.
 - 4. Flashing: Large-scale details for each element of flashing system showing layout, profiles, methods of joining, and anchorage details; including lintel units, shelf units, corner units, end dam units, conditions showing interface and relationship to adjacent materials, and other special applications.
 - 5. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
 - 6. Accessories: Show sizes, coursing, and locations.
 - 7. Movement Joints: Show expansion and control joint locations in substrate and veneer.

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- C. Samples for Verification Purposes: Submit samples for each item listed below of size and construction indicated. Where products involve normal color and texture variations, include sample sets showing the full range of variations expected.
1. Masonry Units: Full-size samples for each different type of veneer unit indicated.
 2. Pigmented and Color Aggregate Mortars and Grouts: Make samples using same sand and mortar ingredients to be used on Project. Label Samples to indicate types and amounts of pigments used.
 3. Accessories: Samples of manufactured products, including flashing materials and other accessories.
 4. Flashing: Samples of each shape, profile, intersection and transition required, not less than 12 in (300 mm) long, including end dam and splice/lap joint for flashing; demonstrate soldering quality.
 5. Exposed Sealants: For each type and color of joint sealant required. Install joint sealants in 1/2 in (12 mm) wide joints formed between two 6 in (150 mm) long strips of material matching the appearance of construction adjacent to joint sealants.
 6. MVIS Fluid Applied Air and Water Barrier Assembly: Minimum 8-1/2 in by 11 in (212 mm by 275 mm).
- D. List of Materials Used in Constructing Wall Mock-ups:
1. Product, material, and equipment names, model numbers, lot numbers, batch numbers, source of supply, and other information required to identify items used. Include mix proportions for mortar and source of aggregates.
 2. Receipt of list does not constitute acceptance of deviations from Contract Documents, unless such deviations are specifically accepted by Architect in writing.

1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Project Acceptance Document: Certification by the manufacturer that its product(s) are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required.
1. Submit valid UL Evaluation Report or Evaluation Service Report (ESR) issued by International Code Council (ICC-ES) for cladding systems used in Project.
- B. Delegated Engineering Submittal: For products and systems indicating compliance with performance requirements. Include structural analysis, calculations and other performance data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Pre-Construction Test Reports: Written reports from independent testing agency required by "Quality Assurance".
1. Submit Bond Strength Test Reports for mortar adhesion.
- D. Field Quality Control Reports: Written report of testing and inspection required by "Field Quality Control".
- E. Warranty:
1. Provide manufacturer's written warranty covering materials and installation (labor) stating obligations, remedies, limitations, and exclusions.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Instructions: Include in operation and maintenance manual as required by Division 01 Section "Closeout Procedures". Submit manufacturer's instructions for maintenance of installed work, including methods and frequency for maintaining optimum

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condition under anticipated use. Include precautions against cleaning materials and methods which may be detrimental to finishes and performance.

1.6 QUALITY ASSURANCE

- A. Quality Standards: In addition to specified requirements, comply with ACI 530.1/ASCE 5/TMS 402 for adhered masonry veneer classification and prescriptive requirements and local building code, whichever is more stringent.
- B. Installer Qualifications:
 - 1. Experience: Installer's personnel with not less than 10 years of experience in the successful performance of Work similar to scope of this Project.
 - 2. Supervision: Installer shall maintain a competent supervisor at Project while the Work is in progress, and who has not less than 10 years of experience installing products and systems similar to scope of this Project.
 - 3. Manufacturer Acceptance: Installer shall be certified, approved, licensed, or acceptable to manufacturer to install products.
- C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1093 to conduct the testing indicated.
- D. Pre-Construction Setting Mortar Testing: Employ and pay an independent testing agency to perform pre-construction testing to establish compliance of proposed Work with requirements.
 - 1. General Requirements: Test mortar for composition to establish code compliance and standard for field testing specified under "Field Quality Control" Article.
 - 2. Bond Strength Test Method: ANSI 137.1 / ASTM C 482 Test Method for Bond Strength of Ceramic Tile to Portland Cement.
 - 3. Reports: Interpret test results and prepare certified reports.
 - 4. Retesting: Retesting of materials failing to meet requirements shall at Contractor's expense.
- E. Hot and Cold Weather Work Plan: Written plan detailing methods, materials and equipment to be used to comply with weather requirements.
- F. Masonry Veneer Cleaning Plan: Based on technical information provided by respective manufacturer for each masonry veneer unit to be cleaned, submit written plan for cleaning exposed masonry veneer surfaces, prepared by commercial cleaning compound manufacturer, with signature of installer indicating acceptance and include following information:
 - 1. Qualifications of applicators.
 - 2. Products to be used and application procedures.
 - 3. Masonry veneer surfaces to be cleaned and required preparations.
 - 4. Environmental requirements by authorities having jurisdiction for use and discharge of cleaning effluents.
 - 5. Protection of surrounding areas, landscaping, and building surfaces adjacent to area of cleaning.
- G. Sample Panels: Prior to installing masonry, build as many sample panels as required to verify selections made under submittals and to demonstrate aesthetic effects using specified materials:
 - 1. Build approximately 48 in (1200 mm) square for each type of exposed masonry units.
 - 2. Locate at locations indicated or, if not indicated, as directed by Architect.
 - 3. Clean exposed faces with masonry cleaner specified.

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4. Where masonry is to match existing masonry, erect panels adjacent and parallel to an existing, south-facing wall where available.
 5. Notify Architect 7 days in advance of the dates and times when panels will be constructed.
 6. Protect accepted sample panels with weather-resistant membrane.
 7. Maintain during construction in an undisturbed condition as a standard for judging completed Work.
 8. Acceptance of panels is for following aesthetic qualities; acceptance does not constitute acceptance of deviations from Contract Documents, unless specifically accepted by Architect in writing:
 - a. Color, texture, and blending of masonry units.
 - b. Color and blending of mortar.
 - c. Relationship of mortar and sealant colors to masonry unit colors.
 - d. Tooling of joints.
 - e. Effectiveness of masonry cleaner.
 - f. Other aesthetic qualities as determined by the Architect.
 9. When directed, demolish and remove sample panels from Project site, including foundations.
- H. Mock-ups: Prior to fabrication and installation, build mock-up for each form of construction and finish required to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mock-up using materials indicated for the completed Work.
1. Build mock-up in the location and of the size indicated or, if not indicated, as directed by Architect. Contractor shall provide structural support framework.
 - a. Show typical components, attachments to building structure, and requirements of installation.
 2. Notify Architect seven days in advance of the dates and times when mock-up will be installed.
 3. Obtain Architect's acceptance of mock-ups before starting fabrication or installation.
 4. Acceptance of mock-ups does not constitute acceptance of deviations from the Contract Documents contained in mock-ups unless such deviations are specifically noted by Contractor and accepted by Architect in writing.
 5. Demolish and remove mock-ups when directed by Architect unless accepted to become part of the completed Work.
- 1.7 PRE-INSTALLATION CONFERENCE
- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.
1. Participants:
 - a. Architect.
 - b. Contractor, including superintendent.
 - c. Installer, including project manager and supervisor.
 - d. If requested, Manufacturer's qualified technical representative.
 - e. Installers of other construction interfaced with Work.
 2. Minimum Agenda: Installer shall demonstrate understanding of the Work required by describing detailed procedures for preparing, installing, and cleaning the Work. Demonstration shall include, but not be limited to, following topics:

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- a. Tour representative areas of Work, inspect and discuss condition of substrate, and other preparatory work performed by other trades.
 - b. Review Contract Document requirements.
 - c. Review approved submittals.
 - d. Review inspection and testing requirements.
 - e. Review environmental conditions and procedures for coping with unfavorable conditions.
 - f. Resolve deviations or differences between Contract Documents and the manufacturer's specifications.
 3. Record discussions, including decisions and agreements, and prepare report.
- 1.8 DELIVERY, STORAGE, AND HANDLING
- A. Delivery: Label pallets of masonry veneer units with manufacturers name, product name, and information required to identify products.
 - B. Storage:
 1. Masonry Veneer Units: Store on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
 2. Cementitious Materials: Store on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
 3. Aggregates: Store where grading and other required characteristics can be maintained and contamination avoided.
 4. Accessories: Store to prevent corrosion and accumulation of dirt and oil.
- 1.9 PROJECT CONDITIONS
- A. Protection during Work: Prevent excess moisture from entering Work in progress.
 1. Cover tops of walls, projections, and sills with water-repellent tarps or heavy plastic sheets at end of each day's Work.
 2. Cover partially completed masonry veneer when construction is not in progress.
 3. Extend cover minimum of 24 in (600 mm) down both sides and hold cover securely in place.
 4. Protect door and window frames from damage.
 - B. Stain Prevention: Prevent mortar and soil from staining exposed masonry veneer. Immediately remove mortar and soil from exposed masonry veneer.
 1. Protect base of walls from rain-splashed mud and mortar splatter.
 2. Protect sills, ledges, and projections from mortar droppings.
 3. Protect surfaces of window and door frames, and other adjacent materials with painted and integral finishes from mortar droppings.
 4. Turn scaffolding planks near Work on edge at end of each day to prevent rain from splashing mortar droppings or dirt onto face of exposed masonry.
 - C. Cold Weather Requirements: Comply with building code and referenced quality standard whichever is more stringent, and the following:
 1. Provide heat and protection (temporary or permanent) as required to protect Work from freezing after application.
 2. Distribute heat uniformly to prevent concentration of heat near sources; provide deflection or protective screens.
 3. Do not use frozen materials or materials mixed or coated with ice or frost.
 4. Do not build on frozen substrates.

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5. Remove and replace masonry veneer damaged by frost or freezing conditions.
- D. Warm Weather Requirements: Comply with building code and referenced quality standard whichever is more stringent, and the following:
 1. Protect Work against uneven and excessive evaporation and from strong flows of dry air, both natural and artificial.
 2. Apply and cure work as required by climatic and job conditions to prevent dryout during cure period.
 3. Provide suitable coverings, moist curing, barriers to deflect sunlight and wind, or combinations of these, as required.
- 1.10 COORDINATION
 - A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.
- 1.11 WARRANTY
 - A. MVIS Manufacturer's Warranty: Furnish manufacturer's written material and labor warranty signed by an authorized representative using manufacturer's standard form agreeing to furnish materials and labor required to repair or replace work which exhibits material defects caused by manufacture or design and installation of product. "Defects" is defined to include but not limited to deterioration or failure to perform as required.
 1. Warranty Period: Installer shall warrant the products to be free from material and labor Defects for a period of 15 years from date of Substantial Completion.
 - B. Installer's Warranty: Furnish installer's written material and labor warranty signed by an authorized representative using installer's standard form agreeing to furnish materials and labor required to repair or replace work which exhibits material or workmanship defects caused by manufacture or design and installation of product. "Defects" is defined to include but not limited to deterioration or failure to perform as required.
 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, loss of adhesion.
 - b. Deterioration of materials beyond normal weathering.
 2. Warranty Period: Installer shall warrant the products to be free from material and labor Defects for a period of 5 years from date of Substantial Completion.
 - C. If exploratory work is required to determine the cause of the defects, the cost of such work shall be borne by the Contractor if the work is found to be defective as judged by the Architect.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND PRODUCTS

- A. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".
- B. Basis of Design (Product Standard): Contract Documents are based on products specified to establish a standard of quality. Other acceptable manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and do not change intended aesthetic, functional and performance requirements as judged by Architect.

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1. Selections: As scheduled or as indicated in Design Selections.

2.2 MATERIALS, GENERAL

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials
- B. Masonry Units: Obtain exposed masonry veneer units of a uniform texture and color, or a uniform blend within ranges accepted for these characteristics.
- C. Cementitious Materials: Obtain cementitious ingredients of a uniform quality, including color, for each component.
- D. Defective Units: Do not install units where defects, including dimensions that vary from specified dimensions by more than stated tolerances, will be exposed in completed Work or will impair quality of completed masonry.
- E. Special Shapes: Provide shapes indicated and as follows for each form of masonry veneer unit required:
 1. For applications requiring units of form, color, texture, and size on exposed surfaces that cannot be produced by sawing standard unit sizes.
 2. For applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
 3. For applications where stretcher units cannot accommodate special conditions including those at L-shape corners, substrate construction and movement joints, bond beams, sashes, and lintels.
 4. For units with exposed surfaces such as ends of sills, caps, and similar applications that would otherwise expose unfinished unit surfaces.

2.3 PERFORMANCE REQUIREMENTS

- A. General Performance: Comply with performance requirements specified, as determined by testing of products and systems representing those indicated for this Project, without failure due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Structural Loads: Engineer products and systems to withstand loads within limits of allowable working stresses of the materials involved under conditions indicated including, but not limited to gravity, wind, seismic, and erection design loads and thermal movements established by authorities having jurisdiction, applicable building codes, and as indicated.
 1. Wind Loads: As indicated on Drawings.
 2. Other Loads: As indicated on Drawings.
- C. Structural Movement: Engineer system to withstand movements of supporting structure including, but not limited to inter-story drift, twist, column shortening, long-term creep and deflection from uniformly distributed and concentrated live loads.
 1. Live Load Deflection: Accommodate differential vertical deflection of floors:
 - a. Deflection: As indicated on Drawings.
- D. Seismic Performance: Systems shall withstand the effects of earthquake motions determined in accordance with the building code and authorities having jurisdiction.
- E. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:
 1. Temperature Change (Range): 120 deg F (49 deg C), ambient; 180 deg F (82 deg C), material surfaces.

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- F. Dimensional Tolerances: Engineer products and systems to accommodate dimensional tolerances of framing members and adjacent construction.
- G. Adhesion Performance: Adhesion between masonry veneer unit and backing shall have shear bond strength of not less than 180 psi (kPa) according to ANSI 137.1 / ASTM C 482.
- H. Shape Limitations of Individual Units:
 - 1. Maximum Weight at Exterior Locations: Not to exceed 15 lb/sq ft (73.2 kg/sq m).
 - 2. Maximum Weight at Interior Locations: Not to exceed 20 lb/sq ft (97.6 kg/sq m).
 - 3. Maximum Dimension in Any One Face: Not to exceed 36 in (900 mm).
 - 4. Overall Face Area: Not to exceed 720 sq in (0.464 sq m).
 - 5. Thickness:
 - a. Not less than as indicated.
 - b. Not more than 2-5/8 in (65 mm).
- I. Shape Limitations of Individual Units - Exterior Porcelain Tile:
 - 1. Maximum Weight at Exterior Locations: Not to exceed 9 lb/sq ft (43.9 kg/sq m).
 - 2. Maximum Dimension in Any One Face: Not to exceed 24 in (600 mm).
 - 3. Overall Face Area: Not to exceed 432 sq in (0.28 sq m).
 - 4. Thickness:
 - a. Not less than as indicated.
 - b. Not more than 5/8 in (15 mm).

2.4 THIN BRICK MASONRY UNITS

- A. Product Quality Standard: ASTM C 216, Type FBX or ASTM C 1088, Grade Exterior, Type TBX, not less than 1/2 in (12 mm) at the narrowest point, with a tolerance of plus or minus 1/16 in (1.5 mm).
 - 1. Special Shapes: Include corners, edge corners, and end edge corners.
 - 2. Back Surface Texture: Scored, combed, wire roughened, ribbed, keybacked, or dovetailed.
 - 3. Initial Rate of Absorption: Less than 30 g/30 sq. in. (30 g/194 sq. cm) per minute; ASTM C 67.
 - 4. Efflorescence: Tested according to ASTM C 67 and rated "not effloresced."
 - 5. Surface Coating: Thin brick with colors or textures applied as coatings shall withstand 50 cycles of freezing and thawing; ASTM C 67 with no observable difference in applied finish when viewed from 10 ft (3 m).

2.5 SUBFRAMING

- A. Metal Sub-framing and Furring: Provide manufacturer standard sections as required for support and alignment of panels.
 - 1. Sub-girts, Zee Clips, Base or Sill Angles or Channels: Provide manufacturer's standard sections as required for support and alignment of system, type as recommended by panel manufacturer.
 - a. Metallic Coated Steel Sheet: ASTM C645, cold-formed, metallic-coated steel sheet, ASTM A792/A792M, Class AZ50 (Class AZM150) aluminum-zinc-alloy coating designation unless otherwise indicated.
 - 1) Thickness: Not less than 0.063 inch, 16 gage nominal thickness.

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- b. Aluminum Sheet: Clear anodized sheet, ASTM B209 (ASTM B209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
 - 1) Thickness: Not less than 0.064 inch, 14 gage nominal thickness.
- c. Aluminum Extrusions: ASTM B 221 / B 221M, alloy and temper recommended by panel manufacturer for type of use.
- 2. Fasteners for Sub-framing and Furring: Self-tapping screws, bolts, nuts, and other suitable fasteners, Series 300 stainless steel of size, corrosion resistance, holding power, and other properties required to comply with performance requirements.
 - a. Provide fasteners with EPDM or PVC sealing washers.

2.6 THERMAL INSULATION

- A. Refer to Division 7 Section Thermal Insulation for mineral wool cavity insulation requirements.

2.7 EXTERIOR CEMENTITIOUS BACKER UNITS

- A. Cementitious Backer Units: ASTM C1325, Type A.
 - 1. Manufacturer and Product: National Gypsum Company; PermaBase Cement Boards.
 - a. Thickness: 1/2 inch (12.7 mm) (13 mm).
 - 2. Comply with UL Evaluation Report UL ER22158-01.
- B. Fasteners: Wafer head screws, Series 300 stainless steel of size, corrosion resistance, holding power, and other properties required to comply with performance requirements, as recommended by manufacturer for this installation.
- C. Joint Treatments: Cement mortar and 4 in wide alkali-resistant, fiberglass mesh tape as recommended by manufacturer.

2.8 MVIS AIR AND WATER BARRIER, FLUID APPLIED

- A. Performance Requirements - MVIS Air and Water Barrier Assembly:
 - 1. General: Air and water barrier shall be capable of performing as a continuous vapor-permeable air barrier and as a liquid-water drainage plane. Air and water barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, tie-ins to embedded flashing, tie-ins to installed waterproofing, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.
 - a. Assembly shall perform as a drainage plane flashed to discharge condensation or water penetration to the exterior.
 - b. Assembly shall accommodate movements of building materials by providing expansion and control joints as required, with accessory air and water seal materials at such locations, changes in substrate and perimeter conditions.
 - c. Assembly shall be capable of withstanding positive and negative combined design wind pressures on the envelope without damage or displacement.
 - d. Assembly shall be joined in an airtight and flexible manner to the air and water barrier material of adjacent assemblies, allowing for the relative movement of assemblies due to thermal and moisture variations and creep, and anticipated seismic movement.
 - 2. Connections to Adjacent Materials: Provide connections to prevent air leakage and water migration at the following locations:

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- a. Foundation and walls, including penetrations, ties and anchors.
 - b. Walls, windows, curtain walls, storefronts, louvers or doors.
 - c. Different wall assemblies and fixed openings within those assemblies.
 - d. Wall and roof connections.
 - e. Floors over unconditioned space.
 - f. Walls, floor and roof across construction, control and expansion joints.
 - g. Walls, floors and roof to utility, pipe and duct penetrations.
 - h. Seismic and expansion joints.
 - i. Other leakage pathways in the building envelope.
3. MVIS Air and Water Barrier: Liquid membrane with an installed dry film thickness according to manufacturer's written instructions, over smooth, void-free substrates.
- a. Basis of Design: Laticrete MVIS Air and Water Barrier, spray or roller applied air and moisture barrier material.
4. Sheathing Joint Treatments: Self-curing liquid rubber polymer and flexible, non-woven fabric mesh designed for use with air and water barrier as recommended by manufacturer.
- a. Basis of Design: Laticrete; Waterproofing/Anti-Fracture Fabric.
- B. Accessory Materials:
1. General: Accessory materials recommended by air and water barrier manufacturer to produce a complete air and water barrier assembly and compatible with primary air and water barrier material.
- a. Provide primers, transition strips, termination strips, joint reinforcing fabric and strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air and water barrier manufacturer to produce a complete air and water barrier assembly and that are compatible with primary air and water barrier material and adjacent construction to which they may seal.
2. One-Piece Electrical Box: Rigid reinforced polyethylene electrical box designed to prevent leaks at air and water barrier, with fixed or adjustable flange to suit installation conditions, with clear hinged weatherproof in-use cover.
- a. Basis of Design: Arlington Industries, Inc.; In Box.

2.9 MORTAR

- A. Material Quality Standards: ANSI A118 Series as indicated.
- B. Mortar:
1. Material Quality Standard: ANSI A118.4, manufacturer's premium, single component system for mixing at time of installation.
2. Basis of Design:
- a. Laticrete International, Inc.; Laticrete MVIS Masonry Veneer Mortar.
 - b. Laticrete International, Inc.; Laticrete MVIS Hi-Bond Masonry Veneer Mortar.
- C. Latex-Portland Cement Sanded Grout for Joints Greater than 1/8 in (3 mm) Wide:
1. Material Quality Standard: ANSI A118.7, with following physical properties:
- a. Manufacturer's premium polymer modified sanded grout product.

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- b. Integral antimicrobial product added during manufacturing to resist mold and mildew growth.
 - 2. Basis of Design:
 - a. Laticrete International, Inc.; Premium Masonry Pointing Mortar.
- 2.10 JOINT SEALANTS
 - A. Refer to Division 7 Section Joint Sealants for sealing joints.
 - 1. Provide silicone sealant recommended by MVIS manufacturer in locations required for MVIS System Warranty.
- 2.11 EMBEDDED FLASHINGS
 - A. Sheet Metal Flashing: Metal flashing, where flashing is exposed or partly exposed and where indicated, complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:
 - 1. Material:
 - a. Material Quality Standard: ASTM A 240 / A 240M or A 666, Type 304.
 - b. Material Quality Standard: ASTM A 240 / A 240M or A 666, Type 316.
 - c. Description: Stainless steel, 2D annealed finish, not less than 0.0250 in (24 ga) (0.64 mm) thick, unless noted otherwise.
 - 2. Solder:
 - a. Material Quality Standard: ASTM B 32, Grade Sn60.
 - b. Description: Solder with acid flux of type recommended by stainless steel sheet manufacturer; use a noncorrosive rosin flux over tinned surfaces.
 - B. High-Temperature Rubberized Asphalt Flashing:
 - 1. Description: Minimum 40 mils (1.0 mm) thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
 - 2. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F (116 deg C).
 - 3. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F (29 deg C).
 - 4. Available Manufacturers and Products:
 - a. Carlisle Coatings & Waterproofing; CCW WIP 300HT.
 - b. Grace Construction Products; Ultra.
 - c. Henry Company; Blueskin PE200 HT.
 - d. Metal-Fab Manufacturing, LLC; MetShield.
 - e. Owens Corning; WeatherLock Metal High Temperature Underlayment.
 - 5. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.
- 2.12 METAL LATH
 - A. Metal Lath:
 - 1. Product Quality Standard: ASTM C 847 with ASTM A 653 / A 653M, G60 (Z180), hot-dip galvanized zinc coating.

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2. Description: Expanded, diamond mesh lath, 3.4 lb/sq yd (1.8 kg/sq m), of following types:
 - a. Self-furred (dimpled) over solid substrates.
 3. Manufacturers:
 - a. Alabama Metal Industries Corp. (AMICO); a Gibraltar Industries Company.
 - b. California Expanded Metal Co. (CEMCO).
 - c. Clarkwestern Dietrich Building Systems.
 - d. Marino / WARE.
 - e. Niles Building Products Co.
 - f. Phillips Manufacturing Co.
- B. Lath Tie Wire: ASTM A 641 / A 641M, Class 1 galvanized, not less than 0.0475 in (18 ga) (1.2 mm) diameter, soft temper.
- C. Strip Lath Reinforcement:
1. Product Description: Strips of expanded, self-furred, diamond mesh lath, 3.4 lb/sq yd (1.8 kg/sq m), not less than 6 in (150 mm) wide, with smooth edges.
 2. Material Quality Standard: Hot-dip galvanized steel, ASTM A 653 / A 653M, G60 (Z180) zinc coating.
 3. Available Manufacturers and Products:
 - a. Alabama Metal Industries Corp. (AMICO); Striplath.
 - b. California Expanded Metal Co. (CEMCO); Stripite.
 - c. Clarkwestern Dietrich Building Systems; Striplath.
- D. Inside Corner Reinforcement:
1. Product Description: Strips of galvanized expanded metal lath, minimum 3 in (75 mm) wide flanges, folded to 105 degrees, with smooth edges.
 2. Material Quality Standard: Hot-dip galvanized steel, ASTM A 653 / A 653M, G60 (Z180) zinc coating.
 3. Manufacturers and Products:
 - a. Alabama Metal Industries Corp. (AMICO); Cornalath.
 - b. California Expanded Metal Co. (CEMCO); Cornerite.
 - c. Clarkwestern Dietrich Building Systems; Cornerite.
- E. Screw Fasteners for Attaching Metal Lath to Sheathed Steel Studs:
1. Product Quality Standard: ASTM C 1063.
 2. Description: Self-drilling and self-tapping screws with pan or wafer type head of size to engage 3 strands of lath; fabricated from corrosive resistant or nonferrous metal; in lengths required to achieve minimum penetration of 3/8 in (10 mm) beyond stud.
- F. Power Actuated Fasteners for Metal Lath to Cementitious Substrates:
1. Product Quality Standard: ANSI A10.3.
 2. Product Description: Low velocity, powder actuated fasteners, stainless steel drive pins, length as required for minimum 3/4 in (19 mm) long penetration, with washers sized engage 3 strands of lath; powder loads suitable for application indicated; sufficient to correctly attach or anchor metal lath to substrate indicated without failure.
 3. Available Manufacturers:
 - a. Hilti Corp.
 - b. ITW Ramset/Red Head.
 - c. Powers Fasteners.

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- d. Simpson Strong Tie Anchor Systems.

2.13 RELATED MATERIALS

A. Building Paper:

1. Product Quality Standard: Fed. Spec. UU-B-790a, Type 1, Grade D, Style 2.
2. Description: Two-ply asphalt saturated Grade D vapor permeable sheathing paper.
3. Minimum Physical Properties and Performance Requirements:
 - a. Water Penetration Resistance: 110 minutes according to ASTM D 779.
 - b. Water Vapor Transmission: 10 perms Minimum Vapor Transmission according to ASTM E 96, Procedure A.
4. Manufacturer and Product: Fortifiber Corp.; Two Ply Jumbo Tex.

2.14 MASONRY VENEER CLEANERS

A. Commercial Cleaning Compounds: Products as recommended and approved by masonry veneer and mortar manufacturers.

1. Description: Manufacturer formulated, general purpose cleaner for removing mortar stains, efflorescence, and other construction related stains from new masonry veneer surfaces, with following suitability requirements:
 - a. Suitable for masonry veneer units and mortar installed, without discoloring or damaging masonry veneer materials.
 - b. Suitable for conditions at project site, including, but not limited to, windows, doors, other exterior wall elements, and adjacent walks or landscaping.
2. Manufacturers:
 - a. Diedrich Technologies, Inc.
 - b. EaCoChem.
 - c. Prosoco, Inc.

B. Cleaning Restrictions: Following methods are not permitted nor will they be allowed:

1. Hydrochloric acid.
2. Muratic acid.
3. Pressurized water blasting.
4. Abrasive blasting.

2.15 METAL FLASHING FABRICATION

A. Field Measurements: Where metal flashing is to fit, cope, or be tailored to other construction, check actual dimensions of other construction by accurate field measurements before fabrication of metal flashing.

B. Fabrication Procedures: Fabricate continuous flashings in sections 8 ft (2.4 m) long minimum, but not exceeding 12 ft (3.6 m). Provide splice plates at joints of formed, smooth metal flashing.

1. Shop form flashing on a bending brake.
2. Shape, trim and hand seam on bench as far as practical with proper tools.
3. Form exposed metal Work without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated.
4. Make angle bends and folds for interlocking metal with full regard for expansion and contraction to avoid buckling or fullness in metal after installation.
5. Form materials to shape indicated with straight lines, sharp angles and smooth curves.
6. Fold and hem exposed edges of flashings.

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- C. Flashing Joinery: Fabricate interior and exterior corners, intersections, and complex flashing conditions in shop, rather than in field, with properly folded, constructed and continuous soldered joints. Field fabricated units are not permitted and will not be allowed.

2.16 SETTING MORTAR AND GROUT MIX

- A. General Procedures:
 - 1. Mix to comply with referenced quality standards and manufacturers' written instructions.
 - 2. Add materials, water, and additives in accurate proportions.
 - 3. Use type of mixing equipment, speeds, containers, time, and other procedures to produce uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

3.2 INSTALLATION, GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to most restrictive of the following standards:
 - 1. ACI 530.1/ASCE 5/TMS 402 and local building code.
 - 2. Respective manufacturer's written installation instructions.
 - 3. Accepted submittals.
 - 4. Contract Documents.
 - 5. ANSI A108.5.

3.3 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants or errors which would result in poor or potentially defective installation or would cause latent defects in Work.
 - 1. Verify that concrete substrates are dry and free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with adhered masonry veneer.
 - a. If necessary, shot-blast concrete substrate with an apparatus recommended by setting materials manufacturer.
 - b. Repair damaged and deteriorated concrete.
 - c. Use patching and fill material to fill holes and depressions in substrates.

3.4 INSTALLING BUILDING PAPER

- A. Install building paper barrier over the face of air and water barrier:
 - 1. Beginning at bottom of substrate wall, align horizontally; pull taut to eliminate fish mouths, wrinkles, buckles, and kinks; install in shingled manner to shed water without interception by exposed edges.

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2. Offset building paper joints from sheet air and water barrier; lap horizontal joints 6 in (150 mm); lap vertical end joints 12 in (300 mm); stagger end laps; lap 12 in (300 mm) at inside and outside corners; lap flashing 6 in (150 mm).

3.5 INSTALLING METAL LATH

- A. Installation of Metal Lath at Sheathed Steel Stud Walls covered with Building Paper and Air and Water Barrier:
 1. Install multiple sheets of metal lath to form continuous plane over substrates.
 2. Layout and arrange so that metal lath joints will not occur over vertical and horizontal laps of previously installed weather resisting sheets.
 3. Begin installation at bottom of substrate wall; install with long dimension at horizontal and stagger vertical end laps.
 4. Lap horizontal sides not less than 1/2 in (12 mm), and securely tie between steel stud supports with lath tie wire at not more than 9 in (225 mm) on centers vertically.
 5. Securely attach metal lath to each steel stud support with screw fasteners at not more than 7 in (175 mm) on centers vertically.
 6. Lap vertical ends not less than 1 in (25 mm).
 - a. If lap occurs over a steel stud support, securely attach with screw fasteners at not more than 7 in (175 mm) on centers vertically.
 - b. If lap does not occur over a steel stud support, securely tie with lath tie wire at not more than 9 in (225 mm) on centers vertically.
 7. Screw fasteners shall extend through not less than 3 strands of metal lath, weather resisting sheets, gypsum sheathing and into steel stud; tip of fastener shall extend beyond stud not less than 3/8 in (10 mm).
 8. Expansion Joints: Do not extend metal lath behind or across expansion joints; attach each side of metal lath to separate joint accessory flange.
 9. Control Joints: Extend metal lath behind or across control joints. Install control joints on top of metal lath without cutting the lath behind the control joint.
 10. Do not attach metal lath to horizontal deflection track at top of wall framing.

3.6 INSTALLATION OF SUBFRAMING

- A. Subframing and Supports: Install sub-framing, furring, and other panel support members and anchorages according to panel manufacturer's written recommendations and delegated engineering submittal for this installation.

3.7 INSTALLATION OF CEMENTITIOUS BACKER UNITS

- A. Install panels and treat joints according to manufacturer's written instructions for type of application indicated.
- B. Comply with UL Evaluation Report UL ER22158-01.

3.8 INSTALLATION OF MVIS AIR AND WATER BARRIER

- A. Apply air and water barrier material to form a seal with strips and transition strips and to achieve a continuous air and water barrier according to air and water barrier manufacturer's written instructions and details. Apply air and water barrier material within manufacturer's recommended application temperature ranges.
- B. Transition and Detailing Treatment: Install appropriate materials to treat cementitious backer unit joints, expansion joints, drift joints, rough openings, transitions, terminations, penetrations and similar surface irregularities. Transitions and detailing can be performed before or after air and

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water barrier membrane application. Ensure installation is performed in accordance with manufacturers written installation instructions and details.

- C. One-Piece Electrical Box: Install in accordance with manufacturer's recommendations. Cover shall project from face of wall surface enough to allow hinged cover to fully open for access.
- D. Do not cover air and water barrier until it has been tested and inspected by Owner's testing agency.
- E. Correct deficiencies in or remove air and water barrier that does not comply with requirements; repair substrates and reapply air and water barrier components.

3.9 INSTALLATION OF ADHERED MASONRY VENEER UNITS

- A. Openings: Leave for equipment to be installed before completion of masonry veneer; after installation of equipment, complete masonry veneer to match construction immediately adjacent to opening.
- B. Cutting: Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, un-chipped edges. Install cut units with cut surfaces and, where possible, cut edges concealed.
- C. Layout: Lay out walls in advance for accurate spacing of surface bond patterns, uniform joint thicknesses, accurate location of openings, movement-type joints, returns, and offsets. Avoid using of less than half-size units at corners, jambs, and where possible at other locations.
 - 1. Masonry veneer shall not be placed over building expansion or control joints. Provide movement joints and continue construction, control, and expansion joints in building structure or substrate construction through masonry veneer work and as indicated on Drawings.
 - 2. Provide movement joints where masonry veneer work abuts a restraining structure or dissimilar assembly.
 - 3. When metal trim or sealant/backer is used for joint, width shall not be less than width of joint in building structure.
- D. Blending of Masonry Veneer Units: Mix units for exposed unit masonry from several pallets or cubes as they are placed to produce uniform blend of colors and textures. If color blending is a critical aspect of Work, manufacturer shall provide instructions for blending.
- E. Work Pattern: Begin Work at bottom of wall and proceed up, or begin and proceed down wall, according to manufacturer's instructions.
- F. Built-In Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry veneer around built-in items.
- G. Thick Set Adhering Method - Metal Lath and Scratch Coat Substrate: Adhere masonry veneer units to cured scratch coat using bond coat mortar according to manufacturer's instructions:
 - 1. Scratch Coat: Nominal 1/2-inch-thick (12.7 mm) layer of latex modified Portland cement mortar shall be applied, encapsulating the lathing. The surface of this mortar shall be scored horizontally, resulting in a scratch coat.
 - 2. Adhering Veneer: Masonry veneer units shall be adhered to the mortar scratch coat with a nominal 1/2-inch-thick (12.7 mm) setting bed of latex modified Portland cement mortar applied to create a full setting bed for the back of the masonry veneer units. Masonry veneer units shall be worked into the setting bed resulting in a nominal 3/8-inch (9.5 mm) setting bed after the masonry veneer units are applied.

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- a. Use sufficient setting mortar so a slight excess will be forced out the edges of masonry units as they are set. Tap units into place, completely filling space between units and scratch coat to provide 100 percent coverage according to manufacturer instructions.
 - b. Remove excess mortar; do not allow mortar to dry on face of units.
 - H. Thin Set Adhering Method - Framed Construction with Cementitious Backer Unit Substrate: Adhere masonry veneer units to CBU using bond coat mortar according to manufacturer's instructions:
 - 1. Adhering Veneer: Masonry veneer units shall be adhered to the CBU substrate with a nominal 1/2-inch-thick (12.7 mm) setting bed of latex modified Portland cement mortar applied to create a full setting bed for the back of the masonry veneer units. Masonry veneer units shall be worked into the setting bed resulting in a nominal 3/8-inch (9.5 mm) setting bed after the masonry veneer units are applied.
 - a. Use sufficient setting mortar so a slight excess will be forced out the edges of masonry units as they are set. Tap units into place, completely filling space between units and CBU to provide 100 percent coverage according to manufacturer instructions.
 - b. Remove excess mortar; do not allow mortar to dry on face of units.
 - I. Thin Set Adhering Method - Masonry or Concrete Construction: Adhere masonry veneer units to masonry or concrete substrates using bond coat mortar according to manufacturer's instructions:
 - 1. Adhering Veneer: Masonry veneer units shall be adhered to the masonry or concrete substrate with a nominal 1/2-inch-thick (12.7 mm) setting bed of latex modified Portland cement mortar applied to create a full setting bed for the back of the masonry veneer units. Masonry veneer units shall be worked into the setting bed resulting in a nominal 3/8-inch (9.5 mm) setting bed after the masonry veneer units are applied:
 - a. Use sufficient setting mortar so a slight excess will be forced out the edges of masonry units as they are set. Tap units into place, completely filling space between units and masonry or concrete to provide 100 percent coverage according to manufacturer instructions.
 - b. Remove excess mortar; do not allow mortar to dry on face of units.
 - J. Joints:
 - 1. Using a grout bag, fill joints with setting mortar.
 - 2. Finish joints that will remain exposed with a tool slightly larger than joint width to form a concave profile. Tool joints after mortar has taken its initial set and in such a manner as to squeeze mortar back into joint.
- 3.10 EMBEDDED FLASHINGS
- A. General: Drawings may not necessarily indicate or describe full extent of Work required for completion of embedded flashing.
 - B. Reglets and Nailers: Install for flashing and other related construction where they are shown.
 - C. Scheduled Locations: In addition to conditions shown on Drawings, install embedded flashings at following locations to direct infiltrated water to exterior:
 - 1. Heads, jambs and sills at through-wall openings.
 - 2. Other obstructions.

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- D. Preparation: Substrate surfaces shall be smooth and free from projections that could puncture flashing.
- E. Flashing Installation:
 - 1. Install true to line and levels indicated; minimize quantity of lap joints by using longest units possible.
 - 2. Set in proper locations with outside hemmed edges flush with building face location indicated; securely attach to substrate with same fasteners as used for attaching metal lath.
 - 3. Terminate ends of horizontal flashings with properly folded and constructed end dams with a depth of not less than indicated, with continuous soldered joints.
 - 4. At lap joints of horizontal flashings, form neat and aligned joints by interlocking splice plate within hemmed edge of sheet metal flashing profile; apply sealant and rubberized asphalt flashing as indicated to create water-resistant joint.
- F. Examination and Repair: Immediately prior to installing masonry veneer, examine exposed surfaces of flashing and seal penetrations and damaged areas with rubberized asphalt flashing material before covering with masonry veneer.

3.11 MASONRY VENEER EXPANSION JOINTS

- A. General: Install masonry veneer expansion joints materials as Work progresses. Do not allow materials to span masonry veneer expansion joints without provision to allow for in-plane wall or partition movement. Maintain joints free and clear of mortar.
 - 1. Movement joints including expansion, deflection and control joints shall align through substrate and masonry veneer.
- B. Distance between Control Joints: 1/2 in (12 mm) wide joints not more than 12 ft (3.6 m) on center each direction and a length-to-width ratio of 2-1/2 to 1.
 - 1. Vertical Surfaces: Not more than 144 sq. ft. (13.4 sq. m).
 - 2. Horizontal Surfaces: Not more than 100 sq. ft. (9.3 sq. m).
- C. Form open joint of width indicated for installation of sealant and backer rod specified in Division 07 Section "Joint Sealants".
- D. Build in horizontal pressure-relieving joints where indicated; construct of width required.

3.12 INSTALLATION TOLERANCES FOR BRICK

- A. Conspicuous Lines:
 - 1. Vertical: For such conditions as external corners, door and window jambs, reveals, and masonry veneer expansion joints, maximum variation of the following from plumb:
 - a. 1/8 in (3 mm) in 10 ft (3 m).
 - b. 1/4 in (6 mm) in 20 ft (6 m).
 - c. 1/2 in (12 mm) overall.
 - 2. Horizontal: For such conditions as exposed lintels, sills, door and window heads, parapets, and reveals, maximum variation of the following from level:
 - a. 1/8 in (3 mm) in 10 ft (3 m).
 - b. 1/4 in (6 mm) in 20 ft (6 m).
 - c. 1/2 in (12 mm) overall.
- B. Exposed Head Joints:
 - 1. Vertical Alignment: Maximum variation of the following from plumb:

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- a. 1/4 in (6 mm) in 10 ft (3 m).
 - b. 1/2 in (12 mm) from plumb top to bottom of wall.
 - 2. Thickness: Maximum variation from width indicated of plus or minus 1/8 in (3 mm); maximum variation from adjacent bed joint and head joint thicknesses 1/8 in (3 mm).
 - C. Exposed Bed Joints: Maximum variation from width indicated of plus or minus 1/8 in (3 mm), with a maximum thickness limited to 1/2 in (12 mm); maximum variation from bed joint thickness of adjacent courses of 1/8 in (3 mm).
 - D. Flush Alignment: Maximum variation of 1/16 in (1.5 mm) except due to warpage of masonry veneer units with tolerances specified for warpage of units.
 - E. Stack Bond: For exposed head joints and bed joints, maximum variation from a straight line of 1/16 in (1.5 mm) from one masonry veneer unit to next.
- 3.13 FIELD QUALITY CONTROL
- A. Manufacturer's Field Service: Manufacturer's qualified technical representative shall periodically inspect Work to ensure installation is proceeding in accordance with manufacturer's designs, recommendations, instructions, and warranty requirements. Representative shall submit written reports of each visit indicating observations, findings, and conclusions of inspection.
 - 1. Manufacturer's Technical Representative Qualifications: Direct employee of technical services department of manufacturer with experience in providing recommendations, observations, evaluations, and problem diagnostics.
 - B. Owner Testing Agency: The Owner may employ and pay a qualified independent testing agency to perform field quality control.
 - 1. Refer to Division 01 Section Field Test for Air and Water Leakage.
 - 2. Refer to Division 01 Building Enclosure Commissioning Plan for Field Observations and Performance Testing.
 - C. Tests and Inspections, General: Tests and inspections shall take place as installation proceeds to determine compliance with specified performance requirements.
 - 1. Correction of Deficiencies:
 - a. Materials and installation will be considered defective if they do not meet specified requirements.
 - b. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.
 - c. Perform additional tests and inspections, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.
 - 2. Prepare test and inspection reports.
 - D. Contractor Testing Agency: Employ and pay a qualified independent testing agency to perform field quality control.
 - 1. Testing: Testing agency will test and evaluate Work during construction as necessary but not less than at following times during Work.
 - a. First day.
 - b. 5 percent.
 - c. 15 percent.
 - d. 30 percent.

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- e. 60 percent.
 - f. 90 percent.
- 2. Bond Strength Test Method: ANSI 137.1 / ASTM C 482 Test Method for Bond Strength of Ceramic Tile to Portland Cement.
 - 3. Inspections: Testing agency will visit project site periodically at random, but not less than once during each week of masonry veneer Work, to inspect progress and to ascertain if Work complies with Contract Documents. Allow inspectors access to scaffolding and Work areas, as needed to perform inspections. Inspections will include verification that:
 - a. Materials are properly stored.
 - b. Installation is within specified construction tolerances.
 - c. Proper mortar ingredients and mixing techniques are being used.
 - d. Mortar time on board is within specified limits.
 - e. Setting mortar bed is within specified limits.
 - f. Joints are being properly tooled.
 - g. Flashing assembly is being properly fabricated and installed.
 - h. Masonry veneer expansion joints are being installed as indicated or as specified.

3.14 ADJUSTING

- A. Repairs for Damage: Remove and replace masonry veneer units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units and install fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During tooling of joints, enlarge any voids or holes, except weeps and vents, and completely fill with mortar. Point up all joints including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for application of sealants, where indicated.

3.15 CLEANING

- A. In-Progress Cleaning: As soon as practical, clean masonry veneer as Work progresses by dry brushing to remove mortar fins and smears prior to tooling joints.
- B. Protection: Prior to Final Cleaning, protect surrounding areas, landscaping, adjacent surfaces, and vehicles from contact with cleaning products.
- C. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry veneer as follows:
 - 1. Protect adjacent and nearby materials, especially windows and glass, to avoid damage.
 - 2. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 - 3. Test cleaning methods on mock-ups; leave one half of panel uncleaned for comparison purposes. Obtain Architect's acceptance of sample cleaning before proceeding with cleaning of permanent masonry veneer.
 - 4. Clean masonry veneer by means recommended by cleaning product manufacturer using masonry cleaner compound as recommended and approved by masonry veneer and mortar manufacturers.
 - 5. Avoid drifting of cleaning spray caused by wind.

3.16 ADHERED MASONRY SCHEDULE

- A. Basis of Design: AMVXX
 - 1. Manufacturer:

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2. Product Series:
 3. Color Name and Number:
 4. Face Style:
 5. Color Selection:
 6. Size (Actual Dimensions)
 - a. Width:
 - b. Height:
 - c. Length:
 - d. Vertical Coursing:
- B. Basis of Design: AMVXX
1. Manufacturer:
 2. Product Series:
 3. Color Name and Number:
 4. Face Style:
 5. Color Selection:
 6. Face Size: <Insert dimensions.>
- C. Basis of Design: AMVXX
1. Manufacturer:
 2. Product Series:
 3. Color Name and Number:
 4. Face Style:
 5. Color Selection:
 6. Size (Actual Dimensions)
 - a. Width: 1 in (25 mm).
 - b. Height: 7-5/8 in (190 mm).
 - c. Length: 15-5/8 in (390 mm).
- D. Basis of Design: AMVXX
1. Manufacturer / Quarry:
 2. Product Series:
 3. Color Name and Number:
 4. Face Style:
 5. Color Selection:
 6. Size (Actual Dimensions)
 - a. Width: 3/4 in (19 mm).
 - b. Height: 7-5/8 in (190 mm).
 - c. Length: 15-5/8 in (390 mm).

END OF SECTION

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SECTION 051200

STRUCTURAL STEEL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes structural steel and supplementary items necessary to complete work required for its fabrication, erection, and installation.
- B. Related Sections:
 - 1. Division 01 Section "Quality Requirements" for independent testing agency procedures and administrative requirements.
 - 2. Division 05 Section Metal Fabrications for miscellaneous steel fabrications and other metal items not defined as structural steel.
 - 3. Division 05 Section "Metal Stairs."
 - 4. Division 09 painting Sections and Division 09 Section "High-Performance Coatings"

1.3 DEFINITIONS

- A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.4 PERFORMANCE REQUIREMENTS

- A. Connections: Provide details for connections required by the Structural Documents to be selected or completed by structural-steel fabricator to withstand LRFD Factored loads indicated and comply with other information and restrictions indicated.
 - 1. Select and complete connections using schematic details indicated and AISC 360
 - 2. Engineering Responsibility: Fabricator's responsibilities include using a qualified Professional Engineer registered in the state of the project to prepare and submit the structural analysis data for structural-steel connections.

1.5 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections.
 - 1. Shop drawings shall not be made by using reproductions of Contract Drawings.
 - 2. Shop drawing shall be submitted through General Contractor to Architect. Any fabrication of material before approval of drawings will be at risk of Contractor.
 - 3. Fabricated material and connections shall fit within architectural constraints.
 - 4. Fabricator alone shall be responsible for errors of detailing and fabrication.
- B. Product Data: Submit manufacturer's certification and test data that following furnished items conform to the specifications for each type of product indicated.

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- C. Shop Drawings: Submit in advance of fabrication, complete shop drawings necessary for fabrication of each component of the structural steel frame. Shop drawings shall be prepared under direct supervision of a Registered Professional Engineer and include the following:
1. Erection drawings ("E" Sheets) shall include dimensions for alignment and elevation of each member, locations of members and attachments, and required number and location of shear connectors on each member.
 2. Indicate piece marks for field assembly, bill of materials, and material specifications
 3. Piece drawings shall include member size, length and camber. Show details of cuts, copes, bevels, connections, splices, holes, and other pertinent data.
 4. Setting drawings, templates and directions for installation of anchor bolts and other anchorage devices embedded in concrete or masonry work.
 5. Indicate welds by standard AWS D1.1/D1.1M symbols, distinguish between shop and field welds, show size, length, and type of each weld.
 - a. Special conditions shall be fully explained by added notes or details.
 - b. Welding symbols for groove welds shall indicate groove depth required to obtain specified effective throat thickness for welding process and position of welding to be used.
 - c. Details of groove welds, joints, and preparation of base material shall be referenced to pre-qualified joints specified in AWS D1.1/D1.1M and shall clearly distinguish between complete joint penetration and partial joint penetration.
 - d. Fillet weld symbols shall indicate required weld size to obtain required effective throat thickness and effective length.
 6. Indicate bolt type, size, and length. Indicate the bolt hole type and size. Distinguish between shop and field bolts. Identify pre-tensioned and slip-critical high-strength bolted connections. Indicate special washers or plate washers where necessary.
 7. For structural-steel connections indicated to comply with design loads, include structural analysis data signed and sealed by the qualified Professional Engineer responsible for their preparation registered in the state of the project.
- D. Mill test reports.
1. Fabricator/Erector shall provide affidavit stating that structural steel furnished meets requirements of ASTM Specifications for grade furnished.
 2. Steel material not represented by certified mill test reports shall be tested by the Testing Agency in accordance with ASTM at the contractor's expense.
- E. Welding certificates: Provide an affidavit that each welder in the fabrication process or on site holds current qualifications per AWS D1.1/D1.1M. Maintain records on site for review by the owner's inspection agency for erector's welders.
- F. Welding Procedures:
1. Provide Welding Procedure Specifications (WPS) and Procedure Qualification Records (PQR) according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for each welded joint whether prequalified or qualified by testing.
 2. Procedures for both shop and field weld processes shall be prepared similar to AWS sample written procedures and shall be submitted to the Engineer of Record, be made available to testing agency, and posted next to welding equipment prior to use.
 3. The WPS shall contain the actual values and allowed ranges to be used for the welding so that complete setup and weld completion instruction is provided to welders; as a minimum the WPS shall list the following:
 4. The written WPS should be developed by a competent welding engineer, and the individual welding parameters should be within the electrode manufacturer's range of operation.
 5. For WPS which require qualification, Procedure Qualification Records (PQR) shall also be submitted for acceptance. Production welding heat input shall be limited based on the PQR.

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- G. Erection Procedures:
 - 1. Submit descriptive data to illustrate structural steel erection procedures, include the following:
 - a. Sequence of erection.
 - b. Temporary guying and bracing required during erection prior to making permanent connections.
- H. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- I. Qualification Data: Submit evidence of installer and fabricator qualifications in conformance with Quality Assurance requirements below.
- J. Source and field quality-control documentation.
 - 1. At completion of fabrication, per the building code special inspection requirements, the fabricator shall submit a certificate of compliance to the Engineer of Record and enforcement agency stating that the work was performed in accordance with the approved construction documents.
 - 2. Submit test reports as required for indicating compliance with the Quality Control sections below.
 - 3. Submit to Testing Agency reports of non-destructive testing required of them. These reports shall be on AWS D1.1/D1.1M suggested forms. Qualification of the fabricator's inspectors and NDT personnel shall be submitted to enforcement agency for acceptance, if required.
- K. Contractor shall submit to the Engineer of Record and the enforcing agency, for acceptance, a quality control or inspection plan that addresses all inspection issues, including in process and final inspection that are addressed in AWS D1.1/D1.1M.

1.6 QUALITY ASSURANCE

- A. Codes and Standards: Comply with provisions of following, except as otherwise indicated:
 - 1. International Building Code 2021 Edition (IBC). All following code and standard versions shall be as referenced by IBC chapter 35, or, where not referenced in IBC, the most recent published versions.
 - 2. Special Inspection and Quality Control requirements, chapter 17 of the International Building Code and any local or state provisions or amendments.
 - 3. American Institute of Steel Construction (AISC) 303 "Code of Standard Practice for Steel Buildings and Bridges."
 - 4. AISC 360 "Specification for Structural Steel Buildings".
 - 5. OSHA 1926 Subpart R – Safety and Health Regulations for Construction - Steel Erection.
 - 6. RCSC "Specification for Structural Joints using ASTM A 325 or A 490 Bolts."
 - 7. AISC Standards "AISC Quality Criteria and Inspection Standards."
 - 8. American Welding Society (AWS) D1.1/D1.1M "Structural Welding Code - Steel."
 - 9. ASTM A 6 "General Requirements for Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use."
 - 10. Steel Structures Painting Council - "Steel Structures Painting Manual", Volumes 1 and 2.
- B. Fabricator Qualifications:
 - 1. A qualified fabricator who participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Standard for Steel Building Structures, Category STD.
 - 2. Shall have 5 years experience.
 - 3. NDE Certification of personnel for non-destructive testing.
- C. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.

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- D. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement P1 or SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."
- E. Welding Qualifications: Qualify procedures and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- F. Material shall be properly identified in accordance with the building code from mill source, to fabrication, and through erection on site.
- G. Contractor's Conference: Conduct conference at project site to comply with requirements of Division 01 Section "Project Meetings" and following:
 - 1. Conduct meeting sufficiently in advance of Steel Pre-Construction Conference to review detailed requirements for preparing shop drawings, fabrication of steel, and procedures for satisfactory steel erection operations. Review requirements for submittals, status of coordinating work, and delivery of materials. Establish preliminary work progress schedule and procedures for materials inspection, testing, and certifications. Require representatives of each entity directly concerned with steel fabrication, erection, and inspection to attend conference.
 - 2. Minutes of meeting shall be recorded, typed and printed by Contractor and distributed to parties concerned within 5 days of meeting. One copy of minutes shall also be transmitted to the Owner, Architect, and Engineer of Record for information purposes.
- H. Pre-Installation Conference: Conduct conference at project site:
 - 1. At least 15 days prior to start of steel construction, Contractor shall hold meeting to review detailed requirements steel erection, deck placement, and related submittal requirements. Additionally, review procedures for materials inspection, testing, and certifications. At minimum, discuss following items as pertains to project.
 - a. Verification of submittals
 - b. Requirements and procedures for any outstanding submittals necessary to begin construction.
 - c. Status of coordinating work.
 - d. Availability of materials for inspection.
 - e. Field weld procedures, inspections, and welder certificates.
 - f. Field testing and inspection requirements.
 - g. Material and product certifications and handling procedures.
 - 2. Contractor shall require responsible representatives of every party who is concerned with steel erection work to attend conference.
 - 3. Minutes of meeting shall be recorded, typed and printed by Contractor and distributed to parties concerned within 5 days of meeting. One copy of minutes shall also be transmitted to the Owner, Architect, and Engineer of Record for information purposes.

1.7 PROPOSED SUBSTITUTIONS

- A. Substitutions of sections or modifications of details, if proposed by Contractor, shall be submitted for approval in sketch form prior to submission of shop drawings, and such substitutions shall be made only when approved by Architect, at no additional cost to Owner. Total amount of credit, if any, shall be stated in writing with submission.
- B. Corrections for inaccuracies that result in change from Structural Documents or final approved shop drawing details shall be submitted in sketch form for approval. Such substitutions or corrections shall be made only when approved by Architect.

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1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to site at such intervals to ensure uninterrupted progress of work.
- B. Storage of materials:
 - 1. Store materials to permit easy access for inspection and identification.
 - 2. Keep steel members off ground and spaced by using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
 - 3. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.
- C. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
 - 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
 - 2. Store electrodes in rod ovens and heat in accordance with AWS D1.1/D1.1M prior to use in welding.

1.9 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation
- C. Coordinate openings, penetrations, and sleeve requirements with final equipment selections and locations by MEP sub-contractors. Verify any changes with Engineer of Record prior to fabrication.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Specific product, material or manufacturer listed under each item below is "acceptable" only if manufacturer can evidence product compliance with requirements of Structural Documents.
- B. For manufacturers not listed, submit as substitution according to the Conditions of the Contract and Division 01 Specification Sections.

2.2 STRUCTURAL STEEL MATERIALS

- A. Plate and Bar: ASTM A 36 or ASTM A 572, Grade 50 as noted.
- B. Welding Electrodes and Filler Metal for Welding:
 - 1. Welding materials must be used within the positions, thicknesses, temperatures and other parameters provided by the manufacturer.
 - 2. Provide filler metal conforming to AWS D1.1/D1.1M for each welding process used:

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2.3 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.
 - 1. Finish: Plain or Hot-dip zinc coating, ASTM A 153, Class C where steel elements are galvanized.
 - 2. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8,) compressible-washer type.
 - a. Finish: Plain or mechanically deposited zinc coating, ASTM B 695, Class 50 where steel elements are galvanized.
 - 3. Bolts shall be new and shall not be reused.
 - 4. Bolts shall be well lubricated at time of installation.
- B. Shear Connectors or Headed Stud Anchors for Concrete Embeds: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.
- C. Miscellaneous Materials and Accessories: As specified hereinafter under various items of work and/or as indicated on drawings or required for good construction practice.

2.4 FINISHES

- A. Galvanizing Repair Paint: High-zinc-dust-content paint for galvanizing welds and repair painting galvanized steel, with dry film containing not less than 93 percent zinc dust by weight, and complying with DOD-P-21035A; MPI#18, MPI#19 or SSPC-Paint 20; or ASTM A 780.

2.5 GROUT

- A. Metallic or Nonmetallic Shrinkage-Resistant Grout: ASTM C 1107, Material shall be ready to use/factory packaged product requiring only addition of water at jobsite.
 - 1. Grout shall be flowable material suitable for application having no drying shrinkage at any age.
 - 2. Grout shall provide a 30 minute working time.
 - 3. Compressive strength of grout shall be not less than 6,000 psi at 7 days and 8,000 psi at 28 days.
- B. Subject to compliance with requirements, acceptable Shrinkage-Resistant Grout manufacturers are as follows:
 - 1. L&M Construction Chemicals - "Duragrout"
 - 2. Euclid Chemical Co. - "NS Grout"
 - 3. BASF - "Master Flow 928 Grout"

PART 3 - SHOP EXECUTION - FABRICATION

3.1 SHOP STANDARDS

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303 and AISC 360. Work shall be delivered to site complete and ready for erection. Sequence of shipments shall be such as to expedite erection and minimize handling of material.
- B. Special Inspection and Quality Control: See specific requirements in the Quality Control section below.

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- C. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, workmanship, appearances, welding procedure specifications, weld quality, technique, and methods used in correcting welding work.
1. Only welded joints deemed as being prequalified in accordance with AWS D1.1/D1.1M are approved for use, submit WPS and PQR forms as required under Submittals section.
 2. Welds not specified shall be continuous fillet welds, sufficient to transmit required forces, using minimum size fillet as specified by AWS D1.1/D1.1M or AISC 360.
 3. Fillet welds terminating at ends or sides shall be returned continuously for distance at least twice normal size of weld (end returns).

3.2 SHOP FINISHES

- A. Location for each finish type:
1. Unfinished/Cleaned steel
 - a. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 - b. Surfaces to be field welded.
 - c. Surfaces to be high-strength bolted with slip-critical connections.
 - d. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
 2. Primed steel
 - a. All steel surfaces not receiving another finish type.
 3. Painted steel
 - a. Surfaces and elements as indicated by the Structural Documents.
 4. Galvanized steel
 - a. All exposed exterior steel
 - b. Galvanize **exposed steel including exterior embeds and welded door frames** attached to structural-steel frame and located in exterior walls.
 - c. Surfaces and elements as indicated by the Structural Documents.
- B. Surface Preparation:
1. Galvanized steel
 - a. Clean and prepare all steel surfaces to be galvanized according to SSPC-SP 2, "Hand Tool Cleaning."
- C. Galvanizing:
1. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123.
 2. Fill vent and drain holes that will be exposed in the finished Work unless they will function as weep holes, by plugging with zinc solder and filing off smooth.
 3. Where steel members on the drawings are specified as galvanized provide galvanized connection products. Where field welding must occur, repair galvanized surface per Repairs and Protections section of this specification.

PART 4 - FIELD EXECUTION – ERECTION

4.1 FIELD STANDARDS

- A. Special Inspection and Quality Control: See specific requirements in the Quality Control section below.

4.2 ERECTION REQUIREMENTS

- A. Base Bearing, and Leveling Plates:

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1. Clean concrete and masonry-bearing surfaces of bond-reducing materials such as oil, grease, and laitance. Roughen concrete surfaces prior to setting plates.
 2. Clean bottom surface of plates prior to setting columns.
 3. Set plates for structural elements level and align to the proper elevation using on wedges, shims, or setting nuts as required.
 4. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before placing grout.
 5. Immediately prior to grout placement verify concrete and base plate surfaces are clean and dampen as required by grout manufacturer.
 6. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts. Addition of water, mixing and placing, shall be in conformance with material manufacturer's instructions. Grout shall be mixed by using a mortar mixer. Batches shall be of size to allow continuous placement of freshly mixed grout. Placing shall be quick and continuous.
 7. Promptly place grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow curing. Exposed surfaces shall have smooth, dense finish.
 8. Base plates must be grouted prior to placement of concrete slabs on framed floors above.
- B. Erection Tolerances: Maintain erection tolerances of structural steel within AISC 303. Each individual member shall be erected, plumbed, leveled and aligned within tolerance.
- C. Erection Sequence:
1. Erect members according to most economical method and sequence available.
 - a. The structure is considered a "Non-Self Supporting Steel Frame" as defined by the AISC 303.
 2. High strength bolted connections shall be in accordance with Field Connection and Field Quality Control specification section requirements.
 3. Welded construction shall be in accordance with Field Connection and Field Quality Control specification section requirements.
- D. Cleanup: Upon completion of erection, Contractor shall remove all false work used.
- 4.3 FIELD CONNECTIONS
- A. Reference Shop Connection section of this specification for specific detailed requirements for High-Strength Bolts and Weld Connections with the following additional requirements.
- B. Weld Connections:
1. Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 2. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
- 4.4 FIELD FINISHES, REPAIRS, AND PROTECTION
- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780.

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PART 5 - QUALITY CONTROL

5.1 INSPECTION STANDARDS

- A. Quality control, testing, and inspections for the fabrication and erection of steel elements in the building shall meet the special inspection requirements of the building code and any local or state provisions.
 - 1. Periodic and continuous inspection requirements for structural steel are indicated below and on the Structural Documents and quality assurance plan.
- B. Source Quality Control: Continuous and periodic special inspections by the owner's Testing Agency required by the building code may not be necessary at the fabrication shop when ALL of the following provisions are met:
 - 1. Fabrication is done on the premises of a fabricator registered and approved to perform such work without special inspection.
 - a. Where acceptable to the local and state authority current AISC certification, as indicated in the Quality Assurance section, shall be sufficient evidence of compliance with this item.
 - 2. Approval of the Engineer of Record is obtained prior to fabrication. Approval shall be based upon the Testing Agencies review of the fabricator's written procedural and quality control manuals and periodic auditing of fabrication practices by an approved agency.
 - 3. At completion of fabrication the fabricator submits a certificate of compliance to the Engineer of Record and enforcement agency stating that the work was performed in accordance with the approved construction documents.
- C. Provide Architect and/or testing agency with access to places where material for contract is being fabricated or produced for purpose of inspection. Architect may inspect structural steel at plant before shipment. However, Architect reserves right to reject any material, at any time before final acceptance, which does not conform to requirements of Drawings and Specifications.
- D. The Contractor, Fabricator, and Erector are responsible for clearly indicating to the Testing Agency when the required inspections can be performed with adequate notification time for the Testing Agency to be on site.

5.2 TESTING AGENCY

- A. Owner will employ and pay a qualified independent testing agency to perform the quality control indicated in this section, including special inspections required by the building code.
 - 1. Inspection and testing by owner's testing agency is for verification and shall not relieve contractor of his responsibility to furnish materials and workmanship in accordance with Structural Documents.
 - 2. Retesting of materials failing to meet specified requirements shall be done at Contractor's expense.
 - 3. In cases of differences of opinion between owner's testing agency and the contractor's inspector regarding conformance, the issue should be brought to the Engineer of Record and the enforcement agency as part of the resolution process
- B. Qualification of Personnel:
 - 1. Personnel performing non-destructive testing shall be qualified in accordance with current edition of American Society for Non-Destructive Testing Recommended Practice No. SNT-TC 1A.
 - 2. Personnel performing inspections of welding work shall be currently registered with American Welding Society and shall comply with requirements of AWS Standards for Qualification and Certification of Welding Inspectors, QC1.

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C. Provided Reports:

1. Fabrication and erection reports shall be issued on a weekly basis during steel execution, and will include following information for that week:
 - a. Progress of work
 - b. Location and progress of inspections.
 - c. Results of inspections, noting any deviations from Structural Documents.
 - d. Correction of deviations.
 - e. Non-destructive testing reports:
 - 1) Reports shall be issued on suggested AWS or similar forms containing same information.
 - 2) Interpret test results and state in test report whether or not test specimen conforms to Structural Documents.
2. Submit certified copies of tests and inspections to the following parties:
 - a. Owner
 - b. Architect
 - c. Engineer of Record
 - d. Contractor
 - e. Fabricator
 - f. Erector
3. In addition to the weekly reports the inspector will maintain a single consolidated record of the steel inspections with locations and types of inspections performed. All failed inspections shall be clearly noted for follow up. This record should be maintained on site for tracking purposes.

D. Scope of Services:

1. Furnish qualified Inspectors as duly designated persons who act in behalf of Architect/Owner on inspection and quality matters.
2. Inspect the Fabricator/Erector's written procedural and quality control manuals, materials and workmanship required of Owner's/Purchaser's representatives, as specified in AISC Specification M5. Such inspections are to be made to fullest extent possible in Fabricator's plant.
3. Perform other inspections and tests related to structural steel and supplementary items contained in this specification section
4. Provide reports, interpret results, and report deviations from Structural Documents to the Architect/Owner.
5. Testing Agency Inspections of Manufacturer/Supplier of Structural Products:
 - a. Testing Agency shall verify following products being furnished are represented by manufacturer's certifications and test data.
 - 1) High Strength bolts.
 - 2) Filler metal for welding.
 - 3) Shear studs used as shear connectors.
 - 4) Direct tension indicators.
 - 5) Tension Control Bolts
 - b. The Testing Agency shall verify that the products used in the field match those products submitted.
6. Testing Agency Inspections of Structural Steel Fabricator and Erector:
 - a. Periodically verify camber of beams and girders in a manner which will allow that information to be compared to as-erected condition of beams and girders, and conditions after completion of concrete operations.
 - b. Randomly check dimensions of structural steel shapes and plates for conformity to ASTM A 6 Specifications.
 - c. Visually inspect material surfaces in accordance with ASTM A 6
 - d. Verify and inspect Bolted and Welded Connections as indicated below.

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5.3 CONTRACTOR

- A. The Contractor shall be responsible for establishing, setting and maintaining control points and building lines to be used in plumbing structural steel frame in accordance with AISC Code of Standard Practice.
- B. At locations identified by Testing Agency, Contractor shall record steel elevations prior to, and after, completion of concreting operations.
- C. Upon completion of erection of steel frame and before start of work by other trades that are supported, attached or applied to frame, the Contractor shall make a final survey of frame and submit report certifying compliance with specified tolerances permitted by AISC Code of Standard Practice.

5.4 FABRICATOR AND ERECTOR

- A. Fabricator and Erector shall correct deficiencies in work that test reports and inspections indicate do not comply with the Structural Documents.
- B. The Fabricator and Erector shall provide quality control along with the necessary documentation for portions and stages of work as specified in this section and required by the building code. The inspections and procedures shall assure that work being performed and material or products being furnished conform to Structural Documents.
- C. The Fabricator and Erector are required to furnish their own inspectors. The inspectors shall be qualified to perform the inspections listed, see Testing Agency Qualification of Personnel.
- D. The Fabricator and Erector shall ensure that the following quality control items are performed and proper documentation of each is maintained:
 - 1. Structural Steel Mill Manufacturer/Supplier:
 - a. Inspect and test materials as specified in designated ASTM Specifications and perform ultrasonic testing of materials required of steel mill supplier, reference submittal requirements.
 - 2. Manufacturer/Supplier of Structural Products:
 - a. Inspect and test products as required in designated ASTM Specifications; reference submittal requirements.
 - 3. Structural Steel Fabricator:
 - a. Provide the Testing Agency with documentation of quality control procedures and records as necessary for verification
 - b. Visually inspect column material.
 - c. Materials and products being furnished by Fabricator shall be received and identified in fabrication plant in such a manner that materials or products can be identified as being represented by mill test reports or manufacturer's certificates.
 - d. Inspect materials for compliance to ASTM A6, prior to fabrication.
 - e. Visually inspect shop bolted and shop welded connections, see below.
 - f. Inspect installation of slip-critical high strength bolts for proper bolt tension, see below.
 - g. Inspect installation of shop welded shear connectors, see below.
 - h. Visually inspect to confirm that plies of connected elements have been brought into firm contact.
 - 4. Structural Steel Erector:
 - a. Provide the Testing Agency with documentation of quality control procedures and records as necessary for verification.
 - b. Visually inspect field bolted and field welded connections as indicated below.
 - c. Inspect installation of slip-critical high strength bolts for proper bolt tension, see below.

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- d. Inspect installation of field welded shear connectors, see below.
- e. Visually inspect to confirm that plies of connected elements have been brought into firm contact.
- f. Field inspection of alignment and fit-up:
 - 1) Verify location and setting of anchor bolts by witness of General Contractor's final check prior to setting of steel members.
 - 2) As erection progresses, check connection of members for proper fit-up and adjustment prior to making permanent connections.
 - 3) Verify plumb of columns is within allowable tolerance.
 - 4) Verify that bracing and guying/cables, if required to secure steel framing during erection, are installed in accordance with erection procedures.
 - 5) During erection, verify specified phases of construction and steel erection are complete in accordance with erection procedure before proceeding with additional erection of structural steel.

5.5 WELDED CONNECTIONS

- A. Welded connections shall be tested and inspected according to AWS D1.1/D1.1M and AWS D.1.3/D1.3M as applicable to specific welding work to be performed.
- B. Fabricator and Erector shall provide Testing Agency with names of welders to be employed on Work prior to starting, together with certification that each welder has passed qualification tests using AWS required procedures as applicable to specific welding work to be performed. Testing Agency shall verify welder's qualifications.
- C. Fabricator and Erector:
 - 1. The Fabricator and Erector shall provide continuous visual inspection of all welding work as specified in AWS D1.1/D1.1M and the building code (including fit-ups, cut-outs, clean-up, root passes, fill-in passes, etc.).
 - 2. Visual inspection means that the inspectors visually inspect the welding for adherence to approved welding procedure specification starting with fit-up and proceeding through the welding process. Reliance only upon use of non-destructive examination (NDE) at end of the welding is not permitted. Use visual inspection in conjunction with NDE for sound welds.
 - 3. Welded connections shall be tested and inspected by Fabricator's and Erector's inspector according to AWS D1.1/D1.1M using the following additional inspection procedures as necessary:
 - a. Liquid or Dye Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - c. Ultrasonic Inspection: ASTM E 164.
 - d. Radiographic Inspection: ASTM E 94.
 - 4. The Fabricator and Erector shall perform ultrasonic testing of complete penetration groove welds for entire weld length, in each joint designated below, in accordance with AWS D1.1/D1.1M, and to following extent:
 - a. 100 percent of welds splicing beams, girders, columns and braces.
 - 5. The Fabricator and Erector inspector shall perform magnetic particle testing for weld length specified in each designated joint, in accordance with AWS D1.1/D1.1M, and to the following extent:
 - a. Fillet welds on continuity plates and backing bar removal areas, test full weld length.
 - b. Flange to web fillet welds, on built-up wide flange members (Type II) in accordance with ASTM E 109. 10 percent of total linear weld length in each designated joint, on each member, shall be inspected at random.
- D. Testing Agency:

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1. The Testing Agency shall inspect welding procedures used by the Fabricator/Erector as specified in AWS D1.1/D1.1M.
2. The Testing agency shall verify documentation of actual testing performed by the Fabricator/Erector.
3. The Testing Agency shall provide periodic visual inspection of welds as specified in AWS D1.1/D1.1M and the building code. Periodically select welds to visually inspect for adherence to approved welding procedure specification starting with fit-up and proceeding through the welding process as the welding is being performed. At the testing agencies option the following additional inspection procedures may be used to inspect and verify welds:
 - a. Liquid penetrant inspection: ASTM E 165.
 - b. Magnetic particle inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - c. Ultrasonic inspection: ASTM E 164
 - d. Radiographic inspection: ASTM E 94
4. The following weld inspections shall be performed by the Testing Agency at the locations and frequency indicated. Extent of testing shall be entire weld length in each designated joint.
 - a. Base metal thicker than 1-1/2 inches shall be ultrasonically inspected for discontinuities directly behind weld after joint completion. Any material discontinuities shall be accepted or rejected on basis of defect rating in accordance with AWS D1.1/D1.1M.
 - b. Ultrasonically test full penetration, moment connection welds in accordance with AWS D1.1/D1.1M, to following extent:
 - 1) 25 percent of welds made by each individual welder shall be tested at random as specified above.
 - 2) If an unacceptable weld is found, two additional welds made by same welder shall be tested at random. If either of these welds is found unacceptable, 100 percent of same welder's welds shall be tested as specified above and welder shall be recertified by Testing Agency, in accordance with qualification tests specified in AWS D1.1/D1.1M, before being allowed to continue welding on this project.
 - c. Column splice welds shall be inspected by ultrasonic testing to following extent:
 - 1) 25 percent of Non-Frame columns
 - 2) 50 percent of Frame Columns
5. Welds found unacceptable shall be repaired by Fabricator/Erector using methods permitted by AWS D1.1/D1.1M, and re-inspected.
6. For each defective weld location an additional location shall be tested.

5.6 BASE PLATE GROUT

- A. For every ten (10) base plates grouted, grout strength shall be tested by the Testing Agency with test cubes made and tested in accordance with Corps of Engineers Specification for Non-Shrink Grout, CRD-C-621 or ASTM C 1107:
 1. Five test cubes shall be made.
 2. Test two cubes at 7 days and two cubes at 28 days.
 3. The fifth test cube shall be used as a hold in case the 28 day test does not meet strength.

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SECTION 061053
MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Miscellaneous rough carpentry and supplementary items necessary for installation.
 - 1. Preservative treated wood materials.
 - 2. Fire retardant treated wood materials
 - 3. Composite plastic lumber materials.

1.2 DEFINITIONS

- A. Boards or Strips: Lumber of less than 2 inches nominal (38 mm actual) size in least dimension.
- B. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) or greater size but less than 5 inches nominal (114 mm actual) size in least dimension.

1.3 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - 1. Preservative-Treated Wood: Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
 - 2. Fire-Retardant-Treated Wood: Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
 - a. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5664.
 - 3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.4 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For the following, from ICC-ES:
 - 1. Preservative-treated wood.
 - 2. Fire-retardant-treated wood.
 - 3. Power-driven fasteners.
 - 4. Post-installed anchors.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

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1.6 PROJECT CONDITIONS

- A. Field Measurements: Where products and systems are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication.

1.7 COORDINATION

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Comply with performance requirements specified, as determined by testing of products and systems representing those indicated for this Project, without failure due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Material Compatibility: Provide materials that are compatible with one another under conditions of service and application required, as demonstrated by manufacturer based on testing and field experience.
- C. Structural Loads: Installed materials and fabrications shall withstand loads within limits of allowable working stresses of the materials involved under conditions indicated, including but not limited to, requirements established by authorities having jurisdiction and applicable building codes.
- D. Miscellaneous Rough Carpentry within Roofing System Assemblies: Wood cants, nailers, curbs, equipment support bases, blocking, and similar members in connection with roofing system assembly and flashings shall be fabricated and installed to withstand specified uplift pressures and thermally induced movement without contributing to failure of roofing system or flashings.
- E. Surface Burning Characteristics for Fire-Retardant-Treated Wood: Products and construction identical to assemblies tested for fire resistance according to ASTM E 84/NFPA 255/UL 723 and included under Category BPVV published in Underwriters Laboratories, Inc. (UL) "Fire Resistance Directory"; or listing of another testing and inspecting agency acceptable to authorities having jurisdiction.

2.2 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. Dress lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content of Lumber: 15 percent for 2-inch nominal (38-mm actual) thickness or less, 19 percent for more than 2-inch nominal (38-mm actual) thickness unless otherwise indicated.

2.3 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: AWPAC U1; Use Category UC4a.
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

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- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application Schedule: Treat miscellaneous carpentry items indicated on Drawings and the following:
 - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, air water barriers, and waterproofing.
 - a. Contractor Option - Untreated Wood within Roofing System Assemblies:
Contractor may use untreated wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing assemblies that are concealed within the roofing membrane.
 - 2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
 - 3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
 - 4. Wood framing members that are less than 18 inches (460 mm) above the ground in crawlspaces or unexcavated areas.
 - 5. Wood floor plates that are installed over concrete slabs-on-grade.

2.4 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
 - 1. Identification: Identify fire-retardant-treated wood with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - 2. Concealed Wood Blocking: Chemical formulations for fire retardant treatment to contain a compatible, non-bleed, light fast, colored dye to identify and indicate treatment.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.
 - 1. Treatment shall not promote corrosion of metal fasteners.
 - 2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D2898.
 - 3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D3201 at 92 percent relative humidity.
- C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.
- D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.

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- E. Application Schedule: Treat miscellaneous carpentry items indicated on Drawings and the following:

1. Concealed blocking within interior partitions.
2. Plywood backing panels supporting equipment at interior locations.

2.5 LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Cants.
4. Furring.
5. Grounds.

- B. Dimension Lumber Items: Construction or No. 2 grade lumber of any of the following species:

1. Hem-fir (north); NLGA.
2. Mixed southern pine or southern pine; SPIB.
3. Spruce-pine-fir; NLGA.
4. Hem-fir; WCLIB or WWPA.
5. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
6. Western woods; WCLIB or WWPA.
7. Northern species; NLGA.
8. Eastern softwoods; NeLMA.

- C. Concealed Boards: 15 percent maximum moisture content of any of the following species and grades:

1. Mixed southern pine or southern pine, No. 2 grade; SPIB.
2. Hem-fir or hem-fir (north), Construction or No. 2 Common grade; NLGA, WCLIB, or WWPA.
3. Spruce-pine-fir (south) or spruce-pine-fir, Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
4. Eastern softwoods, No. 2 Common grade; NELMA.
5. Northern species, No. 2 Common grade; NLGA.
6. Western woods, Construction or No. 2 Common grade; WCLIB or WWPA.

- D. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

- E. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.6 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: Plywood, DOC PS 1, Exposure 1, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2-inch (13-mm) nominal thickness.

1. Panel Grades: According to installation location.
 - a. A-C, exposed at occupied interior locations.
 - b. B-C, exposed at mechanical and electrical equipment rooms.

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2.7 COMPOSITE PLASTIC LUMBER

- A. Composite Plastic Lumber, General: Products acceptable to authorities having jurisdiction with current model code evaluation reports that show compliance with building code in effect for Project for indicated type of construction.
 - 1. Allowable loads and spans, as documented in evaluation reports or in information referenced in evaluation reports, shall not be less than design loads and spans indicated.
- B. Composite Plastic Lumber: Solid shapes made from a mixture of cellulose fiber and polyethylene or polypropylene.
 - 1. Size: As indicated on drawings.
 - 2. Surface Texture and Color: As selected by Architect from manufacturer's full range.
 - 3. Acceptable Manufacturers:
 - a. Tamko Building Products.
 - b. TimberTech.
 - c. Trex Company, Inc.
 - d. Universal Forest Products.

2.8 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 - 1. Unless indicated otherwise, where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.
 - a. Contractor Option - Untreated Wood within Roofing System Assemblies: Provide fasteners with Carbon-steel components, zinc plated to comply with ASTM B633, Class Fe/Zn 5.
- B. Nails, Brads, and Staples: ASTM F1667.
- C. Screws for Fastening to Metal Framing: ASTM C1002 for drywall studs and ASTM C954 for structural studs, length as recommended by screw manufacturer for material being fastened.
- D. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- E. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, as appropriate for the substrate.
 - 1. Mechanical Anchors in Masonry or Concrete: ICC-ES AC01 or ICC-ES AC193.
 - 2. Adhesive Anchors in Masonry or Concrete: ICC-ES AC58 or ICC-ES AC308.
 - 3. Material:
 - a. Interior Locations: Carbon-steel components, zinc plated to comply with ASTM B633, Class Fe/Zn 5, unless indicated otherwise.
 - b. Exterior Locations and where Stainless Steel is Indicated: Stainless steel with bolts and nuts complying with **ASTM F593 and ASTM F594, Alloy Group 1 or 2 (ASTM F738M and ASTM F836M, Grade A1 or A4).**

2.9 MISCELLANEOUS MATERIALS

- A. Adhesives for Gluing to Concrete or Masonry: Formulation complying with ASTM D3498 that is approved for use indicated by adhesive manufacturer.

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PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products, fabrications, and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

3.2 INSTALLATION, GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
1. Respective manufacturer written installation instructions.
 2. Accepted submittals.
 3. Contract Documents.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by isolating metals and other materials from direct contact with incompatible materials.
- C. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- D. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.
- E. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
- F. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated.
1. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. (9.3 sq. m) and to solidly fill space below partitions.
- G. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- H. Comply with AWPAC M4 for applying field treatment to cut surfaces of preservative-treated lumber.
1. Use inorganic boron for items that are continuously protected from liquid water.
 2. Use copper naphthenate for items not continuously protected from liquid water.
- I. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- J. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the requirements of authorities having jurisdiction and the following:
1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
 - a. Select fasteners of appropriate size, type, and length that will not fully penetrate members where opposite side will be exposed to view or will receive finish

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materials. Make tight connections between members. Predrill members when necessary to avoid splitting wood while installing fasteners. Do not countersink nail heads, unless otherwise indicated. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

2. ICC-ES evaluation report for fastener.

K. Install composite plastic lumber per manufacturer's written instructions.

3.3 INSTALLATION OF WOOD BLOCKING AND NAILER

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.
- C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches (38 mm) wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.4 INSTALLATION OF WOOD FURRING

- A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

3.5 PROTECTION

- A. Protect miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION

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SECTION 064023
INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Shop-finished interior architectural woodwork and supplementary items necessary for installation.
- B. Simulated Stone Countertops: Refer to Division 12 Section "Simulated Stone Countertops" for solid surfacing, quartz agglomerate, or cultured marble countertops incorporated into work specified in this Section. Simulated stone trim is specified in this Section.

1.2 DEFINITIONS

- A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction before woodwork installation.
- B. Stair Work and Rails: Rough carriages for stairs are a part of interior architectural woodwork. Platform framing, headers, partition framing, and other rough framing associated with stairwork are specified in Division 06 Section "Miscellaneous Rough Carpentry".
- C. Exposed Surfaces, Semi-Exposed Surfaces, Concealed Surfaces, Types of Cabinet Construction, and other related terms are defined in referenced quality standards.

1.3 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
 - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
 - 2. Wood Veneered Items: Include finishing materials and processes.
 - 3. Fire Retardant Treated Wood: Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.
- B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components and attachments to other work. Distinguish between shop and field-assembled work.
 - 1. Show details full size.
 - 2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
 - 3. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets, soap dispensers, and other items installed in architectural woodwork.
 - 4. Wood Paneling with Transparent Finish: For paneling noted or schedule to be blueprint matched work, show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.
- C. Samples for Verification:
 - 1. Items with Transparent Finish:

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- a. Lumber with or for transparent finish, not less than 50 sq. in. (300 sq. cm) or 5 in (125 mm) wide by 24 in (600 mm) long, for each species and cut, finished on 1 side and 1 edge.
 - b. Veneer leaves representative of and selected from flitches to be used for transparent-finished woodwork.
 - c. Veneer-faced panel products with or for transparent finish, 8 in by 10 in (200 mm by 250 mm), for each species and cut. Include at least one face-veneer seam and finish as specified.
2. Items with Opaque Finish:
- a. Lumber and panel products with shop-applied opaque finish, 50 sq. in. (300 sq. cm) for lumber and 8 in by 10 in (200 mm by 250 mm) for panels, for each finish system and color, with 1/2 of exposed surface finished.
3. Items with Plastic Laminate Finish:
- a. Plastic laminates, 8 in by 10 in (200 mm by 250 mm), for each type, color, pattern, and surface finish, with 1 sample applied to core material and specified edge material applied to 1 edge.
4. Simulated Stone Trim: 6 in (150 mm) long.
5. Cabinets:
- a. Corner Piece: Cabinet-front frame joints between stiles and rails, as well as exposed end pieces, 18 in (450 mm) high by 18 in (450 mm) wide by 6 in (150 mm) deep.
 - b. Cabinet Hardware and Accessories: Exposed cabinet hardware and accessories, one unit for each type and finish.
 - c. Countertops: Section of countertop showing top, front edge, and backsplash construction.
6. Standing and Running Trim: Corner piece showing miter joints.

1.4 INFORMATIONAL SUBMITTALS

1.5 QUALITY ASSURANCE

1. Woodwork Fabricator Certification: Certified participant in AWI's Quality Certification Program or licensee of WI's Certified Compliance Program.
- B. Installer Qualifications:
1. Experience: Installer's personnel with not less than 5 years of experience in the successful performance of Work similar to scope of this Project.
 2. Supervision: Installer shall maintain a competent supervisor at Project while the Work is in progress, and who has not less than 5 years of experience installing products and systems similar to scope of this Project.
 3. Certification: Certified participant in AWI's Quality Certification Program or licensee of WI's Certified Compliance Program.
- C. Source Limitations for Wood Veneered Items: Engage a qualified woodworking firm to assume undivided responsibility for production of interior architectural woodwork with sequence-matched wood veneers and wood doors with face veneers that are sequence matched with woodwork.
- D. Quality Standard: Unless otherwise indicated, comply with "Architectural Woodwork Standards" for standards and for grades of interior architectural woodwork indicated for construction, finish, installation and other requirements:

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1. Provide manufacturer certification indicating that woodwork complies with requirements of referenced quality standards.
 2. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with such selections and requirements in addition to the quality standard.
- E. Fire-Test-Response Characteristics: Where fire-retardant materials or products are indicated or required, provide materials and products with specified fire-test-response characteristics as determined by testing identical products per test method indicated by UL, ITS, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify with appropriate markings of applicable testing and inspecting agency in the form of separable paper label or, where required by authorities having jurisdiction, imprint on surfaces of materials that will be concealed from view after installation.
- F. Mock-ups: Prior to fabrication and installation, build mock-up for each form of construction and finish required to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mock-up using materials indicated for the completed Work.
1. Build mock-up in the location and of the size indicated or, if not indicated, as directed by Architect. Contractor shall provide structural support framework.
 - a. Show typical components, attachments to building structure, and requirements of installation.
 2. Notify Architect seven days in advance of the dates and times when mock-up will be installed.
 3. Obtain Architect's acceptance of mock-ups before starting fabrication or installation.
 4. Acceptance of mock-ups does not constitute acceptance of deviations from the Contract Documents contained in mock-ups unless such deviations are specifically noted by Contractor and accepted by Architect in writing.
 5. Demolish and remove mock-ups when directed by Architect unless accepted to become part of the completed Work.
- G. Mock-ups, Cabinets:
1. One full-size sample of finished base cabinet unit complete with hardware, doors, and drawers, but exclusive of countertop.
 2. One full-size sample of finished wall-mounted cabinet unit complete with hardware, doors, and adjustable shelves.
 3. Accepted sample units will be used as a standard for judging the completed work. Unless otherwise directed, accepted sample units may be incorporated in work. If not incorporated in work, retain accepted sample units at Project site until completion of work and remove sample units from premises when directed by Architect.
- 1.6 PRE-INSTALLATION CONFERENCE
- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.
1. Participants:
 - a. Architect.
 - b. Contractor, including superintendent.
 - c. Installer, including project manager and supervisor.
 - d. If requested, Manufacturer's qualified technical representative.
 - e. Installers of other construction interfaced with Work.

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2. Minimum Agenda: Installer shall demonstrate understanding of the Work required by describing detailed procedures for preparing, installing, and cleaning the Work. Demonstration shall include, but not be limited to, following topics:
 - a. Tour representative areas of Work, inspect and discuss condition of substrate, and other preparatory work performed by other trades.
 - b. Review Contract Document requirements.
 - c. Review approved submittals.
 - d. Review inspection and testing requirements.
 - e. Review environmental conditions and procedures for coping with unfavorable conditions.
 - f. Resolve deviations or differences between Contract Documents and the manufacturer's specifications.
3. Record discussions, including decisions and agreements, and prepare report.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Where products and systems are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication.
 1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.

1.9 COORDINATION

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.
- B. Coordinate Shop Drawings and fabrication with hardware requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND PRODUCTS

- A. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".
- B. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other manufacturers offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.

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2.2 MATERIALS, GENERAL

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.
- B. Provide materials that comply with requirements of "Architectural Woodwork Standards" quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.

2.3 MATERIALS

- A. Wood Species and Cut for Transparent Finish:
 - 1. Selections: As scheduled or as indicated in Design Selections.
- B. Wood Species for Opaque Finish: Any closed-grain hardwood unless indicated otherwise.
- C. Fire Retardant Wood Products for Paneling:
 - 1. Medium-Density Fiberboard: ANSI A208.2, minimum Grade 130-MR50, made with binder containing no added urea formaldehyde.
 - 2. Particleboard: ANSI A208.1, Industrial Grade M-2 Exterior Glue, made with binder containing no added urea formaldehyde, 43 pcf (753kgm3) Density.
 - 3. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.
- D. Wood Products for Cabinets:
 - 1. Hardboard for Vertical Dividers Only: AHA A135.4, tempered, smooth two sides, 1/4 in (6 mm) minimum thickness unless indicated otherwise.
 - 2. Medium-Density Fiberboard: ANSI A208.2, minimum Grade 130-MR50, made with binder containing no added urea formaldehyde.
 - 3. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1, made with adhesive containing no added urea formaldehyde.
 - 4. Softwood Plywood: DOC PS 1.
- E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.
 - 1. Fire-Rated Laminates: Where indicated or scheduled; NEMA LD 3, grades as follows:
 - a. Vertical Surfaces: General Purpose Type 604 (VGF), 0.032 in (0.79 mm) thick.
 - b. Horizontal Surfaces: General Purpose Type 605 (HGF) 0.048 in (1.2 mm) thick.
 - 2. Manufacturers:
 - a. Formica Corporation.
 - b. International Paper.
 - c. Lamin-Art, Inc.
 - d. Nevamar Company, LLC; Decorative Products Div.
 - e. Pioneer Plastics Corp.
 - f. Westinghouse Electric Corp.; Specialty Products Div.
 - g. Wilsonart International; Div. of Premark International, Inc.
 - 3. Colors, Patterns, and Finishes:
 - a. Selections: As scheduled or as indicated in Design Selections.
- F. Chemical-Resistant, High-Pressure Decorative Laminate: NEMA LD 3, Grade HGP, and as follows:

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1. Laminate has the following ratings when tested with indicated reagents according to NEMA LD 3, Test Procedure 3.9.5:
 - a. Nitric Acid (30 Percent): Moderate effect.
 - b. Sulfuric Acid (77 Percent): Moderate effect.
 - c. Hydrochloric Acid (37 Percent): Moderate effect.
 - d. Phosphoric Acid (75 Percent): No effect.
 - e. Acetic Acid (98 Percent): No effect.
 - f. Formaldehyde: No effect.
 - g. Ethyl Acetate: No effect.
 - h. Ethyl Ether: No effect.
 - i. Phenol (85 Percent): Moderate effect.
 - j. Benzene: No effect.
 - k. Xylene: No effect.
 - l. Butyl Alcohol: No effect.
 - m. Furfural: No effect.
 - n. Methyl Ethyl Ketone: No effect.
 - o. Sodium Hydroxide (25 Percent): No effect.
 - p. Sodium Sulfide (15 Percent): No effect.
 - q. Ammonium Hydroxide (28 Percent): No effect.
 - r. Zinc Chloride: No effect.
 - s. Gentian Violet: No effect.
 - t. Methyl Red: No effect.
 2. Manufacturers and Products:
 - a. Formica Corporation; Lab Grade 840 Black.
 - b. Panolam Industries International Incorporated; Pionite Chemguard.
 - c. Wilsonart International, Div. of Premark International, Inc.; Chemsurf.
 3. Colors, Patterns, and Finishes:
 - a. Selections: As scheduled or as indicated in Design Selections.
- G. PVC Laminate: Fire-retardant acrylic/PVC sheet covered in a decorative rigid PVC veneer, 0.040 in (1 mm) thick.
1. Manufacturer and Product: Spectrim; Ven4ma.
 2. Colors, Patterns, and Finishes:
 - a. Selections: As scheduled or as indicated in Design Selections.
- H. Simulated Stone Trim:
1. Solid Surface Material: Homogeneous-filled plastic resin complying with ISFA 2-01.
 - a. Manufacturers:
 - 1) Avonite Surfaces.
 - 2) E. I. du Pont de Nemours and Company.
 - 3) Formica Corporation.
 - 4) LG Chemical, Ltd.
 - 5) Meganite Inc.
 - 6) Samsung Chemical USA, Inc.
 - 7) Swan Corporation (The).
 - 8) Transolid, Inc.
 - 9) Wilsonart International.

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2. Quartz Agglomerate: Solid sheets consisting of quartz aggregates bound together with a matrix of polymers, resins, and pigment and complying with ISFA 3-01.
 - a. Manufacturers:
 - 1) Cambria.
 - 2) Cosentino USA.
 - 3) E. I. du Pont de Nemours and Company.
 - 4) LG Chemical, Ltd.
 - 5) Meganite Inc.
 - 6) Samsung Chemical USA, Inc.
 - 7) Technistone USA, Inc.
 - 8) Transolid, Inc.
3. Cultured Marble: Gel-coated solid fabrication of filled plastic resin complying with CSA B45.5/IAPMO Z124.
 - a. Manufacturers:
 - 1) Bathroom World Manufacturing Company
 - 2) Cameo Marble
 - 3) Cherry Marble Group.
 - 4) Comar Products, Inc.
 - 5) Craig Baker Marble Co., Inc.
 - 6) Cultured Marble Products
 - 7) Custom Marble Products, Inc.
 - 8) Imperial Marble Corp.
 - 9) Marbleon, Inc.
 - 10) MarCraft, Inc.
 - 11) Mincey Marble Manufacturing, Inc.
 - 12) Princess Marble
 - 13) Roma Marble, Inc.
 - 14) Rynone Manufacturing Corp.
 - 15) Tiffany Marble
4. Colors, Patterns, and Finishes:
 - a. Selections: As scheduled or as indicated in Design Selections.

I. Glass:

1. Tempered Float Glass for Cabinet Doors: ASTM C 1048, Kind FT, Condition A, Type I, Class 1 (clear), Quality-Q3, 6 mm thick, unless otherwise indicated.
2. Mirror Glass for Cabinet Doors: ASTM C 1503, Mirror Select Glazing, Quality-Q3, 6 mm thick, unless otherwise indicated.
3. Decorative Glass for Cabinet Doors: Provide decorative glass complying with Division 08 Section "Glazing".
4. Tempered Float Glass for Cabinet Shelves: ASTM C 1048, Kind FT, Condition A, Type I, Class 1 (clear), Quality-Q3; with exposed edges seamed before tempering, 6 mm thick, unless otherwise indicated.

2.4 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated or required, use materials complying with requirements in this Article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified.

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1. Do not use treated materials that do not comply with requirements of referenced woodworking standard or that are warped, discolored, or otherwise defective.
 2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
 3. Identify fire-retardant-treated materials with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Comply with performance requirements of AWPA C20 (lumber) and AWPA C27 (plywood). Use the following treatment types:
1. Exterior Type: Organic-resin-based formulation thermally set in wood by kiln drying.
 2. Interior Type A: Low-hygroscopic formulation.
 3. Mill lumber before treatment and implement special procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of treated woodwork.
 4. Kiln-dry materials before and after treatment to levels required for untreated materials.
- C. Fire-Retardant Particleboard: Panels complying with the following requirements, made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 25 or less per ASTM E 84.
- D. Fire-Retardant Fiberboard: Medium-density fiberboard panels complying with ANSI A208.2, made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 200 or less per ASTM E 84.

2.5 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Division 08 Section "Door Hardware (Scheduled by Describing Products)."
1. Refer to Interior Design Documents and Schedules for additional hardware selections.
- B. Hinges: Provide number of hinges recommended by hinge manufacturer for size and weight of door.
- C. Butt Hinges: 2-3/4 in (69 mm), 5-knuckle steel hinges made from 0.095 in (2.4 mm) thick metal, and as follows:
1. Semi-concealed Hinges for Flush Doors: BHMA A156.9, B01361.
 2. Semi-concealed Hinges for Overlay Doors: BHMA A156.9, B01521.
- D. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602,
1. Product Standard: Grass; "Tiomos 120 Series", 120 degree swing, self-closing from 10 deg.
 - a. Angle Reduction Clip: Provide angle reducing clip at doors adjacent to walls and corners, door swing to be limited to 85 degrees. Finish: Steel with nickel plating. Manufacturer and Product: Grass; Tiomos Angle Reduction Clip, F072135751.
- E. Back-Mounted Pulls: BHMA A156.9, B02011.

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- F. Wire Pulls: Back mounted, solid metal, 4 in (100 mm) long, 5/16 in (8 mm) in diameter.
 - 1. Product Standard: EPCO-MC-402-4, 4 in (100 mm) center to center of screws, 1-5/16 in (34 mm) projection, 5/16 in (8 mm) diameter. Stainless steel.
- G. Catches: Magnetic catches, BHMA A156.9, B03141.
- H. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.
- I. Shelf Rests: BHMA A156.9, B04013; metal.
 - 1. Product Standard: K & V No. 345, nickel plated.
- J. Drawer Slides: BHMA A156.9, B05091.
 - 1. Heavy Duty (Grade 1HD-100 and Grade 1HD-200): Side mounted; full-extension type; zinc-plated steel ball-bearing slides.
 - 2. Box Drawer Slides: Grade 1HD-100; for drawers not more than 6 in (150 mm) high and 24 in (600 mm) wide.
 - a. Product Standard for 24 in (600 mm) Wide and Less: Full extension; Accuride "7434".
 - b. Product Standard for Wider than 24 in (600 mm): Full extension; Accuride "7432".
 - 3. File Drawer Slides: Grade 1HD-200; for drawers more than 6 in (150 mm) high or 24 in (600 mm) wide.
 - a. Product Standard for 42 in (1050 mm) Wide and Less: Full extension with 1 in (25 mm) over travel; Accuride "3640".
 - 4. Pencil Drawer Slides: Grade 1; for drawers not more than 3 in (75 mm) high and 24 in (600 mm) wide.
 - a. Product Standard for 16 in (400 mm) Wide and Less: Low profile, 75 lb (34 kg) load rating (at 2/3 travel), full extension; Accuride "2632".
 - b. Keyboard Slides: Grade 1HD-100; for computer keyboard shelves.
 - c. Product Standard for Slides Only, 16 in (400 mm) Wide and Less: Adjustable height, 75 lb (34 kg) load rating; Accuride "2109".
 - d. Product Standard for Slides and Tray: Fixed tilt, adjustable height; Accuride "Cbergo-Tray 200".
 - e. Product Standard for Slides, Tray and Accessories: Adjustable tilt, adjustable height, cable management, palm rest, and mouse pad; Accuride "Cbergo-Tray 300".
 - 5. Trash Bin Slides: Grade 1HD-200; for trash bins not more than 20 in (500 mm) high and 16 in (400 mm) wide.
- K. Aluminum Slides for Sliding Glass Doors: BHMA A156.9, B07063.
- L. Door Locks: BHMA A156.11, E07121.
 - 1. Product Standard: K & V No. 984, nickel plated.
- M. Drawer Locks: BHMA A156.11, E07041.
 - 1. Product Standard: K & V No. 986, nickel plated.
- N. Sliding Door Locks:
 - 1. Product Standard: K & V No. 984, nickel plated.

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- O. Grommets for Cable Passage through Countertops: Molded-plastic grommets and matching plastic caps with slot for wire passage.
1. Size: 1-1/4 in (32-mm) or 2 in (50 mm) OD as indicated.
 2. Color: Brown, black or white as indicated or selected by Architect.
 3. Product Standards: Doug Mockett & Company, Inc "OG or SG Series" or Hafele 429.93.
- P. Concealed Pocket Door Slides (Vertical Swing/Slide/Retract):
1. Description: Side mounted flipper door slide assembly suitable for recessed full overlay door, 42 in (1050 mm) high and less, 30 lb (14 kg) load rating, into concealed pocket within cabinet, painted steel slides with all steel ball bearings.
 2. Product Standard: Accuride "1321".
- Q. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
1. Satin Stainless Steel: BHMA 630, unless otherwise indicated.
- R. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.
- S. Manufacturers:
1. Accuride.
 2. Julius Blum, Inc.
 3. The Engineered Products Company.
 4. Grass America, Inc.
 5. Hafele America Company.
 6. Hettich America Corporation.
 7. Knappe & Vogt Manufacturing Company (K & V).
 8. Stanley Hardware, Division of the Stanley Works.
- T. Cabinet Accessories:
1. Flat-Screen Computer Monitor and Keyboard Mounting System:
 - a. Product Standard: Hafele; Monitor Suspension System (Flat Screen Monitors).
 2. Counter Support Brackets: Unless noted otherwise, provide brackets factory-primed for field painting.
 - a. Manufacturers and Products:
 - 1) A&M Hardware, Inc.; Work Station Brackets.
 - 2) Rakks/Rangine Corporation; Counter Support Brackets, EH Series.
 3. Table Legs:
 - a. Product Standard: Richelieu; Round Table Legs, Product UC250175, 28 in (711.2 mm) long by 2-1/2 in (62 mm) diameter steel table leg with satin chrome finish.
- U. Tackable Wall Surface: Refer to Division 09 Section "Fabric Wrapped Panels".
- V. Tackable Wall Surface:
1. Fabric Wall Coverings: Provide wall coverings with following surface burning characteristics as determined by testing identical products per ASTM E 84/NFPA 255/UL 723. Identify wall coverings with appropriate markings of applicable testing and inspecting organization.
 - a. Flame Spread: 25 or less; Smoke Developed: 450 or less.

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- b. Selections: As scheduled or as indicated in Design Selections.
- 2. Substrate Material: Fiberglass board, ASTM C 612, Class 1 and 2; 6 pcf (96 kgm3) density, compressible, unfaced, with chemically hardened edges.
- 3. Panel Fabrication: Fabricate panels to sizes and configurations indicated; attach facing materials to core (substrate material) to produce installed panels with visible surfaces fully covered and free from waves in fabric weave, wrinkles, sags, blisters, seams, adhesive, or other foreign matter.

2.6 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln dried to less than 15 percent moisture content.
- B. Rough Carriages for Stairs: Select Structural grade, kiln dried to 15 percent maximum moisture content.
- C. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.
- D. Handrail Brackets: Cast or Extruded with wall flange drilled and tapped for concealed hanger bolt and with support arm for screwing to underside of rail. Sized to provide 1-1/2 in (38 mm) clearance between handrail and wall.
- E. Adhesives:
 - 1. General: As recommended by woodwork fabricator to suit application.
 - 2. Adhesive for Bonding Plastic Laminate Faces and Edges: PVA as recommended by woodwork fabricator to suit application.
- F. Hanging Clips: Provide manufacturer standard nonferrous-metal or hot-dip galvanized zee hanging clips.

2.7 FABRICATION, GENERAL

- A. Interior Woodwork Grade: Unless otherwise indicated, provide Premium Grade interior woodwork complying with referenced quality standard.
- B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.
- C. Fire Retardant Treated Wood: Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- D. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
 - 1. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members 3/4 in (19 mm) Thick or Less: 1/16 in (1.5 mm).
 - 2. Edges of Rails and Similar Members More Than 3/4 in (19 mm) Thick: 1/8 in (3 mm).
- E. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

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1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
 2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.
- F. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
1. Countertops: Seal edges of openings in countertops.
- G. Install glass to comply with applicable requirements in Division 08 Section "Glazing" and in GANA's "Glazing Manual". For glass in wood frames, secure glass with removable stops.
- 2.8 INTERIOR STANDING AND RUNNING TRIM
- A. Grade for Transparent Finish: Premium.
 - B. Grade for Opaque Finish: Premium.
 - C. Grade for Opaque Finish: Custom.
 - D. Provide split species on trim that faces areas with different wood species, matching each face of woodwork to species and cut of finish wood surfaces in areas finished.
 - E. For trim items wider than available lumber, use veneered construction. Do not glue for width.
 - F. Backout or groove backs of flat trim members and kerf backs of other wide, flat members, except for members with ends exposed in finished work.
 - G. Assemble casings in plant except where limitations of access to place of installation require field assembly.
- 2.9 INTERIOR FRAMES AND JAMBS
- A. Grade for Transparent Finish: Premium.
 - B. Grade for Opaque Finish: Premium.
 - C. For frames or jambs wider than available lumber, use veneered construction. Do not glue for width.
 - D. Fire-Rated Interior Frames and Jambs: Products fabricated from fire-retardant particleboard or fire-retardant medium-density fiberboard with veneered, exposed surfaces and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.
 1. Fire Rating: 20 minutes.
- 2.10 STAIR WORK AND RAILS
- A. Grade for Transparent Finish: Premium.
 - B. Grade for Opaque Finish: Premium.
 - C. Cut carriages to accurately fit treads and risers. Glue treads to risers, and glue and nail treads and risers to carriages.

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1. House wall and face stringers and glue and wedge treads and risers.
2. Fabricate stairs with treads and risers no more than **1/8 in (3 mm)** from indicated position and no more than **1/16 in (1.5 mm)** out of position for adjacent treads and risers.

2.11 FLUSH WOOD PANELING

- A. Grade for Transparent Finish: Premium.
- B. Grade for Opaque Finish: Premium.
- C. Lumber Trim and Edges: If not indicated, trim and edges shall be solid wood lumber compatible with grain and color of veneered panels.
- D. Matching Requirements: As scheduled or as indicated in Design Selections.
- E. Fire-Retardant-Treated Paneling: Provide panels consisting of wood veneer and fire-retardant particleboard or fire-retardant medium-density fiberboard. Panels shall have flame-spread index of 75 or less and smoke-developed index of 450 or less per ASTM E 84.

2.12 FLUSH PLASTIC-LAMINATE PANELING

- A. Grade: Premium.
- B. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:
 1. Faces: Grade HGS, 1.0 mm thick.
 2. Edges: Same as faces.
- C. Concealed Backs of Panels with Exposed Plastic Laminate Surfaces: High-pressure decorative laminate, Grade BKH, 1.0 mm thick.
- D. Fire-Retardant-Treated Paneling: Provide panels consisting of fire-retardant plastic laminate and fire-retardant particleboard or fire-retardant medium-density fiberboard. Panels shall have a flame-spread rating of 75 or less and a smoke-developed rating of 450 or less per ASTM E 84.

2.13 STILE AND RAIL WOOD PANELING FOR TRANSPARENT FINISH

- A. Grade: Premium.
- B. Stiles and Rails: If not indicated, at fabricator's option, stiles and rails may be either lumber or veneered construction with edges banded or with lumber moldings, as indicated, to conceal core and veneer joints.
- C. Panels: Flat or raised panels with veneered faces and solid lumber rims as indicated.
- D. Insert Panels: Blueprint matched in a horizontal sequence for adjacent panels and doors, with continuous vertical matching between adjacent panels. Book and balance or Book, balance, and center match face-veneer leaves within each panel as indicated.
 1. Flitch Requirements: As scheduled or as indicated in Design Selections for requirements concerning flitches reserved by Architect.
- E. Shop-assemble stile and rail paneling into largest units practical for delivery and installation. Provide shop-prepared detachable joints for necessary field connections. Sand and pull joints tight in shop so field joints will comply with joint tolerances for specified grade. Unless otherwise indicated, provide continuous mortise-and-tenon joints between panel units and provide removable temporary protection for joints during handling and delivery.

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1. Outside Corner of Stile and Rail Paneling: Shop-prepare using lock-mitered or mitered-and-splined construction. Assemble, sand, and glue in shop, if site conditions permit.
 - F. Fire-Retardant-Treated Paneling: Provide panels consisting of fire-retardant lumber and fire-retardant particleboard or fire-retardant medium-density fiberboard. Panels shall have a flame-spread rating of 75 or less and a smoke-developed rating of 450 or less per ASTM E 84.
- 2.14 STILE AND RAIL WOOD PANELING FOR OPAQUE FINISH
- A. Grade: Premium.
 - B. Provide fire-retardant treatment of stile and rail paneling as indicated below. For components of paneling fabricated from solid lumber, mill pieces before treatment.
 1. For stiles and rails, use fire-retardant-treated lumber or fire-retardant medium-density fiberboard.
 2. For insert panels, use fire-retardant medium-density fiberboard or fire-retardant particleboard with closed-grain hardwood veneer on face and back or medium density overlay.
 - C. Shop-assemble stile and rail paneling into largest units practical for delivery and installation. Provide shop-prepared detachable joints for necessary field connections. Sand and pull joints tight in shop so field joints will comply with joint tolerances for specified grade. Unless otherwise indicated, provide continuous mortise-and-tenon joints between panel units and provide removable temporary protection for joints during handling and delivery.
 1. Outside Corner of Stile and Rail Paneling: Shop-prepare using lock-mitered or mitered-and-splined construction. Assemble, sand, and glue in shop, if site conditions permit.
- 2.15 INTERIOR ORNAMENTAL WORK
- A. Interior ornamental work includes but is not limited to the following:
 1. Balustrades.
 2. Columns.
 3. Grilles.
 4. Mantels.
 5. Pediment heads.
 6. Pilasters.
 - B. Grade for Transparent Finish: Premium.
 - C. Grade for Opaque Finish: Premium.
- 2.16 WOOD CABINETS FOR TRANSPARENT FINISH
- A. Grade: Premium.
 - B. AWI Type of Cabinet Construction: Flush overlay unless indicated otherwise.
 - C. Lumber Trim and Edges: If not indicated, trim and edges shall be solid wood lumber compatible with grain and color of veneered panels.
 - D. Grain Direction: Vertically for drawer fronts, doors, and fixed panels, unless indicated otherwise.
 - E. Matching Requirements: As scheduled or as indicated in Design Selections.

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- F. Semi-exposed Surfaces: Provide surface materials indicated below:
1. Surfaces Other Than Drawer Bodies: Same species and cut indicated for exposed surfaces.
 2. Lumber Trim and Edges: Solid wood of same species and cut indicated for exposed surfaces.
 3. Drawer Sides, Backs and Sub-Fronts: **1/2 in (12 mm)** minimum thickness, as indicated.
 - a. Solid-hardwood lumber, same species indicated for exposed surfaces.
 4. Drawer Bottoms: **1/4 in (6 mm)** minimum thickness, as indicated.
 - a. Hardwood plywood with veneer core.
 5. Drawer Box Construction: One of the following:
 - a. Glued multiple dovetail.
 - b. Glued French dovetail.
 - c. Glued and doweled.
 6. Interior Drawer Box Finish, as indicated:
 - a. Clear catalyzed polyurethane.
- G. Body Members (Ends, Divisions, Bottoms and Sub-Tops): Medium-density fiberboard, **3/4 in (19 mm)** minimum thickness.
- H. Face Frames, Rails, Kicks and Bases: Solid-hardwood lumber or hardwood plywood, **3/4 in (19 mm)** thick minimum thickness. Do not use hardwood plywood if hinge screws enter edge of rail only.
- I. Shelves: Hardwood plywood with veneer core with the following thickness:
1. For Spans Up To **32 in (800 mm)**: **3/4 in (19 mm)**.
 2. For Spans Up To **42 in (1050 mm)**: **1 in (25 mm)**.
- J. Drawer Fronts: Medium density fiberboard, **3/4 in (19 mm)** thick minimum thickness.
- K. Doors:
1. Hinged Flush Type: Medium density fiberboard with minimum thickness of **3/4 in (19 mm)**.
 - a. Maximum cabinet door size: **24 in (600 mm)** width and **84 in (2100 mm)** height.
 - b. Maximum cabinet door size: **20 in (500 mm)** width and **84 in (2100 mm)** height.
 - c. For Doors Larger Than Sizes Above: **1-3/8 in (35 mm)** or **1-3/4 in (45 mm)** doors; refer to Division 8 Section Flush Wood Doors.
 - d. If hinge screws enter only edge of door, provide **3/4 in (19 mm)** lumber edges glued to core prior to laminating.
 2. Sliding Flush Type: As required by referenced quality standard for grade specified.
 3. Stile and Rail Type: As required by referenced quality standard for grade specified.

2.17 WOOD CABINETS FOR OPAQUE FINISH

- A. Grade: Premium.
- B. AWI Type of Cabinet Construction: Flush overlay unless indicated otherwise.
- C. Lumber Trim and Edges: If not indicated, trim and edges shall be solid wood lumber compatible with grain and color of veneered panels.

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- D. Panel Product for Exposed Surfaces: Hardwood plywood with veneer core.
- E. Semi-exposed Surfaces: Provide surface materials indicated below:
 - 1. Surfaces Other Than Drawer Bodies: Match materials indicated for exposed surfaces.
 - 2. Lumber Trim and Edges: Solid wood compatible with grain and color of veneered panels.
 - 3. Drawer Sides, Backs and Sub-Fronts: **1/2 in (12 mm)** minimum thickness, as indicated.
 - a. Solid-hardwood lumber.
 - 4. Drawer Bottoms: **1/4 in (6 mm)** minimum thickness, as indicated.
 - a. Hardwood plywood with veneer core.
 - 5. Drawer Box Construction: One of the following:
 - a. Glued multiple dovetail.
 - b. Glued French dovetail.
 - c. Glued and doweled.
 - 6. Interior Drawer Box Finish, as indicated:
 - a. Clear catalyzed polyurethane.
- F. Body Members (Ends, Divisions, Bottoms and Sub-Tops): Medium-density fiberboard, **3/4 in (19 mm)** minimum thickness.
- G. Face Frames, Rails, Kicks and Bases: Solid-hardwood lumber or hardwood plywood, **3/4 in (19 mm)** thick minimum thickness. Do not use hardwood plywood if hinge screws enter edge of rail only.
- H. Shelves: Hardwood plywood with veneer core with the following thickness:
 - 1. For Spans Up To **32 in (800 mm)**: **3/4 in (19 mm)**.
 - 2. For Spans Up To **42 in (1050 mm)**: **1 in (25 mm)**.
- I. Drawer Fronts: Medium density fiberboard, **3/4 in (19 mm)** thick minimum thickness.
- J. Doors:
 - 1. Hinged Flush Type: Medium density fiberboard with minimum thickness of **3/4 in (19 mm)**.
 - a. Maximum cabinet door size: **24 in (600 mm)** width and **84 in (2100 mm)** height.
 - b. Maximum cabinet door size: **20 in (500 mm)** width and **84 in (2100 mm)** height.
 - c. For Doors Larger than Sizes Above: **1-3/8 in (35 mm)** or **1-3/4 in (45 mm)** doors; refer to Division 8 Section Flush Wood Doors.
 - d. If hinge screws enter only edge of door, provide **3/4 in (19 mm)** lumber edges glued to core prior to laminating.
 - 2. Sliding Flush Type: As required by referenced quality standard for grade specified.
 - 3. Stile and Rail Type: As required by referenced quality standard for grade specified.

2.18 PLASTIC-LAMINATE CABINETS

- A. Grade: Premium.
- B. AWI Type of Cabinet Construction: Flush overlay unless indicated otherwise.
- C. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:

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1. Horizontal Surfaces Other Than Tops: Grade HGP, .038 in (1 mm) thick.
 2. Postformed Surfaces: Grade HGP, .038 in (1 mm) thick.
 3. Doors and Vertical Surfaces: Grade VGS, .028 in (0.7 mm) thick.
 4. Edges: PVC Edge Banding, 0.12 in (3 mm) thick, matching laminate in color, pattern, and finish.
 5. Edges: Grade HGS, .048 in (1.2 mm) thick.
- D. Semi-exposed Surfaces: Provide surface materials indicated below:
1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, Grade CLS, .020 in (0.5 mm) thick.
 2. Edges: PVC Edge Banding, .038 in (1 mm) thick, matching laminate in color, pattern, and finish.
 3. Drawer Sides, Backs and Sub-Fronts: 1/2 in (12 mm) minimum thickness, as indicated.
 - a. Solid-hardwood lumber.
 4. Drawer Bottoms: 1/4 in (6 mm) minimum thickness, as indicated.
 - a. Hardwood plywood with veneer core.
 5. Drawer Box Construction: One of the following:
 - a. Glued multiple dovetail.
 - b. Glued French dovetail.
 - c. Glued and doweled.
 6. Interior Drawer Box Finish, as indicated:
 - a. Clear catalyzed polyurethane.
- E. Body Members (Ends, Divisions, Bottoms and Sub-Tops): Medium-density fiberboard, 3/4 in (19 mm) minimum thickness.
- F. Face Frames, Rails, Kicks and Bases: Solid-hardwood lumber or hardwood plywood, 3/4 in (19 mm) thick minimum thickness.
- G. Face Frames and Rails: Solid-hardwood lumber or hardwood plywood, 3/4 in (19 mm) thick minimum thickness.
- H. Kicks and Bases: Solid-hardwood lumber, 1 1/2 (38 mm) thick minimum thickness.
- I. Shelves: Hardwood plywood with veneer core with the following thickness:
1. For Spans Up To 32 in (800 mm): 3/4 in (19 mm).
 2. For Spans Up To 42 in (1050 mm): 1 in (25 mm).
- J. Drawer Fronts: Medium density fiberboard, 3/4 in (19 mm) thick minimum thickness.
- K. Doors:
1. Hinged Flush Type: Medium density fiberboard with minimum thickness of 3/4 in (19 mm).
 - a. Maximum cabinet door size: 24 in (600 mm) width and 84 in (2100 mm) height.
 - b. Maximum cabinet door size: 20 in (500 mm) width and 84 in (2100 mm) height.
 - c. For Doors Larger than Sizes Above: 1-3/8 in (35 mm) or 1-3/4 in (45 mm) doors; refer to Division 08 Section "Flush Wood Doors".
 - d. If hinge screws enter only edge of door, provide 3/4 in (19 mm) lumber edges glued to core prior to laminating.

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- 2. Sliding Flush Type: As required by referenced quality standard for grade specified.
 - 3. Stile and Rail Type: As required by referenced quality standard for grade specified.
 - L. Concealed Backs of Panels with Exposed Plastic Laminate Surfaces: High-pressure decorative laminate, Grade BKL, .020 in (0.5 mm) thick.
 - M. Concealed Edges of Base Cabinet Panels: Including but not limited to floors, vertical edges, splashes and countertops; Clear Catalyzed Polyurethane.
- 2.19 WOOD COUNTERTOPS
- A. Grade: Premium.
 - B. Type of Top: Panel product for transparent finish (wood veneer laminated over core) as follows:
 - 1. Edge Treatment: Solid wood matching face for species and cut, 3/4 in (19 mm) thick minimum thickness, as indicated.
 - 2. Core Material: Medium-density fiberboard, moisture resistant, binder containing no added urea formaldehyde, 3/4 in (19 mm) thick minimum thickness.
- 2.20 PLASTIC-LAMINATE COUNTERTOPS
- A. Grade: Premium.
 - B. High-Pressure Decorative Laminate Grade:
 - 1. High-Pressure Decorative Laminate Grade for Flat Countertops: Grade HGS, .048 in (1.2 mm) thick.
 - 2. High-Pressure Decorative Laminate Grade for Post-formed Countertops: Grade HGP, .038 in (1.0 mm) thick.
 - C. Grain Direction for Wood Grain Laminates: Parallel to cabinet fronts.
 - D. Edge Treatment: PVC edge banding, 0.12 in (3 mm) thick, matching laminate in color, pattern, and finish, as indicated.
 - E. Edge Treatment: Grade HGS or HGP, .048 in (1.2 mm) thick.
 - F. Core Material for Countertops: Medium-density fiberboard, moisture resistant, binder containing no added urea formaldehyde, 3/4 in (19 mm) thick minimum thickness.
 - G. Core Material for Side and Back Splashes: Medium-density fiberboard, moisture resistant, binder containing no added urea formaldehyde, 1/2 in (12 mm) thick minimum thickness.
 - H. Backer Sheet: Provide plastic-laminate backer sheet, Grade BKL, .020 in (0.5 mm) thick, on underside of countertop substrate.
 - I. Concealed Backs and Edges at Side and Back Splashes: High-pressure decorative laminate, Grade BKL, .020 in (0.5 mm) thick.
- 2.21 SOLID SURFACING COUNTERTOPS
- A. Refer to Division 12 Section "Simulated Stone Countertops".
- 2.22 QUARTZ AGGLOMERATE COUNTERTOPS
- A. Refer to Division 12 Section "Simulated Stone Countertops".

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2.23 CULTURED MARBLE COUNTERTOPS

- A. Refer to Division 12 Section "Simulated Stone Countertops".

2.24 STAINLESS STEEL COUNTERTOPS AND SHELVING

- A. Stainless-Steel: 0.0625 in (1.5 mm) thick, stainless-steel sheet, ASTM A 666, Type 304, with No. 4 satin finish.
- B. Countertops: Weld shop-made joints, and grind and polish surfaces to produce uniform, directional, textured, polished finish indicated, free of cross scratches. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
1. Sound-deaden entire undersurface with heavy-build mastic coating.
 2. Extend top down to provide a 1 in (25 mm) thickness and a 1/2 in (12 mm) return flange under frame.
 3. Form backsplash coved to and integral with top surface.
 4. Provide raised marine edge around perimeter of tops containing sinks; pitch two ways to sink to provide drainage without channeling or grooving.
- C. Integral Sinks: Where stainless-steel sinks occur in stainless-steel tops, factory weld into one integral unit, grind welds smooth, and polish, passivate, and rinse.
1. Fabricate stainless-steel sinks with corners rounded and coved to at least a 5/8 in (15 mm) radius. Slope sink-bottoms to outlet. Provide double-wall construction for sink partitions with top edge rounded to at least a 1/2-in (12 mm) diameter.
- D. Fixed Shelving: Fold front and side edges down to provide 1-inch (25 mm) thickness. Fold rear edge up 1-1/2 inch (38 mm) to form a mounting flange. Weld corners. Construct integral wall mounting brackets of 0.0781 inch (2 mm) stainless steel with 1-1/2 inch (38 mm) flange at wall and completely welded to underside of shelf.
- E. Adjustable Shelving: Fold front, side, and rear edges down to provide a 1-inch (25 mm) thickness and mounting flange. Weld corners. Mount on adjustable stainless steel brackets supported by slotted wall standards.

2.25 CLOSET AND UTILITY SHELVING

- A. Grade: Custom.
- B. Shelf Material: 3/4 in (19 mm) solid lumber or veneer-faced panel product with solid-lumber edge.
- C. Cleats: 3/4 in (19 mm) solid lumber.

2.26 SHOP FINISHING

- A. Grade: Provide finishes of same grades as items to be finished.
- B. General: Finish architectural woodwork at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.
- C. Shop Priming: Shop apply the prime coat including backpriming, if any, for items specified to be field finished. Refer to Division 09 Painting Sections for material and application requirements.
- D. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.

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1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling and to end-grain surfaces. Concealed surfaces of plastic-laminate-clad woodwork do not require backpriming when surfaced with plastic laminate.

E. Finish:

1. Selections: As scheduled or as indicated in Design Selections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive interior architectural woodwork and associated work to which interior architectural woodwork will be applied for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

3.2 INSTALLATION, GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
 1. Quality standards. (The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with such selections and requirements in addition to the quality standard.)
 2. Respective manufacturer/fabricator's written installation instructions.
 3. Accepted submittals.
 4. Contract Documents.

3.3 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.
- B. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.
- C. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.4 INSTALLATION

- A. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication, to extent that it was not completed in the shop.
- B. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 in per 96 in (3 mm per 2400 mm).
- C. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- D. Fire-Retardant-Treated Wood: Handle, store, and install fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions, including those for adhesives used to install woodwork.

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- E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.
- F. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Do not use pieces less than **36 in (900 mm)** long, except where shorter single-length pieces are necessary. Scarf running joints and stagger in adjacent and related members.
 - 1. Fill gaps, if any, between top of base and wall with plastic wood filler, sand smooth, and finish same as wood base if finished.
 - 2. Install wall railings on indicated metal brackets securely fastened to wall framing.
 - 3. Install standing and running trim with no more variation from a straight line than **1/8 in per 96 in (3 mm per 2400 mm)**.
- G. Paneling: Anchor paneling to supporting substrate with concealed panel-hanger clips. Do not use face fastening, unless covered by trim or otherwise indicated.
 - 1. Install flush paneling with no more than **1/16 in per 96 in (1.5 mm per 2400 mm)** vertical cup or bow and **1/8 in per 96 in (3 mm per 2400 mm)** horizontal variation from a true plane.
 - 2. Flush Paneling with Revealed Joints: Install with variations in reveal width, alignment of top and bottom edges, and flushness between adjacent panels not exceeding **1/32 in (0.75 mm)**.
- H. Stairs: Securely anchor carriages to supporting substrates. Install stairs with treads and risers no more than **1/8 in (3 mm)** from indicated position.
- I. Railings:
 - 1. General: Install rails with no more than **1/8 in per 96 in (3 mm per 2400 mm)** variation from a straight line.
 - 2. Stair Rails: Glue and dowel or pin balusters to treads and railings, and railings to newel posts.
 - 3. Wall Rails: Support rails on indicated metal brackets securely fastened to wall framing.
 - a. Space rail brackets as required but not more than **5 ft (1525 mm)** on center.
- J. Cabinets, General: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
 - 1. Install cabinets with no more than **1/8 in per 96 in (3 mm per 2400 mm)** sag, bow, or other variation from a straight line.
 - 2. Maintain veneer sequence matching of cabinets with transparent finish.
- K. Base and Wall Cabinets: Set base cabinets straight, level, and plumb. Adjust subtops within **1/16 in (1.5 mm)** of a single plane. Fasten base cabinets to partition framing, or reinforcements in partitions with fasteners spaced **24 in (600 mm)** on center. Bolt adjacent cabinets together with joints flush, tight, and uniform.
 - 1. Where base cabinets are not installed adjacent to walls, fasten to floor at toe space with fasteners spaced **24 in (600 mm)** on center. Secure sides of cabinets to floor, where they do not adjoin other cabinets, with not less than two fasteners.
 - 2. Wall Cabinets: Fasten wall cabinets through back, near top and bottom, at ends and not more than **16 in (400 mm)** on center with No. 10 wafer-head sheet metal screws through

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metal backing or metal framing behind wall finish or toggle bolts through metal backing or metal framing behind wall finish.

- L. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
 - 1. Where possible make field jointing in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.
 - 2. Plastic Laminate Countertops: Secure field joints in plastic-laminate countertops with concealed clamping devices located within 6 in (150 mm) of front and back edges and at intervals not exceeding 24 in (600 mm). Tighten according to manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.
 - 3. Abut top and edge surfaces in one true plane, with internal supports placed to prevent deflection.
 - 4. Simulated Stone Countertops: Refer to Division 12 Section "Simulated Stone Countertops".
 - 5. Install countertops with no more than 1/8 in per 96 in (3 mm per 2400 mm) sag, bow, or other variation from a straight line.
 - 6. Secure backsplashes to tops with concealed metal brackets at 16 in (400 mm) on center and to walls with adhesive.
 - 7. Calk space between backsplash and wall with sealant specified in Division 07 Section "Joint Sealants".
- M. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.

3.5 ADJUSTING AND CLEANING

- A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean woodwork on exposed and semi-exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

3.6 WOOD TYPES SCHEDULE

- A. Wood Species and Cut for Transparent Finish:
 - 1. WD01:
 - a. Species and Cut:
 - b. Stain:
 - c. Locations: As indicated on drawings.

3.7 LAMINATE TYPES SCHEDULE

- A. High-Pressure Decorative Laminates (HPDL) Basis of Design (Product Standard):
 - 1. PL01:
 - a. Manufacturer:
 - b. Texture:
 - c. Color:

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- d. Locations: As indicated on drawings.
 - B. Chemical-Resistant, High-Pressure Decorative Laminates (HPDL) Basis of Design (Product Standard):
 - 1. CRPL01:
 - a. Manufacturer:
 - b. Texture:
 - c. Color:
 - d. Locations: As indicated on drawings.
 - C. PVC Laminate Basis of Design (Product Standard):
 - 1. PL11:
 - a. Manufacturer:
 - b. Texture:
 - c. Color:
 - d. Locations: As indicated on drawings.
- 3.8 SIMULATED STONE TRIM SCHEDULE
- A. Simultated Stone Fabrications (Product Standard):
 - 1. SSF01: Solid Surfacing
 - a. Type: [Solid Surfacing][Quartz Agglomerate][Cultured Marble]
 - b. Manufacturer:
 - c. Product:
 - d. Locations: As indicated on drawings.
- 3.9 TACKABLE WALL SURFACE TYPES SCHEDULE
- A. Fabric Wall Surface Basis of Design (Product Standard):
 - 1. FP01:
 - a. Manufacturer:
 - b. Product:
 - c. Selection:
 - d. Locations: As indicated on drawings.
- 3.10 FLUSH WOOD PANELING MATCHING SCHEDULE
- A. Matching Requirements:
 - 1. Matching of Adjacent Veneer Leaves:
 - a. Book match.
 - b. Slip match.
 - c. As indicated on drawings.
 - 2. Matching within Panel Face:
 - a. Running match.
 - b. Balance match.
 - c. Center-balance match.
 - d. As indicated on drawings.
 - 3. Panel-Matching Method: Match panels within each separate area by the following method:

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- a. Blueprint-matched panels and components.
 - b. Flitch Requirements:
- 4. Vertical Panel Matching Method: For panels arranged two or more panels high, match as follows:
 - a. Continuous end match; veneer leaves of upper panels are continuations of veneer leaves of lower panels.
 - b. Architectural end book match; veneer leaves are individually book matched from lower panels to upper panels.
 - c. Architectural end slip match; veneer leaves are individually slip matched from lower panels to upper panels.
 - d. Panel end book match; panels are book matched from lower panels to upper panels.
 - e. Panel end slip match; panels are slip matched from lower panels to upper panels.
- 3.11 STILE AND RAIL WOOD PANELING FLITCH REQUIREMENTS SCHEDULE
 - A. Flitch Requirements:
- 3.12 WOOD CABINETS MATCHING SCHEDULE
 - A. Matching Requirements:
 - 1. Matching of Veneer Leaves:
 - a. Book match.
 - b. Slip match.
 - c. Random match.
 - d. As indicated on drawings.
 - 2. Matching Within Panel Face:
 - a. Running match.
 - b. Balance match.
 - c. Center-balance match.
 - d. As indicated on drawings.
 - 3. Veneer Matching within Room: Blueprint matching; Provide cabinet veneers in each room or other space from a single flitch with doors, drawer fronts, and other surfaces matched in a sequenced set with continuous match where veneers are interrupted perpendicular to the grain.
- 3.13 SHOP FINISHING SCHEDULE
 - A. Transparent Finish:
 - 1. Finish System - 5: Conversion varnish.
 - 2. Staining: Match Architect's sample.
 - 3. Staining:
 - 4. Wash Coat for Stained Finish: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
 - 5. Filled Finish for Open-Grain Woods: After staining (if any), apply paste wood filler to open-grain woods and wipe off excess. Tint filler to match stained wood.
 - a. Apply wash-coat sealer after staining and before filling.
 - 6. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter per ASTM D 523.
 - B. Opaque Finish:

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1. Finish System - 5: Conversion varnish.
2. Color: Match Architect's sample.
3. Sheen: Semi-gloss, 46-60 gloss units measured on 60-degree gloss meter per ASTM D 523.

END OF SECTION

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SECTION 071326
SHEET WATERPROOFING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Sheet waterproofing systems and supplementary items necessary for installation at the following applications
 - 1. Vertical post-applied modified bituminous sheet waterproofing at foundation walls.
 - 2. Vertical pre-applied (blindsides) sheet waterproofing at retention system walls.
 - 3. Vertical pre-applied (blindsides) sheet waterproofing at retention system walls with shotcrete foundation walls.
 - 4. Horizontal pre-applied (blindsides) sheet waterproofing below slabs-on-grade over mud slab or prepared subgrade.
- B. Related Requirements:
 - 1. Foundation Drainage System: Refer to Division 33 Section Foundation Drainage System.

1.2 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
 - 1. Include construction details, material descriptions, tested physical and performance properties, and installation instructions for waterproofing.
 - 2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.
- B. Shop Drawings: Show locations and extent of waterproofing and details of installation, including plans, elevations, sections, details of components and attachments to other work.
 - 1. Include details of substrate joints and cracks, expansion joints, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.
 - 2. Include manufacturer's written approval of shop drawings prior to submission.
- C. Samples: For each exposed product and for each color and texture specified, including the following products:
 - 1. 8-by-8-inch (200-by-200-mm) square of waterproofing and flashing sheet.
 - 2. 4-by-4-inch (100-by-100-mm) square of drainage panels.

1.3 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Project Acceptance Document: Certification by the manufacturer that its product(s) are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required, and that a warranty will be issued.
 - 1. Provide written confirmation by the manufacturer that Geotechnical Report has been reviewed and that manufacturer takes no exception to the design of the below grade waterproofing system.
 - 2. Submit the following certifications prior to installation:
 - a. Concrete Substrate: Waterproofing manufacturer shall certify that concrete substrate condition and corrections, if necessary, comply with manufacturer installation guidelines.

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- B. Field Quality-Control Reports: Written report of testing and inspection required by "Field Quality Control".
- C. Warranties:
 - 1. Provide manufacturer's written warranty covering materials and installation (labor) stating obligations, remedies, limitations and exclusions.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.
 - 1. Experience: Installer's personnel with not less than 5 years of experience in the successful performance of Work similar to scope of this Project.
 - 2. Supervision: Installer shall maintain a competent supervisor at Project while the Work is in progress, and who has not less than 5 years of experience installing products and systems similar to scope of this Project.
 - 3. Manufacturer Acceptance: Installer shall be certified, approved, licensed, or acceptable to manufacturer to install products.
- B. Pre-Construction Subsoil Water Testing: Provide subsoil water testing as recommended or required by waterproofing manufacturer.
 - 1. General Requirements: Test subsoil water for compatibility with waterproofing materials.
 - 2. Test Method: Use manufacturer's standard test method to test for acids, alkalis, brine, or other contaminants that may inhibit performance of waterproofing materials.
 - 3. Specimen Quantity: Obtain and submit as many subsoil water samples required from Project at approximate locations where waterproofing will be installed.
 - 4. Reports: Interpret test results and certify reports indicating requirements for use of waterproofing materials and for corrective measures necessary.
- C. Mockups: Build mockups to verify selections made under Sample submittals and to set quality standards for installation.
 - 1. Build for each typical waterproofing installation including accessories to demonstrate surface preparation, sealing at penetrations, crack and joint treatments, inside and outside corner treatments, and protection.
 - a. Size: 100 sq. ft. (9.3 sq. m) in area.
 - b. Description: Each type of wall and deck installation.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - a. If Architect determines mock-up does not comply with requirements, reconstruct mock-ups until accepted.
 - 3. Accepted mock-ups may become part of completed Work if undisturbed at time of Substantial Completion.

1.5 PRE-INSTALLATION CONFERENCE

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.
 - 1. Participants:
 - a. Architect.
 - b. Contractor, including superintendent.

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- c. Installer, including project manager and supervisor.
 - d. If requested, Manufacturer's qualified technical representative.
 - e. Installers of other construction interfaced with Work.
 - 2. Minimum Agenda: Installer shall demonstrate understanding of the Work required by describing detailed procedures for preparing, installing, and cleaning the Work. Demonstration shall include, but not be limited to, following topics:
 - a. Tour representative areas of Work, inspect and discuss condition of substrate, and other preparatory work performed by other trades.
 - b. Review Contract Document requirements.
 - c. Review approved submittals.
 - d. Review inspection and testing requirements.
 - e. Review environmental conditions and procedures for coping with unfavorable conditions.
 - f. Resolve deviations or differences between Contract Documents and the manufacturer's specifications.
 - 3. Record discussions, including decisions and agreements, and prepare report.
- 1.6 DELIVERY, STORAGE, AND HANDLING
- A. Deliver liquid materials to Project site in original packages with seals unbroken, labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.
 - B. Store liquid materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by waterproofing manufacturer.
 - C. Remove and replace liquid materials that cannot be applied within their stated shelf life.
 - D. Store rolls according to manufacturer's written instructions.
 - E. Protect stored materials from direct sunlight.
- 1.7 PROJECT CONDITIONS
- A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended in writing by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.
 - 1. Do not apply waterproofing in snow, rain, fog, or mist.
 - B. Maintain adequate ventilation during preparation and application of waterproofing materials.
- 1.8 COORDINATION
- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.
- 1.9 WARRANTY
- A. Manufacturer's Warranty: Furnish manufacturer's written material and labor warranty signed by an authorized representative using manufacturer's standard form agreeing to furnish materials and labor required to repair or replace work which exhibits material defects caused by manufacture or design and installation of product. "Defects" is defined to include but not limited to deterioration or failure to perform as required.
 - 1. Warranty Period: Manufacturer shall warrant the products to be free from material and labor Defects for a period of 10 years from date of Substantial Completion.

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- a. Warranty includes waterproofing, flashings, counter-flashings, insulation, below grade expansion joints and other components of waterproofing system necessary to provide a complete installation.
- B. Installer's Warranty: Furnish installer's written workmanship warranty signed by an authorized representative using installer's standard form agreeing to provide labor required to repair or replace work which exhibits workmanship defects. "Defects" is defined to include but not limited to deterioration or failure to perform as required.
 - 1. Warranty Period: Installer shall warrant the installation to be free from workmanship Defects for a period of 2 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".
- B. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other manufacturers offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.
 - 1. Post-Applied Sheet Waterproofing:
 - a. Basis of Design: GCP Applied Technologies; Bituthene 3000 or 4000.
 - 2. Pre-Applied Sheet Waterproofing for Vertical Applications:
 - a. Basis of Design: GCP Applied Technologies; Preprufe 160R Plus.
 - 3. Pre-Applied Sheet Waterproofing for Shotcrete Applications, Non-Hydrostatic Drained Conditions:
 - a. Basis of Design: GCP Applied Technologies; GCP Applied Technologies; Preprufe 275/275LT.
 - 4. Pre-Applied Sheet Waterproofing for Grout-Injected Shotcrete Applications, Hydrostatic Non-Drained Conditions:
 - a. Basis of Design: GCP Applied Technologies; Preprufe SCS Waterproofing.
 - 5. Pre-Applied Sheet Waterproofing for Horizontal Applications:
 - a. Basis of Design: GCP Applied Technologies; Preprufe 300R Plus.

2.2 MATERIALS, GENERAL

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.
 - 1. Provide waterproofing materials, protection course, and molded-sheet drainage panels from single source from single manufacturer.
 - 2. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.

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2.3 PERFORMANCE REQUIREMENTS

- A. General Performance: Comply with performance requirements specified, as determined by testing of products and systems representing those indicated for this Project, without failure due to defective manufacture, fabrication, installation, or other defects in construction.
 - 1. Provide sheet waterproofing systems that prevent the passage of liquid water.
- B. Material Compatibility: Provide waterproofing materials that are compatible with one another under conditions of service and application required, as demonstrated by manufacturer based on testing and field experience.

2.4 POST-APPLIED SHEET WATERPROOFING

- A. Post-Applied Sheet Waterproofing: Minimum **60-mil (1.5-mm)** nominal thickness, self-adhering sheet consisting of **56-mils (1.4 mm)** of rubberized asphalt laminated on one side to a **4-mil-(0.10-mm-)** thick, polyethylene-film reinforcement, and with release liner on adhesive side.
 - 1. Manufacturers and Products:
 - a. AVM Industries Inc.; Aussie Mate 580 AL.
 - b. Carlisle Coatings & Waterproofing Inc.; CCW MiraDRI 860/861.
 - c. CETCO Building Materials Group; Envirosheet.
 - d. GCP Applied Technologies; Bituthene 3000 or 4000.
 - e. Meadows, W. R., Inc.; Mel-Rol.
 - f. Polyguard Products, Inc.; Polyguard 650.
 - g. Sika Corporation; SikaShield S-60.
 - h. Soprema; Colphene 3000.
 - 2. Sheet Strips: Self-adhering, rubberized-asphalt strips of same material and thickness as sheet waterproofing.

2.5 PRE-APPLIED (BLINDSIDE) SHEET WATERPROOFING

- A. Pre-Applied (Blindside) Sheet Waterproofing for Vertical Applications: Uniform, flexible, multilayered-composite sheet membrane that forms a permanent bond with fresh concrete placed against it; complete with accessories and preformed shapes for an unbroken waterproofing assembly.
 - 1. Self-Adhering HDPE Sheet Waterproofing:
 - a. Description: Minimum **73-mils (1.85 mm)** thick, uniform, flexible sheet membrane consisting of high-density polyethylene film laminated to a layer of waterproofing adhesive and nonwoven geotextile fabric.
 - 1) Manufacturer and Product: AVM Industries Inc.; Aussie Skin 550G Blindside Waterproofing Membrane.
 - b. Description: Minimum **32-mils (0.8 mm)** thick, uniform, flexible sheets consisting of **16-mils (0.4 mm)** thick HDPE sheet coated with pressure-sensitive rubber adhesive, protective adhesive coating, and release liner.
 - 1) Manufacturer and Product: GCP Applied Technologies; Preprufe 160R Plus.
 - c. Description: Minimum **73-mils (1.85 mm)** thick, uniform, flexible sheet membrane consisting of high-density polyethylene film laminated to a layer of waterproofing adhesive and nonwoven geotextile fabric.
 - 1) Manufacturer and Product: Polyguard Products Inc.; Underseal Blindside Waterproofing Membrane.

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2. Self-Adhering TPO Sheet Waterproofing:
 - a. Description: Minimum 70-mils (1.78 mm) thick, uniform, flexible sheets consisting of 45-mils (1.14 mm) thick reinforced TPO backing sheet with 25-mil (0.64 mm) butyl alloy membrane / adhesive.
 - 1) Manufacturer and Product: Carlisle Coatings & Waterproofings; MiraPly V Vertical Blindside Waterproofing.
 - b. Description: Minimum 1.10-mm thick, uniform, flexible composite sheet consisting of 0.50 mm thick polyolefin membrane with non-woven polypropylene fleece.
 - 1) Manufacturer and Product: Sika; SikaProof A-05.
3. Self-Adhering SBS Modified Bitumen Sheet Waterproofing:
 - a. Description: Minimum 120-mils (3.0 mm) thick, uniform, flexible sheets consisting of self-adhesive SBS modified bitumen with composite reinforcement and release film.
 - 1) Manufacturer and Product: Soprema; Colphene BSW V.
4. Self-Adhering Composite Sheet Waterproofing:
 - a. Description: Minimum 73-mils (1.85 mm) thick, uniform, flexible composite sheet membrane consisting of an elastomeric membrane bonded to a multi-ply plasmatic matrix and non-woven geotextile fabric.
 - 1) Manufacturer and Product: W.R. Meadows; PRECON Vertical Blindside Waterproofing Membrane.
5. Thermoplastic Sheet Waterproofing:
 - a. Description: Minimum 60-mil (1.5 mm) nominal thick PVC, Elvaloy KEE thermoplastic membrane reinforced with 5 oz. (385 mL) weft inserted knit polyester fabric integrally bonded to an Active Polymer Core (APC)
 - 1) Manufacturer and Product: CETCO Building Materials Group; Coreflex 60.
- B. Pre-Applied (Blindside) Sheet Waterproofing for Shotcrete Applications, Non-Hydrostatic Drained Conditions:
 1. Description: Minimum 73-mils (1.85 mm) thick, uniform, flexible sheet membrane consisting of high-density polyethylene film laminated to a layer of waterproofing adhesive and nonwoven geotextile fabric.
 - a. Manufacturer and Product: AVM Industries Inc.; Aussie Skin 550G Blindside Waterproofing Membrane.
 2. Description: Minimum 38-mils (0.95 mm) thick, uniform, flexible sheets consisting of 20-mils (0.5 mm) thick HDPE sheet coated with pressure-sensitive rubber adhesive, protective adhesive coating.
 - a. Manufacturer and Product: GCP Applied Technologies; GCP Applied Technologies; Preprufe 275/275LT.
- C. Pre-Applied (Blindside) Sheet Waterproofing for Grout-Injected Shotcrete Applications, Hydrostatic Non-Drained Conditions:
 1. Description: Minimum 0.17 in (4.3 mm) thick, uniform, flexible composite sheets consisting of a polymer mesh-reinforced cavity backed by a plastic film and faced with a non-woven, semipermeable geotextile barrier.

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- a. Manufacturer and Product: GCP Applied Technologies; Preprufe SCS Waterproofing.
- D. Pre-Applied (Blindside) Sheet Waterproofing for Horizontal Applications: Uniform, flexible, multilayered-composite sheet membrane that forms a permanent bond with fresh concrete placed against it; complete with accessories and preformed shapes for an unbroken waterproofing assembly.
- 1. Adhesive-Coated HDPE Sheet Waterproofing:
 - a. Description: Minimum **73-mils (1.85 mm)** thick, uniform, flexible sheet membrane consisting of high-density polyethylene film laminated to a layer of waterproofing adhesive and nonwoven geotextile fabric.
 - 1) Manufacturer and Product: AVM Industries Inc.; Aussie Skin 550G Blindside Waterproofing Membrane.
 - b. Description: Minimum **46-mils (1.2 mm)** thick, uniform, flexible sheets consisting of **30-mils (0.76 mm)** thick HDPE sheet coated with pressure-sensitive rubber adhesive, protective adhesive coating, detackifying surface treatment, an uncoated self-adhering side lap strip, and release liner.
 - 1) Manufacturer and Product: GCP Applied Technologies; Preprufe 300R Plus.
 - c. Description: Minimum **85-mils (2.0 mm)** thick, uniform, flexible sheet membrane consisting of high-density polyethylene film laminated to a layer of waterproofing adhesive and nonwoven geotextile fabric.
 - 1) Manufacturer and Product: Polyguard Products Inc.; Underseal Underslab Waterproofing Membrane.
 - 2. Adhesive-Coated TPO Sheet Waterproofing:
 - a. Description: Minimum **70-mils (1.78 mm)** thick, uniform, flexible sheets consisting of **45 mils (1.14 mm)** thick reinforced TPO backing sheet with **25-mil (0.64 mm)** butyl alloy membrane / adhesive.
 - 1) Manufacturer and Product: Carlisle Coatings & Waterproofings; MiraPly H Horizontal Blindside Waterproofing.
 - b. Description: Minimum **68-mils (1.72 mm)** thick, uniform, flexible polyolefin membrane with hybrid bonding layer, mechanical adhesive bond.
 - 1) Manufacturer and Product: Sika; SikaProof A+ 12.
 - 3. SBS Modified Bitumen Sheet Waterproofing:
 - a. Description: Minimum **140-mils (3.5 mm)** thick, uniform, flexible sheets consisting of SBS modified bitumen with polyester reinforcement.
 - 1) Manufacturer and Product: Soprema; Colphene BSW H.
 - 4. Self-Adhering Composite Sheet Waterproofing:
 - a. Description: Minimum **73-mils (1.85 mm)** thick, uniform, flexible composite sheet membrane consisting of an elastomeric membrane bonded to a multi-ply plasmatic matrix and non-woven geotextile fabric.
 - 1) Manufacturer and Product: W.R. Meadows; PRECON Below Grade Underslab Waterproofing Membrane.

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5. Thermoplastic Sheet Waterproofing:
- a. Description: Minimum 60-mil (1.5 mm) nominal thick PVC, Elvaloy KEE thermoplastic membrane reinforced with 5 oz. (385 mL) weft inserted knit polyester fabric integrally bonded to an Active Polymer Core (APC).
 - 1) Manufacturer and Product: CETCO Building Materials Group; Coreflex 60.

2.6 AUXILIARY MATERIALS

- A. General: Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.
 - 1. When required by waterproofing manufacturer, obtain Engineer of Record's approval to use manufacturer's recommended waterstops to meet warranty requirements.
- B. Primer: Liquid primer recommended for substrate by sheet-waterproofing material manufacturer.
- C. Surface Conditioner: Liquid, waterborne surface conditioner recommended for substrate by sheet-waterproofing material manufacturer.
- D. Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, of trowel grade or low viscosity, provided by waterproofing manufacturer.
- E. Substrate Patching Membrane: Low-viscosity, two-component, modified asphalt coating, provided by waterproofing manufacturer.
- F. Mastic and Adhesives: Liquid mastic and adhesives, and adhesive tapes provided by waterproofing manufacturer.
- G. Detail Tape: Two-sided, pressure-sensitive, self-adhering reinforced tape, 4-1/2 in (112 mm) wide, with tack-free protective adhesive coating on one side and release film on self-adhering side; provided by waterproofing manufacturer.
- H. Termination Bars: Aluminum bars or stainless steel bars ASTM A 666, Type 304; 2 types, one flat and one flat with upper flange shaped to receive sealant, locations as indicated; 1 in by 1/8 in (25 mm by 3 mm) thick; predrilled at 8 in (200 mm) centers; with stainless steel fasteners.
- I. Epoxy Grout: High performance, solvent free, impermeable three-part epoxy grout designed to maintain continuity of waterproofing system at structural penetrations.
 - 1. Basis of Design: GCP Applied Technologies; Grout EG 75.
 - a. Locations: Piles, piers, and similar structural penetrations, other locations recommended by waterproofing manufacturer.
- J. Injectable Waterstop: As required by waterproofing manufacturer to ensure watertight installation.
 - 1. Basis of Design: GCP Applied Technologies; INJECTO Tube Groutable Hose Waterstop used with Flex SLV or LV PUnE hydrophobic polyurethane chemical grout as recommended by waterproofing manufacturer for this application.
 - a. Locations: Concrete cold joints at base of foundation, around block-out openings, other locations recommended by waterproofing manufacturer.
- K. Waterstop: Polymer/butyl rubber waterstop strip that expands when in contact with water.
 - 1. Basis of Design: GCP Applied Technologies; Adcor 500S.
 - a. Locations: All typical concrete to concrete cold joints.

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- L. Expansion Joint System: Heavy-duty, double-celled, thermoplastic extruded sealing gland flanked by integral side flashing sheets. System shall include manufacturer's standard termination bars and anchors. For blind-side below grade applications.
 - 1. Basis of Design: Sika Corp.; Emseal BG System.
- M. Tieback Covers: Cover system used to maintain waterproofing integrity at soil retention tieback heads. Provide detail components as recommended by manufacturer for application conditions.
- N. Protection Course: As recommended by waterproofing manufacturer for this application.
 - 1. ASTM D6506, semirigid sheets of fiberglass or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners and as follows:
 - a. Thickness: Nominal 1/8 inch (3 mm) for vertical applications; 1/4 inch (6 mm) elsewhere.
 - b. Adhesive: Rubber-based solvent type recommended by waterproofing manufacturer for protection course type.

2.7 MOLDED-SHEET DRAINAGE PANELS

- A. Molded-Sheet Drainage Panel with Polymeric Film, Vertical Applications: Composite subsurface drainage panel acceptable to waterproofing manufacturer and consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a nonwoven, needle-punched geotextile facing laminated to one side of the core and a polymeric film bonded to the other side (facing waterproofing).
 - 1. Drainage Core: Three-dimensional, non-biodegradable, molded polypropylene or polystyrene.
 - a. Minimum Compressive Strength: 15,000 lbf/sf (718 kPa) according to ASTM D 1621.
 - b. Minimum In-Plane Flow Rate: 15 gpm/ft (188 L/min per m) of unit width at hydraulic gradient of 1.0 and compressive stress of 25 psi (172 kPa) according to ASTM D 4716.
 - 2. Manufacturers and Products:
 - a. AVM Industries Inc.; Drain Board 6020 XL.
 - b. CETCO Building Materials Group; 15XP Prefabricated Drainage Composite.
 - c. GCP Applied Technologies; Hydroduct 220.
 - d. Carlisle Coatings & Waterproofings; CCW MiraDRAIN 6200.
 - e. Polyguard Products Inc.; Polyflow 15P.
 - f. Sika Corporation; SikaDrainage Mat 420.
 - g. Soprema; Sopradrain 15G.
 - h. W.R. Meadows; Mel-Drain 5035 B.
- B. Molded-Sheet Drainage Panel with Polymeric Film, Horizontal Applications: Composite subsurface drainage panel acceptable to waterproofing manufacturer and consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a woven-geotextile facing laminated to one side of the core and a polymeric film bonded to the other side (facing waterproofing).
 - 1. Drainage Core: Three-dimensional, non-biodegradable, molded polypropylene or polystyrene.
 - a. Minimum Compressive Strength: 18,000 lbf/sf (862 kPa) according to ASTM D 1621.

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- b. Minimum In-Plane Flow Rate: 18 gpm/ft (225 L/min per m) of unit width at hydraulic gradient of 1.0 and compressive stress of 25 psi (172 kPa) according to ASTM D 4716.
 - 2. Manufacturers and Products:
 - a. AVM Industries Inc.; Drain Board 6020 XL.
 - b. CETCO Building Materials Group; 15XP Prefabricated Drainage Composite.
 - c. GCP Applied Technologies; Hydroduct 660.
 - d. Carlisle Coatings & Waterproofings; CCW MiraDRAIN 9000.
 - e. Polyguard Products Inc.; Flow 18-H.
 - f. Sika Corporation; SikaDrainage Mat 720.
 - g. Soprema; Sopradrain 18G.
 - h. W.R. Meadows; Mel-Drain 7055.
 - C. High-Capacity, Molded-Sheet Collector-Panel System Wrapped with Geotextile: Composite subsurface collector-panel system by same manufacturer as primary molded-sheet drainage panels; consisting of a high-profile, studded, nonbiodegradable, molded-plastic-sheet drainage core; wrapped with a nonwoven-geotextile facing. Provide system with manufacturer's outlets, connectors, tapes, and other accessories to connect primary molded-sheet drainage panels with piped sub-drainage system.
 - 1. Compressive Strength per ASTM D1621: 9000 psf (431 kPa) minimum.
 - 2. Flow Rate per ASTM D4716: 17 to 80 gpm per ft. (211 to 994 L/min. per m) minimum.
 - 3. Manufacturers and Products:
 - a. AVM Industries Inc.; Bottom Drain.
 - b. CETCO Building Materials Group; Aquadrain 100BD.
 - c. GCP Applied Technologies; Hydroduct Coil 600.
 - d. Carlisle Coatings & Waterproofings; CCW MiraDRAIN HC.
 - e. Polyguard Products Inc.; Totalflow.
 - D. Drainage Panel Auxiliary Materials.
 - 1. Adhesive for Bonding Drainage Panels: Product compatible with drainage panels being bonded and with demonstrated capability to bond securely to substrates indicated without damaging substrates.
 - 2. Miscellaneous Accessories: As required by manufacturer for complete installation assembly, including flanges around piping penetrations and expanded base and tie-in fittings as necessary to coordination with foundation drainage system.
- 2.8 INSULATION PANELS
 - A. Insulation: Comply with Division 7 Section 072100 Thermal Insulation for general building insulation.
- PART 3 - EXECUTION
- 3.1 EXAMINATION
 - A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.
 - B. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of waterproofing.

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1. Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.
2. Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for capillary moisture by plastic sheet method according to ASTM D4263.
3. Verify that compacted subgrade or mud slab is dry, smooth, sound, and ready to receive waterproofing sheet.

C. Excavation Support and Protection System:

1. Fill minor gaps and spaces **1/2 in (12 mm)** wide or wider with wood, metal, concrete, or other appropriate filling material.
2. Cover or fill large voids and crevices with cement mortar.
3. Encase tieback rods, nuts, and plates with detail tape and prepare for covering with waterproofing.

3.2 INSTALLATION, GENERAL

A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:

1. ASTM D 6135.
2. Respective manufacturer's written installation instructions.
3. Accepted submittals.
4. Contract Documents.

3.3 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.
- B. Excavation Dewatering: Verify that the waterproofing application area is dry and free of standing and uncontrolled water. Should the dewatering system fail at any time during application of waterproofing system, the materials shall be completely removed and work shall start over with new materials once the area is dry and free of water.
- C. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.
- D. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.
- E. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- F. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.
- G. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D4258.
1. Install sheet strips of width according to manufacturer's written instructions and center over treated construction and contraction joints and cracks exceeding a width of **1/16 inch (1.6 mm)**.

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- H. Bridge and cover isolation joints, expansion joints, and discontinuous deck-to-wall and deck-to-deck joints with overlapping sheet strips of widths according to manufacturer's written instructions.
 - 1. Invert and loosely lay first sheet strip over center of joint. Firmly adhere second sheet strip to first and overlap to substrate.
- I. Corners: Prepare, prime, and treat inside and outside corners according to ASTM D6135.
 - 1. Install membrane strips centered over vertical inside corners. Install **3/4-inch (19-mm)** fillets of liquid membrane on horizontal inside corners and as follows:
 - a. At footing-to-wall intersections, extend liquid membrane in each direction from corner or install membrane strip centered over corner.
 - b. At plaza-deck-to-wall intersections, extend liquid membrane or sheet strips onto deck waterproofing and to finished height of sheet flashing.
- J. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions according to ASTM D6135.

3.4 INSTALLATION OF POST-APPLIED SHEET WATERPROOFING

- A. Install modified bituminous sheets according to waterproofing manufacturer's written instructions and per recommendations in ASTM D6135.
- B. Primer: Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by sheet waterproofing in same day. Reprime areas exposed for more than 24 hours.
- C. Apply and firmly adhere sheets over area to receive waterproofing. Accurately align sheets and maintain uniform **6-inch- (150-mm-)** minimum lap widths and end laps. Overlap and seal seams with liquid membrane, and stagger end laps to ensure watertight installation. Roll membrane and seams with a hard neoprene roller.
 - 1. When ambient and substrate temperatures range between **25 and 40 deg F (minus 4 and plus 5 deg C)**, install self-adhering, modified bituminous sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than **60 deg F (16 deg C)**.
 - 2. Apply sheets so that direction of flow of water is over and not against laps.
 - 3. Apply sheet strips under waterproofing membrane at, but not limited to, the following locations:
 - a. Expansion joints.
 - b. Discontinuous deck-to-wall and deck-to-deck joints.
 - c. Under clamping ring at drains.
 - d. Wall angles and corners.
 - e. Substrate cracks.
 - f. Penetrations.
 - g. Isolation, construction and contraction joints.
 - h. Locations where waterproofing membrane may be subjected to unusual strain.
- D. Horizontal Application: Apply sheets from low to high points of decks to ensure that laps shed water.
- E. Apply continuous sheets over already-installed sheet strips, bridging substrate cracks, construction, and contraction joints.
- F. Waterproofing Tie-Ins: Install waterproofing and accessories to tie into adjacent waterproofing to ensure watertight installation.

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- G. Termination and Penetration Treatment: Prepare vertical and horizontal surfaces at terminations and penetrations through waterproofing and at expansion joints, drains, and sleeves.
 - 1. Unless indicated otherwise, terminate top edges of sheets under metal counterflashings or with metal termination bars and sealants.
 - 2. Seal all exposed sheet edges at terminations, vertical and horizontal, not concealed by metal counterflashings or metal termination bars and sealants with liquid membrane or mastic.
- H. Damaged Waterproofing: Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Tape perimeter of damaged or nonconforming area extending 6 inches (150 mm) beyond repaired areas in all directions. Apply a patch of sheet waterproofing and firmly secure with detail tape.
 - 1. Patch tears, voids, misaligned or inadequately lapped seams.
 - 2. Slit fishmouths and blisters, overlap flaps, and patch.
- I. Immediately install protection course with butted joints over waterproofing membrane.
 - 1. Molded-sheet drainage panels or insulation panels may be used in place of a separate protection course to vertical applications when approved by waterproofing manufacturer and installed immediately.

3.5 INSTALLATION OF PRE-APPLIED (BLINDSIDE) SHEET WATERPROOFING

- A. Install blindside sheet waterproofing according to manufacturer's written instructions.
- B. Molded-Sheet Drainage Panels at Vertical Applications: Place and secure over substrate with adhesive, with geotextile filter fabric facing excavation support and protection system. Lap edges and ends of geotextile filter fabric to maintain continuity. Protect installed drainage panels during subsequent construction.
- C. Vertical Applications: Install sheet with appropriate face against substrate. Accurately align sheets and maintain uniform side and end laps of minimum dimensions required by membrane manufacturer. Overlap and seal seams, and stagger and tape end laps to ensure watertight installation. Mechanically fasten to substrate.
 - 1. Seams and Laps: Install 12-inch strip of post-applied membrane sheet strips behind laps and 4-inch strip of membrane detail tape over front of lap. Additionally at field cut seams, provide a 6-inch overlap with a full bed of liquid membrane. Roll membrane and seams with hard neoprene roller.
 - 2. Securely fasten top termination of membrane with continuous metal termination bar anchored into substrate and cover with detail tape.
- D. Horizontal Applications: Install sheet with face against substrate. Accurately align sheets and maintain uniform side and end laps of minimum dimensions required by membrane manufacturer. Overlap and seal seams, and stagger and tape end laps to ensure watertight installation.
 - 1. Seams and Laps: Install 12-inch strip of post-applied membrane sheet strips behind laps and 4-inch strip of membrane detail tape over front of lap. Additionally at field cut seams, provide a 6-inch overlap with a full bed of liquid membrane. Roll membrane and seams with hard neoprene roller.
- E. Corners: Seal lapped terminations and cut edges of sheet waterproofing at inside and outside corners with detail tape.

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- F. Seal penetrations through sheet waterproofing to provide watertight seal with detail tape patches or wraps and a liquid-membrane troweling.
- G. Waterproofing Tie-Ins: Install waterproofing and accessories to tie into adjacent waterproofing to ensure watertight installation.
- H. Termination and Penetration Treatment: Prepare vertical and horizontal surfaces at terminations and penetrations through waterproofing and at expansion joints, drains, and sleeves.
- I. Damaged Waterproofing: Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Tape perimeter of damaged or nonconforming area extending **6 inches (150 mm)** beyond repaired areas in all directions. Apply a patch of sheet waterproofing and firmly secure with detail tape.

3.6 INSTALLATION OF INSULATION PANEL

- A. Install insulation panels over waterproofed surfaces. Cut and fit to within **3/4 inch (19 mm)** of projections and penetrations.
- B. On vertical surfaces, set insulation drainage panels in adhesive or tape applied according to manufacturer's written instructions.
 - 1. Install board insulation before installing molded sheet drainage panels.
- C. On horizontal surfaces, loosely lay insulation drainage panels according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

3.7 INSTALLATION OF MOLDED-SHEET DRAINAGE PANEL

- A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate, according to manufacturer's written instructions. Use adhesive or another method that does not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.

3.8 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Manufacturer's qualified technical representative shall periodically inspect Work to ensure installation is proceeding in accordance with manufacturer's designs, recommendations, instructions, and warranty requirements. Representative shall submit written reports of each visit indicating observations, findings, and conclusions of inspection.
 - 1. Manufacturer's Technical Representative Qualifications: Direct employee of technical services department of manufacturer with experience in providing recommendations, observations, evaluations, and problem diagnostics.
 - 2. Final Inspection: Arrange for waterproofing system manufacturer's qualified technical representative to inspect waterproofing installation on completion of waterproofing membrane and flashing. Notify Architect and Owner 48 hours in advance of date and time of final inspection.
- B. Owner Testing Agency: The Owner may employ and pay a qualified independent testing agency to perform field quality control.
- C. Contractor Tests and Inspections, General: Tests and inspections shall take place as installation proceeds to determine compliance with specified performance requirements.
 - 1. Agency shall be certified by waterproofing manufacturer to provide observations and inspections required to provide warranty indicated.

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- a. Agency shall prepare reports and digital photographs documenting observations. Reports shall be made available to the Contractor, waterproofing installer, waterproofing manufacturer and Architect.
2. Pre-Applied Sheet Waterproofing: Including but not limited to the following:
 - a. Prior to beginning concrete slab reinforcing installation, inspect waterproofing membrane for rips, tears, and punctures.
 - b. Prior to concrete placement work, inspect concrete installer's tools and notify Contractor to have tools with spikes or other sharp surfaces that could inflict intentional or unintentional damage on the installed waterproofing membrane removed from work area.
 - c. Immediately prior to concrete placement work, inspect waterproofing membrane for rips, tears, and punctures, inspect penetrations at columns and mechanical and electrical piping.
 - d. Continuously inspect concrete placement work, watching for damage to waterproofing membrane.
 - e. Periodically inspect portions of slab that were not placed (block-outs, voids, and leave-outs) for water infiltration of subgrade until concrete is subsequently placed.
3. Correction of Deficiencies:
 - a. Materials and installation will be considered defective if they do not meet specified requirements.
 - b. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.
 - c. Perform additional tests and inspections, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.
4. Prepare test and inspection reports.
- D. Contractor Flood Testing: Flood test each deck area for leaks, according to procedures in ASTM D5957, after completing waterproofing but before placing overlying construction. Install temporary containment assemblies, plug or dam drains, and flood with potable water.
 1. Flood to an average depth of **2-1/2 inches (64 mm)** with a minimum depth of **1 inch (25 mm)** and a maximum depth of **4 inches (100 mm)**. Maintain **2 inches (51 mm)** of clearance from top of sheet flashings.
 2. Flood each area for 24 hours.
 3. Examine underside of decks and terminations for evidence of leaks during flood testing.
 4. After flood testing, repair leaks, repeat flood tests, and make further repairs until waterproofing installation is watertight.
- E. Contractor Electronic Leak-Detection Testing, Electronic Field Vector Mapping (EFVM): Perform leak testing by an electronic detection process to verify entire waterproofing membrane is free of defects. EFVM shall be performed by a qualified testing agency.
 1. Test each deck area for leaks using an electronic leak-detection method that locates discontinuities, holes, open seams, and capillary defects in the waterproofing membrane.
 - a. Perform leak detection of horizontal waterproofing membrane prior to placement of protection board and remaining system components
 2. Perform tests on abutting or overlapping smaller areas as necessary to cover entire test area.
 3. Create a conductive electronic field over the area of waterproofing to be tested and electronically determine locations of discontinuities or leaks, if any, in the waterproofing.
 4. Provide survey report indicating locations of discontinuities, if any.

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3.9 PROTECTION, REPAIR, AND CLEANING

- A. Do not permit foot or vehicular traffic on unprotected membrane.
- B. Protect waterproofing from damage and wear during remainder of construction period.
- C. Protect installed insulation panels from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.
- D. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.
- E. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION

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SECTION 071900
WATER REPELLENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes penetrating water repellent and supplementary items necessary to complete work required for its installation.

1.2 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
 - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.

1.3 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Project Acceptance Document: Certification by the manufacturer that its product(s) are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required, and that a warranty will be issued.
 - 1. Certification by water repellent manufacturer that products supplied complies with local regulations controlling use of VOCs.
- B. Warranty:
 - 1. Provide manufacturer's written warranty covering materials and installation (labor) stating obligations, remedies, limitations and exclusions.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Experience: Installer's personnel with not less than 5 years of experience in the successful performance of Work similar to scope of this Project.
 - 2. Supervision: Installer shall maintain a competent supervisor at Project while the Work is in progress, and who has not less than 5 years of experience installing products and systems similar to scope of this Project.
 - 3. Manufacturer Acceptance: Installer shall be certified, approved, licensed, or acceptable to manufacturer to install products.
- B. Regulatory Requirements: Comply with applicable rules of pollution-control regulatory agency having jurisdiction in Project locale regarding VOCs and use of hydrocarbon solvents.
- C. Field Samples: Select one representative surface for each substrate to receive water repellents. Apply water repellent to each substrate, with either partial or full coverage as directed. Comply with application requirements of this Section.
 - 1. Obtain approval of field samples before applying water repellents.
 - 2. Maintain field samples during construction in an undisturbed condition as a standard for judging the completed Work.

1.5 PRE-INSTALLATION CONFERENCE

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.

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1.6 PROJECT CONDITIONS

- A. Weather and Substrate Conditions: Do not proceed with application of water repellent under any of the following conditions, except with written instruction of manufacturer:
1. Ambient temperature is less than 40 deg F (4.4 deg C).
 2. Concrete surfaces have cured for less than 28 days.
 3. Rain or temperatures below 40 deg F (4.4 deg C) are predicted within 24 hours.
 4. Application is earlier than 24 hours after surfaces have been wet.
 5. Substrate is frozen or surface temperature is less than 40 deg F (4.4 deg C).
 6. Windy condition exists that may cause water repellent to be blown onto vegetation or surfaces not intended to be coated.

1.7 COORDINATION

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

1.8 WARRANTY

- A. Manufacturer's Warranty: Furnish manufacturer's written material and labor warranty signed by an authorized representative using manufacturer's standard form agreeing to furnish materials and labor required to repair or replace work which exhibits material defects caused by manufacture or design of product. "Defects" are defined to include but not limited to deterioration or failure to perform as required.
1. Warranty does not include deterioration or failure of coating due to unusual weather phenomena, failure of prepared and treated substrate, formation of new joints and cracks in excess of 1/16 in (1.5 mm) wide, fire, vandalism, or abuse by maintenance equipment.
 2. Warranty Period: Manufacturer shall warrant the products to be free from material and labor Defects for a period of 5 years from date of Substantial Completion

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section Substitution Procedures.
- B. Manufacturers:
1. Advanced Chemical Technologies, Inc.
 2. Anti Hydro International, Inc
 3. L&M Construction Chemicals, Inc.
 4. Nox-Crete Products Group
 5. PROSOCO, Inc.
 6. Textured Coatings of America, Inc.

2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Comply with performance requirements specified, as determined by testing of products and systems representing those indicated for this Project, without failure due to defective manufacture, fabrication, installation, or other defects in construction.

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- B. Provide water repellents with the following properties based on testing manufacturer's standard products, according to test methods indicated, applied to substrates simulating Project conditions using same materials and application methods to be used for Project.
1. Absorption: Minimum 90 percent reduction of absorption after 24 hours in comparison of treated and untreated specimens, per ASTM C642.
 2. Water-Vapor Transmission: Maximum 10 percent reduction in rate of vapor transmission in comparison of treated and untreated specimens, per ASTM E 96.
 3. Water Penetration and Leakage through Masonry: Maximum 90 percent reduction in leakage rate in comparison of treated and untreated specimens, per ASTM E 514.
 4. Durability: Maximum 5 percent loss of water repellency after 2500 hours of weathering in comparison to specimens before weathering, per ASTM G 53.
 5. Permeability: Minimum 80 percent breathable in comparison of treated and untreated specimens, per ASTM D 1653.
 6. Chloride-Ion Intrusion in Horizontal Concrete: Transportation Research Board, National Research Council's NCHRP Report 244, Series II tests.
 - a. Reduction of Water Absorption: 80 percent.
 - b. Reduction in Chloride Content: 80 percent.

2.3 WATER REPELLENTS

- A. Vertical Applications: Silane, 20 Percent Solids: Penetrating water repellent for vertical application. A monomeric compound containing approximately 20 percent alkyltrialkoxysilanes and meeting VOC requirements.
- B. Horizontal Applications: Silane, 40 Percent Solids: Penetrating water repellent for horizontal application. A monomeric compound containing approximately 40 percent alkyltrialkoxysilanes and meeting VOC requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates surfaces to receive water repellents and associated work and conditions under which work will be installed. Do not proceed with installation until unsatisfactory conditions have been corrected in a manner acceptable to Installer. Starting work within a particular area will be construed as applicator's acceptance of surface conditions.

3.2 INSTALLATION, GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
1. Respective manufacturer written installation instructions.
 2. Accepted submittals.
 3. Contract Documents.

3.3 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work
- B. Test for pH level, according to water repellent manufacturer's written instructions, to ensure chemical bond to silicate minerals.

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- C. Protect adjoining work, including sealant bond surfaces, from spillage or blow-over of water repellent. Cover adjoining and nearby surfaces of aluminum and glass if there is the possibility of water repellent being deposited on surfaces. Cover live plants and grass.
- D. Coordination with Sealants: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.
 - 1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those used in the work.
- E. Test Application: Before performing water-repellent work, including bulk purchase and delivery of products, prepare a small application in an unobtrusive location and in a manner approved by Architect to demonstrate the final effect (visual, physical, and chemical) of planned application. Proceed with work only after Architect approves test application or as otherwise directed.

3.4 APPLICATION

- A. Apply a heavy-saturation spray coating of water repellent on surfaces indicated for treatment using low-pressure spray equipment. Comply with manufacturer's written instructions for using airless spraying procedure, unless otherwise indicated.
 - 1. Architectural Precast Concrete: At Contractor's option, first application of water repellent on precast concrete units may be completed before installing units. Mask sealant-bond surfaces to prevent water repellent from migrating onto joint surfaces.
- B. Apply a second saturation spray coating, repeating first application. Comply with manufacturer's written instructions for limitations on drying time between coats and after rainstorm wetting of surfaces between coats. Consult manufacturer's technical representative if written instructions are not applicable to Project conditions.

3.5 CLEANING

- A. Protective Coverings: Remove protective coverings from adjacent surfaces and other protected areas.
- B. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Repair damage caused by water-repellent application. Comply with manufacturer's written cleaning instructions.

3.6 SCHEDULE

- A. Apply water repellents to following areas:
 - 1. Architectural precast concrete panels.
 - 2. Cast stone units.

END OF SECTION

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SECTION 072100
THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Thermal insulation and supplementary items necessary for installation.
 - 1. Extruded polystyrene foam-plastic board insulation.
 - 2. Mortar faced, extruded polystyrene foam-plastic board insulation.
 - 3. Molded (expanded) polystyrene foam-plastic board insulation.
 - 4. Glass-fiber blanket insulation.
 - 5. Glass-fiber board insulation.
 - 6. Mineral-wool blanket insulation.
 - 7. Mineral-wool board insulation.
 - 8. Thin profile, high thermal blanket insulation.
 - 9. Loose-fill insulation.
 - 10. Spray-applied glass fiber insulation.
 - 11. Polyethylene vapor retarder membrane.
- B. Related Requirements:
 - 1. Refer to Division 03 Section Expanded Polystyrene Foam Block Formwork expanded polystyrene rigid insulation used for foam block fill.
 - 2. Refer to Division 03 Section Lightweight Insulating Concrete for expanded polystyrene rigid insulation used as a component in lightweight insulating concrete under roof membrane.
 - 3. Refer to Division 04 Section Concrete Unit Masonry for insulation installed in masonry cells.
 - 4. Refer to Division 07 Section EIFS for expanded polystyrene rigid insulation used as a component in EIFS.
 - 5. Refer to Division 07 Sections for Roofing sections with insulation specified as part of roofing construction.
 - 6. Refer to Division 09 Section Gypsum Board Assemblies for sound attenuation blankets used as acoustic insulation.

1.2 DEFINITIONS

- A. Mineral Fiber: Insulation composed principally of fibers manufactured from rock, slag, or glass, with or without binders. Mineral fiber includes "glass fiber" insulation and "mineral wool" insulation.
- B. Mineral Wool: A synthetic vitreous fiber insulation made by melting predominantly igneous rock, and/or furnace slag and other inorganic material, physically forming the melt into fibers.

1.3 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
 - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
- B. Shop Drawings for Spray-Applied Thermal Insulation: Show details of fabrication and installation, including plans, elevations, sections, details of components and attachments to other work.

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1. Indicate locations and types of surface preparations required before applying spray-applied thermal insulation.
 2. Indicate extent of minimum thicknesses needed to achieve required thermal rating, color, and texture.
 3. Treatment of spray-applied thermal insulation after application.
- C. Samples of Spray-Applied Thermal Insulation for Verification: For each exposed product of each color and texture specified, 12-inch (300 mm) square in size.
- D. Insulation Schedule: Include the following information:
1. Insulation type and location.
 2. Insulation manufacturer and product name.
 3. Insulation method of installation and fastening.

1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturer Project Acceptance Document for Spray-Applied Thermal Insulation: Certification by the manufacturer that its product(s) are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required.
- B. Installer's Certification: Listing type, manufacturer, and R-value of insulation installed in each element of the building thermal envelope unless labeled by manufacturer.
1. For blown-in or sprayed insulation, indicate initial installed thickness, settled thickness, settled R-value, installed density, coverage area, and number of bags installed.
 2. Sign, date, and post the certification in a conspicuous location on Project site.
- C. Product Test Reports for Spray-Applied Thermal Insulation: Written reports based on evaluation of comprehensive tests performed by qualified testing agencies indicating that each product complies with requirements.
1. Certificates: Furnish manufacturer's certification that spray-applied thermal insulation is free of asbestos (including actinolite, amosite, anthophyllite, chrysotile, crocidolite and tremolite), or other toxic materials.
 2. Compatibility and Adhesion Test Reports: From manufacturer indicating the following:
 - a. Materials have been tested for bonding with substrates.
 - b. Materials have been verified by spray-applied thermal insulation manufacturer to be compatible with substrate primers and coatings.
 - c. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- D. Research Reports: For foam-plastic insulation, from ICC-ES.
- E. Field Quality Control Reports for Spray Thermal Insulation: Written report of testing and inspection required by Field Quality Control.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer with not less than 5 years of experience in the successful production and in-service performance of products and systems similar to scope of this Project.
- B. Installer Qualifications for Spray-Applied Thermal Insulation:
1. Experience: Installer's personnel with not less than 5 years of experience in the successful performance of Work similar in scope of this Project.

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2. Supervision: Installer shall maintain a competent supervisor at Project while the Work is in progress, and who has not less than 5 years of experience installing products and systems similar in scope of this Project.
3. Manufacturer Acceptance: Installer shall be certified, approved, licensed, or acceptable to manufacturer to install products.

1.6 MOCKUP FOR SPRAY-APPLIED THERMAL INSULATION

- A. Mock-ups: Prior to installation, build mock-up for each form of construction and finish required to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mock-up using materials indicated for the completed Work.
 1. Build mock-up in the location and of the size indicated or, if not indicated, as directed by Architect.
 2. Notify Architect seven days in advance of the dates and times when mock-up will be installed.
 3. Obtain Architect's acceptance of mock-ups before starting installation.
 4. Acceptance of mock-ups does not constitute acceptance of deviations from the Contract Documents contained in mock-ups unless such deviations are specifically noted by Contractor and accepted by Architect in writing.
 5. Demolish and remove mock-ups when directed by Architect unless accepted to become part of the completed Work.

1.7 PRE-INSTALLATION CONFERENCE

- A. Participants:
 1. Architect.
 2. Contractor, including superintendent.
 3. Installer, including project manager and supervisor.
 4. If requested, Manufacturer's qualified technical representative.
 5. Installers of other construction interfaced with Work.
- B. Minimum Agenda: Installer shall demonstrate understanding of the Work required by describing detailed procedures for preparing, installing, and cleaning the Work. Demonstration shall include, but not be limited to, following topics:
 1. Tour representative areas of Work, inspect and discuss condition of substrate, and other preparatory work performed by other trades.
 2. Review Contract Document requirements.
 3. Review accepted submittals.
 4. Review inspection and testing requirements.
 5. Review environmental conditions and procedures for coping with unfavorable conditions.
 6. Resolve deviations or differences between Contract Documents and the manufacturer's specifications.
- C. Record discussions, including decisions and agreements, and prepare report.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver insulation materials in original packaging with identification labels intact. Ensure that insulation materials are not exposed to moisture during delivery.
- B. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

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- C. Protect foam-plastic board insulation as follows:
 - 1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
 - 2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
 - 3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.
- D. Protect mineral-wool insulation by storing materials off ground, away from harmful conditions, and at temperature conditions recommended by manufacturer. Store in original packaging.

1.9 FIELD CONDITIONS FOR SPRAY-APPLIED THERMAL INSULATION

- A. Environmental Limitations: Do not apply sprayed thermal insulation when ambient or substrate temperature is 34 deg F (1 deg C) or lower, unless temporary protection and heat are provided to maintain temperature at or above this level until material is dry and firm to the touch, completely cured through to substrate.
- B. Ventilation: Ventilate building spaces during and after application of sprayed thermal insulation and provide complete air exchanges in accordance with manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until sprayed thermal insulation is fully cured.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND PRODUCTS

- A. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to Conditions of the Contract and Division 01 Section "Substitution Procedures".
- B. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other manufacturers offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.

2.2 MATERIALS, GENERAL

- A. Single Source Responsibility: Furnish each type of product from a single manufacturer. Provide secondary materials only as recommended by the manufacturer of primary materials.
- B. General: Provide insulating materials that comply with requirements and referenced standards in sizes to fit applications indicated, selected from manufacturer's standard thicknesses, widths, and lengths.

2.3 PERFORMANCE REQUIREMENTS, GENERAL

- A. General Performance: Comply with performance requirements specified, as determined by testing of products and systems representing those indicated for this Project, without failure due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Fire Rated Assemblies: Provide materials and assemblies selected from UL Fire Resistance Directory for fire-resistance rated designs, or other Testing Agency acceptable to Authorities Having Jurisdiction.

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- C. Surface Burning Characteristics: Provide materials and assemblies tested in accordance with ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
 - D. Combustibility: Provide materials and assemblies tested in accordance with ASTM E136 Standard Test Method for Assessing Combustibility of Materials.
 - E. Plenum Rated: Provide materials and assemblies tested in accordance with UL 181 Standard Closure Systems for Use with Flexible Air Ducts and Air Connectors, or other independent testing agency acceptable to Authorities Having Jurisdiction.
 - 1. Air Erosion Testing: No evidence of fiber erosion after initial blowdown.
 - 2. Mold Growth and Humidity Testing: No evidence of microbial growth, delamination or other deterioration resulting from high humidity conditions.
- 2.4 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD INSULATION (EXTRUDED POLYSTYRENE RIGID INSULATION)
- A. Performance Requirements:
 - 1. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
 - 2. Smoke-Developed Index: Not more than 450 when tested in accordance with ASTM E84.
 - 3. Labeling: Provide identification mark indicating R-value of each piece of insulation **12 inches (305 mm)** and wider in width unless installer provides certification.
 - B. Extruded Polystyrene Board Insulation (XPS): ASTM C578, Type IV, **25-psi (173-kPa)** minimum compressive strength; unfaced.
 - 1. Manufacturers:
 - a. DiversiFoam Products; CertiFoam 25.
 - b. Dow Chemical Company (The); STYROFOAM Square Edge.
 - c. Owens Corning; FOAMULAR 250.
 - 2. Locations:
 - a. Backfilled walls, as indicated on Drawings.
 - b. Planters.
 - C. Extruded Polystyrene Board Insulation (XPS): ASTM C578, Type VI, **40-psi (276-kPa)** minimum compressive strength.
 - 1. Manufacturers:
 - a. DiversiFoam Products; CertiFoam 40.
 - b. Dow Chemical Company (The); STYROFOAM Roofmate or Highload 40.
 - c. Owens Corning; FOAMULAR 400 or 404.
 - 2. Locations:
 - a. Below slabs-on-grade, as indicated on Drawings.
 - b. Pedestrian walkways on split slabs over elevated decks at Grade.
 - c. Pedestrian walkways on split slabs over elevated decks above Grade.
 - d. Vehicular drives on split-slabs over elevated decks in Parking Garages.
 - D. Extruded Polystyrene Board Insulation (XPS): ASTM C578, Type VII, **60-psi (414-kPa)** minimum compressive strength.
 - 1. Manufacturers:
 - a. DiversiFoam Products; CertiFoam 60.
 - b. Dow Chemical Company (The); STYROFOAM Plazamate or Highload 60.

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- c. Owens Corning; FOAMULAR 600 or 604.
 - 2. Locations:
 - a. Landscaping or vegetative roofing over elevated decks.
 - E. Extruded Polystyrene Board Insulation (XPS): ASTM C578, Type V, 100-psi (690-kPa) minimum compressive strength.
 - 1. Manufacturers:
 - a. Dow Chemical Company (The); STYROFOAM Highload 100.
 - b. Owens Corning; FOAMULAR 1000.
 - 2. Locations:
 - a. Vehicular drives, truck docks on split-slabs over elevated decks at Grade
 - b. As indicated on Drawings.
- 2.5 MORTAR-FACED, EXTRUDED-POLYSTYRENE FOAM PLASTIC BOARD INSULATION
- A. Performance Requirements:
 - 1. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
 - 2. Smoke-Developed Index: Not more than 450 when tested in accordance with ASTM E84.
 - 3. Labeling: Provide identification mark indicating R-value of each piece of insulation 12 inches (305 mm) and wider in width unless installer provides certification.
 - B. Mortar-Faced, Extruded Polystyrene Board Insulation (XPS-MF): ASTM C578, Type VI, 40-psi (276-kPa) minimum compressive strength, tongue-and-groove edges on long dimension, minimum 3/8-inch (10 mm) latex-modified cement mortar topping.
 - 1. Manufacturers:
 - a. Sika, Sarnatherm Lightguard.
 - b. T. Clear Corporation, Lightguard.
 - 2. Locations:
 - a. Pedestrian walkways on pedestal paver assemblies over elevated decks.
 - C. Mortar-Faced, Extruded Polystyrene Board Insulation (XPS-MF): ASTM C578, Type VI, 40-psi (276-kPa) minimum compressive strength, tongue-and-groove edges on long dimension, minimum 15/16-inch (10 mm) latex-modified cement mortar topping.
 - 1. Manufacturers:
 - a. Sika, Sarnatherm Heavyguard.
 - b. T. Clear Corporation, Heavyguard.
 - 2. Locations:
 - a. Pedestrian walkways on pedestal paver assemblies over elevated decks.
- 2.6 GLASS-FIBER BLANKET INSULATION (GLASS MINERAL FIBER BATT INSULATION)
- A. Performance Requirements:
 - 1. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
 - 2. Smoke-Developed Index: Not more than 50 when tested in accordance with ASTM E84.
 - 3. Labeling: Provide identification mark indicating R-value of each piece of insulation 12 inches (305 mm) and wider in width unless installer provides certification.

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- B. Glass-Fiber Blanket Insulation, Unfaced (GF-U): ASTM C665, Type I; passing ASTM E136 for combustion characteristics, free of formaldehyde.
1. Manufacturers:
 - a. CertainTeed Corporation; CertaPro Sustainable Insulation.
 - b. Johns Manville; a Berkshire Hathaway company; Unfaced.
 - c. Knauf Insulation; EcoBatt with ECOSE Technology.
 - d. Owens Corning; EcoTouch Thermal.
 2. Thickness: Full depth of metal stud cavity unless indicated otherwise.
 3. Adhesive or Sealing Tape: Product provided or recommended by manufacturer with demonstrated capability to bond securely to substrates indicated.
 4. Locations:
 - a. Exterior stud framed assemblies.
 - b. As indicated on Drawings.
- C. Glass-Fiber Blanket Insulation, Reinforced-Foil Faced (GF-F): ASTM C665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene, free of formaldehyde.
1. Manufacturers:
 - a. CertainTeed Corporation; CertaPro Sustainable Insulation FSK-25.
 - b. Johns Manville; a Berkshire Hathaway company; FSK-25 Faced.
 - c. Knauf Insulation; EcoBatt with ECOSE Technology, FSK-25 Faced.
 - d. Owens Corning; EcoTouch Thermal FSK-25 Faced.
 2. Thickness: Full depth of metal stud cavity unless indicated otherwise.
 3. Adhesive or Sealing Tape: Product provided or recommended by manufacturer with demonstrated capability to bond foil-faced vapor-retarder membrane securely to substrates indicated.
 4. Locations:
 - a. Exterior stud framed assemblies.
 - b. As indicated on Drawings.
- 2.7 GLASS-FIBER BOARD INSULATION (GLASS MINERAL FIBER SEMI-RIGID INSULATION)
- A. Performance Requirements:
1. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
 2. Smoke-Developed Index: Not more than 50 when tested in accordance with ASTM E84.
 3. Nominal Density: 3 lb/cu. ft. (48 kg/cu. m).
 4. Thermal Resistivity: 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F (29.8 K x m/W at 24 deg C).
 5. Labeling: Provide identification mark indicating R-value of each piece of insulation **12 inches (305 mm)** and wider in width unless installer provides certification.
- B. Glass-Fiber Board Insulation, Unfaced (GFB-U): ASTM C612, Type IA; unfaced, passing ASTM E136 for combustion characteristics.
1. Manufacturers:
 - a. CertainTeed Corporation; CertaPRO Commercial Board 300.
 - b. Johns Manville; a Berkshire Hathaway company; Insul-SHIELD 300.
 - c. Knauf Insulation; Insulation Board with Ecosse Technology.
 - d. Owens Corning; 703.

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2. Thickness: As indicated on Drawings but not less than 2-inches (50 mm).
 - C. Glass-Fiber Board Insulation, Faced (GFB-F): ASTM C612, Type IA; faced on one side with foil-scrim-kraft or foil-scrim-polyethylene vapor retarder.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation; CertaPRO® Commercial Board 300.
 - b. Johns Manville; a Berkshire Hathaway company; Insul-SHIELD 300.
 - c. Knauf Insulation; Insulation Board with Ecosse Technology.
 - d. Owens Corning; 703.
 2. Thickness: As indicated on Drawings but not less than 2-inches (50 mm).
 - D. Mineral-Wool Blanket Insulation, Unfaced (MW-U): ASTM C665, Type I (blankets without membrane facing); consisting of fibers; passing ASTM E136 for combustion characteristics.
 1. Basis-of-Design Product: ROCKWOOL (Roxul, Inc.); Comfortbatt.
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. ROCKWOOL (Roxul, Inc.).
 - c. Thermafiber, Inc.; an Owens Corning company.
 3. Thickness: Full depth of metal stud cavity unless indicated otherwise.
 4. Locations:
 - a. Exterior stud framed assemblies.
 - b. As indicated on Drawings.
 - E. Mineral-Wool Blanket Insulation, Reinforced-Foil Faced (MW-F): ASTM C665, Type III (reflective faced); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Thermafiber, Inc.; an Owens Corning company.
 2. Thickness: Full depth of metal stud cavity unless indicated otherwise.
 3. Locations:
 - a. Exterior stud framed assemblies.
 - b. As indicated on Drawings.
- 2.8 MINERAL-WOOL BOARD INSULATION (MINERAL WOOL SEMI-RIGID INSULATION)
- A. Performance Requirements:
 1. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
 2. Smoke-Developed Index: Not more than 50 when tested in accordance with ASTM E84.
 3. Labeling: Provide identification mark indicating R-value of each piece of insulation 12 inches (305 mm) and wider in width unless installer provides certification.
 - B. Mineral-Wool Board Insulation, Unfaced (MWB-U): ASTM C612, Type IVA; passing ASTM E136 for combustion characteristics.
 1. Basis-of-Design Product: ROCKWOOL (Roxul, Inc.); ROCKBOARD 40.
 2. Manufacturers:

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- a. Johns Manville; a Berkshire Hathaway company.
 - b. ROCKWOOL (Roxul, Inc.)
 - c. Thermafiber, Inc.; an Owens Corning company.
3. Nominal Density: 4 lb/cu. ft. (64 kg/cu. m).
 4. Thermal Resistivity: 4.2 deg F x h x sq. ft./Btu x in. at 75 deg F (0.72 m² x K/W at 24 deg C).
 5. Locations:
 - a. Locations other than exterior cavity wall and rainscreen applications.
 - b. As indicated on Drawings.
- C. Mineral-Wool Board, Unfaced (MWB-UEC) - Closed Joint Cladding Assemblies: ASTM C612, Type IVB; passing ASTM E136 for combustion characteristics.
1. Basis-of-Design Product: ROCKWOOL (Roxul, Inc.); Cavityrock.
 2. Manufacturers:
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. ROCKWOOL (Roxul, Inc.)
 - c. Thermafiber, Inc.; an Owens Corning company.
 3. Monolithic Nominal Density - Thicknesses up to 2 Inches: Greater than 4.3 lb/cu. ft. (69 kg/cu. m).
 4. Dual Nominal Density - Thicknesses greater than 2 Inches:
 - a. Inner Layer: 3.8 lb/cu. ft. (61 kg/cu. m).
 - b. Outer Layer: 6.24 lb/cu. ft. (100 kg/cu. m).
 5. Thermal Resistivity: 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F (0.76 m² x K/W at 24 deg C).
 6. Locations:
 - a. Exterior cavity wall and rainscreen applications, closed joints.
- D. Mineral-Wool Board, Faced (MWB-FEC) - Open Joint Cladding Assemblies: ASTM C612, Type IVB; passing ASTM E136 for combustion characteristics, black mineral fleece facing.
1. Basis-of-Design Product: ROCKWOOL (Roxul, Inc.); Cavityrock Black.
 2. Manufacturers:
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. ROCKWOOL (Roxul, Inc.)
 - c. Thermafiber, Inc.; an Owens Corning company.
 3. Monolithic Nominal Density - Thicknesses up to 2 Inches: Greater than 4.3 lb/cu. ft. (69 kg/cu. m).
 4. Dual Nominal Density - Thicknesses greater than 2 Inches:
 - a. Inner Layer: 3.8 lb/cu. ft. (61 kg/cu. m).
 - b. Outer Layer: 6.24 lb/cu. ft. (100 kg/cu. m).
 5. Thermal Resistivity: 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F (0.76 m² x K/W at 24 deg C).
 6. Locations:
 - a. Exterior cavity wall and rainscreen applications, open joints.
- E. Mineral-Wool Board, Faced (MWB-FCW): ASTM C612, Type IVA; passing ASTM E136 for combustion characteristics, reinforced foil facing.

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1. Basis-of-Design Product: ROCKWOOL (Roxul, Inc.); CURTAINROCK 40 or CURTAINROCK 80, as recommended by manufacturer for project specific installation requirements.
2. Manufacturers:
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. ROCKWOOL (Roxul, Inc.)
 - c. Thermafiber, Inc.; an Owens Corning company.
3. Nominal Density: Not less than 4 lb/cu. ft. (64 kg/cu. m).
4. Thermal Resistivity: 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F (0.72 m² x K/W at 24 deg C).
5. Locations:
 - a. Curtain wall applications.

2.9 THIN PROFILE, HIGH THERMAL BLANKET INSULATION

- A. Performance Requirements:
 1. Flame-Spread Index: Not more than 5 when tested in accordance with ASTM E84.
 2. Smoke-Developed Index: Not more than 5 when tested in accordance with ASTM E84.
- B. Silicon Aerogel Insulation: Unfaced, reinforced silicon aerogel insulation blankets.
 1. Basis of Design: Dow; DOWSIL HP-1000 Building Insulation Blanket.
 2. Thickness: As indicated on Drawings but not less than thickness required for an R-19.

2.10 SPRAY-APPLIED THERMAL INSULATION

- A. Performance Requirements:
 1. Flame-Spread Index: Not more than zero when tested in accordance with ASTM E84.
 2. Smoke-Developed Index: Not more than zero when tested in accordance with ASTM E84.
 3. Thermal Conductivity: 4.00/inch R-value (0.25 K-factor) in accordance with ASTM C518.
 4. Noise Reduction Coefficient (NRC): 0.75 at 1 inch (25 mm); 0.95 at 2 inches (50 mm) in accordance with ASTM C423 and ISO 354.
 5. Bond Strength: Minimum 43-lbf/sq. ft. (2.05-kPa) cohesive and adhesive strength based on field testing in accordance with ASTM E736.
 6. Dry Density: 2.2 lb/cu. ft. (36.7 kg/cu. m) in accordance with ASTM D1622/D1622M.
 7. Air Erosion: Maximum weight loss of 0.0 oz./sq. ft. (0 g/sq. m) in 24 hours in accordance with ASTM E859.
 8. Fungus and Bacterial Resistance: No growth in accordance with MIL STD810F.
- B. Self-Supported, Spray-Applied Glass Fiber Insulation (GF-SA): Type 902 bio-soluble white fiberglass conforming to CAN/ULC S102-10 and ASTM E136 and sprayed using manufacturer's liquid water-based bonding adhesive. Does not contain asbestos, crystalline silica, or combustible fibers. Noncombustible in accordance with ASTM E136.
 1. Basis-of-Design Product: Monoglass Inc.: Sonoglass Spray-On Insulation, grey color.
 2. Application Thickness: As indicated on Drawings but not less than 5 inches (125 mm) before tamping.
- C. Substrate Primers: For spray-applied insulation, use manufacturer-approved, spray-applied, stain-blocking primers.

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- D. Spray-Applied Insulation Adhesive: Manufacturer's standard water-based, spray-applied adhesive for mixing with fibers at point of discharge during spray application of thermal insulation and for final topcoat of sprayed thermal insulation.

1. Refer to Division 9 Section Painting for interior painting requirements.

- E. Spray-Applied Insulation Sealer: Spray-applied, water-soluble, liquid-copoly emulsion.

1. Basis-of-Design Product: Monoglass Inc.; InsulSeal.

a. Tint Color: Gray, unless indicated otherwise.

2. Locations:

a. Installations exposed to view in finished construction.

b. Installation in crawl spaces.

3. Acoustical Installations: Insulation sealer thickness shall not reduce the acoustical performance of the underlying insulation.

2.11 INSULATION FASTENERS

- A. Power-Driven, Thermal Break Insulation Fasteners: High density polyethylene washer with heat-treated carbon steel pin, zinc plated; capable of holding insulation of specified thickness securely in position with pin type and minimum penetration recommended by manufacturer.

1. Basis-of-Design Product: Ramset I-F Insulation Fastening System, IFS (Steel) and IFC (Concrete or CMU)

2.12 ACCESSORIES

- A. Insulation for Miscellaneous Voids:

1. Glass-Fiber Insulation: ASTM C764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E84.

2. Spray Polyurethane Foam Insulation: ASTM C1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84.

- B. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions: Examine substrates to which thermal insulation will be applied for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting Work within a particular area will be construed as acceptance of surface conditions.

3.2 INSTALLATION, GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:

1. Respective manufacturer's written installation instructions.
2. Accepted submittals.
3. Contract Documents.

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- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Install insulation with manufacturer's R-value label exposed after insulation is installed unless installer provides certification.
- D. For dual density products, install insulation with manufacturer's "THIS SIDE OUT" label exposed after insulation is installed.
- E. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- F. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.
- B. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.4 INSTALLATION OF EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD INSULATION

- A. On vertical surfaces, set insulation units using manufacturer's recommended adhesive in accordance with manufacturer's written instructions.
 - 1. If not otherwise indicated at foundations and slabs, extend insulation a minimum of **24 inches (610 mm)** below exterior grade line.
- B. On horizontal surfaces, loosely lay insulation units in accordance with manufacturer's written instructions. Stagger end joints and tightly abut insulation units.
 - 1. If not otherwise indicated, extend insulation a minimum of **24 inches (610 mm)** in from exterior walls.
- C. Seal joints between insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are placed. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.

3.5 INSTALLATION OF MORTAR-FACED, EXTRUDED POLYSTYRENE FOAM PLASTIC BOARD

- A. Install mortar-faced board insulation loosely laid, according to manufacturer's written instructions, with tongue-and-groove joints nested. Stagger end joints of adjoining rows and abut insulation.

3.6 INSTALLATION OF MINERAL FIBER BLANKETS AND BOARD INSULATION ON CONCRETE CONSTRUCTION

- A. Butt panels together for tight fit.
- B. Anchor Installation: Install insulation on concrete substrates by Power-Driven, Thermal Break Insulation Fasteners:
 - 1. Space anchors in accordance with insulation manufacturer's written instructions for insulation type, thickness, and application.

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- C. Adhered insulation anchors are not allowed.

3.7 INSTALLATION OF EXTERIOR CAVITY-WALL INSULATION

- A. Mineral-Wool Board Insulation: Install insulation fasteners **4 inches (100 mm)** from each corner of board insulation, at center of board, and as recommended by manufacturer.
1. Fit courses of insulation between masonry wall ties and other obstructions, with edges butted tightly in both directions, and with faces flush.
 2. Press units firmly against inside substrates.
- B. Adhered insulation anchors are not allowed.

3.8 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

- A. Blanket Insulation: Install in cavities formed by framing members in accordance with the following requirements:
1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - a. For partitions with gypsum board on only one side, apply adhesive to backside of gypsum board and press insulation in place to form bond and prevent insulation from sagging within cavity.
 3. Maintain **3-inch (76-mm)** clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
 4. For metal-framed wall cavities where cavity heights exceed **96 inches (2438 mm)**, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
 5. Vapor-Retarder-Faced Blankets: Tape joints and ruptures in vapor-retarder facings and seal each continuous area of insulation to ensure airtight installation.
 - a. Set units with facing placed as indicated on Drawings.
- B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately **2.5 lb/cu. ft. (40 kg/cu. m)**.
 2. Spray Polyurethane Insulation: Apply in accordance with manufacturer's written instructions.

3.9 INSTALLATION OF LOOSE-FILL INSULATION

- A. Loose-Fill Insulation: Apply in accordance with ASTM C1015 and manufacturer's written instructions.
1. Level horizontal applications to uniform thickness as indicated, lightly settle to uniform density, but do not compact excessively.

3.10 INSTALLATION OF SPRAY-APPLIED INSULATION

- A. Spray-Applied Glass Fiber Insulation: Apply spray-applied glass-fiber insulation according to manufacturer's written instructions and using powered spray equipment that introduces water-based adhesive to fibers as they discharge from the spray nozzle, to produce a uniform thickness, free of starved spots or other evidence of thin application or of application patterns.

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Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in installation areas is completed, and other items not indicated to receive insulation are masked.

1. Primer: Prepare and apply primer to gypsum panels and other prepared substrates to receive sprayed thermal insulation.
2. Place insulation in full thickness over the entire area of each substrate to be protected.
 - a. Spray-apply insulation materials to maximum extent possible. Complete coverage by trowel application or other placement method recommended in writing by manufacturer.
 - b. Maintain profile of substrates except fill voids between members, including voids formed by fluted decks above beams and similar voids.
3. Immediately remove droppings and overspray to prevent damage in accordance with manufacturer's written instructions.
4. Board- or spray-tamp surface of spray-applied thermal insulation to provide an even texture and apply coating of adhesive to provide a sound surface.

3.11 INSTALLATION OF VAPOR RETARDERS ON FRAMING

- A. Install multiple membrane sheets to form continuously sealed vapor retarder at interior face of framing; maintain membrane integrity throughout construction phase.
 1. Place vapor retarders on side of construction indicated on Drawings.
- B. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place with adhesives, vapor retarder fasteners, or other anchorage system as recommended by manufacturer. Extend vapor retarders to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.
 1. Before installing vapor-retarder, apply sealing tape to flanges of metal framing, including top and bottom runner tracks, metal studs, and framing around wall openings.
 2. Pull vapor-retarder taut and press into sealing tape and firmly roll to enhance adhesion.
 3. Locate perimeter terminations over framing members or other solid substrates. Include sheet metal flanges or extensions to prevent attachment to sprayed fireproofing directly.
 4. Seal top, sides, and bottom edges to building structure with seaming tape, seal edges at perimeter of wall openings.
- C. Seal vertical joints in vapor retarders over framing by lapping no fewer than two studs and sealing with vapor-retarder tape according to vapor-retarder manufacturer's written instructions. Locate all joints over framing members or other solid substrates.
- D. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.
- E. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarders extending 6 in (150 mm) beyond damaged areas in each direction.

3.12 INSTALLATION OF CURTAIN-WALL INSULATION

- A. Install board insulation in curtain-wall construction in accordance with curtain-wall manufacturer's written instructions.
 1. Hold insulation in place by securing metal clips, brackets, pins and straps or integral pockets within window frames, spaced at intervals recommended in writing by insulation manufacturer to hold insulation securely in place.
 2. Maintain cavity width of dimension indicated on Drawings between insulation and glass.

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3. Install insulation to fit snugly without bowing.
4. Install insulation mullion covers, minimum 8 in (200 mm) width centered over horizontal and vertical aluminum frames within spandrel.

3.13 FIELD QUALITY CONTROL FOR SPRAY-APPLIED THERMAL INSULATION

- A. Manufacturer's Field Service: Manufacturer's qualified technical representative shall periodically inspect Work to ensure installation is proceeding in accordance with manufacturer's designs, recommendations, instructions, and warranty requirements. Representative shall submit written reports of each visit indicating observations, findings, and conclusions of inspection.
 1. Manufacturer's Technical Representative Qualifications: Direct employee of technical services department of manufacturer with experience in providing recommendations, observations, evaluations, and problem diagnostics.
- B. Owner's Testing Agency Field Service for Spray-Applied Thermal Insulation: The Owner may employ and pay a qualified independent testing agency to perform field quality control.
 1. Tests: As determined by Owner testing agency for adhesion/cohesion, density and thickness.
- C. Tests and Inspections, General: Tests and inspections shall take place as installation proceeds to determine compliance with specified performance requirements.
 1. Correction of Deficiencies:
 - a. Materials and installation will be considered defective if they do not meet specified requirements.
 - b. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.
 - c. Perform additional tests and inspections, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.
 2. Prepare test and inspection reports.

3.14 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.
- B. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.
- C. Remove sprayed thermal insulation from surfaces not required to be insulated.
 1. Broom-clean work areas affected by the Work of this Section.
- D. Protect vapor retarders from damage until concealed by permanent construction.

END OF SECTION

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SECTION 07 22 16 – ROOF BOARD INSULATION

PART 1 – GENERAL

1.1 REFERENCES (INCLUDING LATEST REVISIONS)

- A. Comply with governing local, state, and federal regulations, safety standards, and codes.
- B. Testing Laboratory Services: Test results shall meet or exceed established standards.
- C. Underwriters Laboratories, Inc. (Roofing Covering): Class A fire hazard classification.
- D. American Society of Testing Materials (ASTM)
 - 1. C 177 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus
 - 2. C 209 Methods of Testing Insulating Board (Cellulosic Fiber), Structural and Decorative
 - 3. C 728 Perlite Thermal Insulation Board
 - 4. C 1289 Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
 - 5. D 41 Asphalt Primer Used in Roofing and Waterproofing
 - 6. D 312 Asphalt Used in Roofing
 - 7. D 1621 Test Method for Compressive Properties of Rigid Cellular Plastics
 - 8. D 4601 Asphalt Coated Glass Fiber Base Sheet Used in Roofing
- E. The National Roofing Contractors Association (NRCA) - Roofing and Waterproofing Manual
- F. American National Standards Institute/Single Ply Roofing Industry (ANSI/SPRI)
- G. American Society of Civil Engineers - ASCE 7 Minimum Design Loads for Buildings and Other Structures (for wind uplift criteria)

1.2 QUALITY ASSURANCE

- A. Regulatory Requirements
 - 1. Classified by Underwriter's Laboratories (UL) as Class A roof covering.
 - 2. Follow local, state, and federal regulations, safety standards, and codes.
- B. Installation
 - 1. Installation shall be in accordance with manufacturer's current published application procedures, NRCA general recommendations, and ASCE 7 wind uplift criteria.
 - 2. Roof system manufacturer's technical specifications shall be considered part of this specification and shall be used as reference for specific application procedures.
- C. Contract Documents
 - 1. In the case of an inconsistency between the drawings and specifications or within either document not clarified by addendum, the better quality or greater quantity of work shall be provided in accordance with the Project Manager's/Architect's interpretation.

1.3 SUBMITTALS

- A. Product Data: Submit Manufacturer's product data sheets for each product. Indicate each item or component to be used on project to include thicknesses, sizes, profiles, etc.

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- B. Shop Drawings: Layout of roof plan showing crickets, tapered design, tapered insulation pattern, direction of slope, amount of slope, spot elevations indicating thicknesses at high and low points.
 - 1. Submit fastening requirements from manufacturer for each roof zone as per applicable building code.
 - 2. Submit manufacturer's recommended fastener layout/placement pattern for each roof zone. Refer to Factory Mutual Loos Prevention Data Sheet (LPDS) 1-29 for more information.
- C. Certification: Submit roof manufacturer's certification in writing that insulation is acceptable as substrate for application of specified roof system.
- D. Pullout Tests in accordance to ANSI/SPRI FX-1.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store materials in accordance with manufacturer's recommendations.
- B. When stored outdoors:
 - 1. Tarp and shield insulation from moisture and ultraviolet rays.
 - 2. Elevate insulation above substrate four inches minimum.
 - 3. Secure insulation to resist high winds.
 - 4. Distribute insulation stored on roof deck to prevent concentrated loads that would impose excessive stress or stain on deck or structural members. Verify that structure can accommodate additional loading.
 - 5. Wet insulation, or insulation that has been wet but which has dried, may not be used and shall be removed completely and immediately from the job site.
 - 6. Do not double stack bundles of insulation on the roof top.

1.5 SEQUENCING AND SCHEDULING

- A. Substrate Acceptance: Roof system manufacturer's representative shall inspect roof deck and associated substrates and provide written acceptance of conditions.
- B. Manufacturer's approved roofing contractor shall inspect and approve deck and substrates.
- C. Plan roof layout with respect to roof deck slope to prevent rainwater drainage into completed roofing.
- D. Do not install more insulation than can be covered with complete roof system in same day.

1.6 PRODUCT CONDITIONS

- A. Environmental Requirements:
 - 1. Apply roofing and insulation in dry weather.
 - 2. Do not proceed with roof construction during inclement weather or when precipitation is predicted 40% or more possibility.
 - 3. Do not apply insulation over wet or moist deck or in foggy conditions.
 - 4. Days with wind speeds of 30 mph or greater shall be considered "Bad Weather" days.
- B. Emergency Equipment: Maintain on-site equipment and material necessary to apply emergency temporary seals in the event of sudden storms or inclement weather.
- C. Costs for emergency roofing shall be borne by Contractor.

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PART 2 – PRODUCTS

2.1 INSULATION – FLAT STOCK

- A. All insulation shall be approved in writing by the membrane manufacturer as to thickness, type, and manufacturer. All insulation must be approved for the specific application, Underwriters Laboratory approved, and be listed in the FM Global Approval Guide.
- B. Polyisocyanurate Roof Insulation: Insulation shall be two layers of rigid polyisocyanurate foam board; meeting Federal Specification No. HH-I-1972/1 or 2 with 20 psi minimum compressive strength and 2.0 pcf minimum density. First layer shall be a minimum thickness of two and one-half inch (2-1/2"). R-value over each roof area shall meet or exceed R-33. Board shall be surfaced on two (2) sides with non-asphaltic facer material.

2.2 INSULATION – TAPERED

- A. Factory Tapered Polyisocyanurate for Field of Roof: Shall be tapered polyisocyanurate board, with a 20 psi minimum compressive strength and nominal 2.0 pcf density. Insulation shall be of thickness required for one-fourth inch (1/4") slope per foot to roof drains as shown on drawings with a minimum edge thickness of one and one-half inch (1-1/2"). R-value over each roof area shall meet or exceed R-33. Insulation shall be surfaced on two (2) sides with a non-asphaltic facer material.
- B. Factory Tapered Polyisocyanurate Crickets: Factory cut twenty-four inch by forty-eight inch (24" x 48") polyisocyanurate board cut to one-half inch (1/2") per foot slope used in conjunction with standard thickness of polyisocyanurate board to provide positive slope.

2.3 COVER BOARD

- A. Shall be non-structural glass mat faced, non-combustible, moisture resistant, silicone treated gypsum core panel, manufactured to conform to ASTM C-1177. Thickness shall be 1/2" with a nominal board size of 4' x 8', DEXcell FA as manufactured by Gold Bond Building Products, or approved equal.

2.4 ASPHALT ROOF PRIMER

- A. Quick-dry asphalt-based primer for priming of asphalt roof surfaces, as manufactured by GAF, or approved equal.

Applicable Federal Specification	SS-A-701B
ASTM	D 41
Flash Point	105° F
Viscosity at 80° F (ASTM D 217)	50-60 K.U.
Weight per gallon	7.4 pounds
Drying time (to touch)	Min. 4 hours

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2.5 BITUMEN

- A. Shall be ASTM D 312 Type IV extra steep asphalt.
- B. Contractor shall mix with the hot asphalt an additive that eliminates the asphalt odor, such as Trumbull TruLo as manufactured by Owens Corning, or deScent as manufactured by ArrMaz Custom Chemicals, or approved equal.

2.6 FASTENERS

- A. Fasteners and fastening plates and/or termination bars shall be FM Approved and shall be listed in the FM Global Approval Guide, and as recommended by the insulation/fastener manufacturer for the specific application to meet the minimal requirements for wind uplift as required by the local jurisdiction and/or FM Global.

PART 3 – EXECUTION

3.1 PROTECTION OF ROOFING

- A. Provide special protection from traffic on yet to be removed roofing.
- B. Provide special protection from traffic on completed work.

3.2 EXAMINATION AND PREPARATION

- A. Do not install until defects are corrected and deck substrate meets roof system manufacturer's requirements.
- B. Do not apply insulation unless asphalt application temperature, EVT of approximately 375° F to 425° F, can be maintained or when water or moisture is present on substrate. Do not heat asphalt above flashing point, or 525° F.
- C. Examine substrate and related surfaces, and verify that there are no conditions such as inadequate anchorage, foreign materials, moisture, ridges, depressions, or other conditions which would prevent satisfactory installation of roof system.
- D. Start of work constitutes acceptance of deck substrate and site conditions.
- E. Sweep deck substrate clean of dust and debris immediately prior to installation of tapered insulation.

3.3 APPLICATION OF INSULATION – GENERAL INSTRUCTIONS

- A. Manufacturer's Instructions: In regard to attachment, the manufacturer's instructions or specifications shall determine the suitability for an application. Installation must meet ASCE 7 criteria and meet local governing building codes.
- B. Precautions: The surface of the insulation must not be ruptured due to overdriving of fasteners.
- C. Thermal insulation boards shall be laid on the substrate in parallel rows with end joints staggered and butted as close as possible. All joints shall be tight and at the roof perimeter and roof penetrations, insulation shall be cut neatly and fitted to reduce openings to a minimum. All openings one-fourth inch (1/4") or larger shall be filled with insulation.

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- D. Insulation shall be tapered or feathered at drains and scuppers to provide proper drainage (if applicable).
- E. No more insulation shall be installed than can be covered by the completed roof system by the end of the day or the onset of inclement weather.
- F. Tapered insulation and crickets, when specified, shall be placed in accordance with the drawings and/or as required to minimum of NRCA standards.

3.4 APPLICATION OF INSULATION - ADHERED IN HOT OVER BASE SHEET

- A. Specified flat stock insulation shall be bonded to the specified base sheet with a solid mopping of steep asphalt Type IV, as required by slope (NRCA), at the minimum rate of twenty-five pounds (25#) $\pm 20\%$, per one hundred (100) square feet of surface and immediately walked in place.
- B. The top surface of the first layer of flat stock insulation shall be coated with hot asphalt using twenty-five pounds (25#) $\pm 20\%$, per one hundred (100) square feet of surface, and specified flat stock insulation shall be applied using offset joints, so that each layer breaks joints to a minimum of six inches (6") both ways with the preceding layer, and immediately walked in place.
- C. The top surface of preceding insulation shall be coated with hot asphalt using twenty-five pounds (25#) $\pm 20\%$, per one hundred (100) square feet of surface, and specified tapered insulation shall be applied using offset joints, so that each layer breaks joints to a minimum of six inches (6") both ways with the preceding layer, and immediately walked in place.
- D. The top surface of the preceding insulation shall be coated with hot asphalt using twenty-five pounds (25#) $\pm 20\%$, per one hundred (100) square feet of surface, and specified cover board shall be applied using offset joints, so that each layer breaks joints to a minimum of six inches (6") both ways with the preceding layer, and immediately walked in place.

3.5 BACKNAILING/STRAPPING

- A. On slopes greater than one inch (1") in twelve inches (12"), refer to NRCA and/or manufacturer's guidelines for backnailing procedures and follow the more stringent guidelines for all specified materials.

<u>Slope</u>	<u>Interply& Top Pour</u>	<u>Backnail</u>	<u>Strap</u>
0 - 1/2" per 12"	Type IV	No	No
1/2" - 2" per 12"	Type IV	Yes	Strap if possible
2" - 3" per 12"	Type IV	Yes	Yes

3.6 ADJUSTING

- A. Remove insulation which has been damaged (broken, cracked, punctured, wet, etc.) and install acceptable new units before installation of roof system.

3.7 CLEANING

- A. Remove debris and material wrappers from jobsite. Leave insulation clean and dry, ready to receive roofing membrane.

END OF SECTION 07 22 16

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SECTION 072617
BELOW SLAB VAPOR RETARDERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Below slab vapor retarders and supplementary items necessary for installation.
- B. Adhered and Specialty Floor Finishes at Slab-on-Grade Areas: Refer to floor finish section(s) for concrete moisture barrier treatment at adhered floorings, thin-set terrazzo and wood flooring systems.

1.2 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
 - 1. Include manufacturer's specifications for materials, construction details, installation instructions, and recommendations for maintenance.
 - 2. Include manufacturer's standard drawing details for laps, openings, penetrations, corners, and other conditions applicable to this project.

1.3 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Project Acceptance Document: Certification by the manufacturer that its product(s) are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required.
- B. Field Quality Control Reports: Written report of testing and inspection required by "Field Quality Control" Article.
- C. Warranties:
 - 1. Provide manufacturer's written warranty covering materials and installation (labor) stating obligations, remedies, limitations and exclusions.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Experience: Installer's personnel with not less than 5 years of experience in the successful performance of Work similar to scope of this Project.
 - 2. Supervision: Installer shall maintain a competent supervisor at Project while the Work is in progress, and who has not less than 5 years of experience installing products and systems similar to scope of this Project.
 - 3. Manufacturer Acceptance: Installer shall be certified, approved, licensed, or acceptable to manufacturer to install products.
- B. Mock-Ups: Prior to beginning Work of this Section, install minimum 150 sf (14 sq m) mock-up of below slab vapor retarder using materials indicated for the completed Work; incorporating subgrade construction, sealing at penetrations, and seaming to demonstrate installation of below slab vapor retarder system. Acceptance of mock-ups does not constitute acceptance of deviations from the Contract Documents contained in mock-ups unless such deviations are specifically accepted by Architect in writing. Apply mock-ups to set quality standards for materials and execution.
 - 1. If Architect determines mock-up does not comply with requirements, reconstruct mock-ups until accepted.

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1.5 PRE-INSTALLATION CONFERENCE

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.
1. Participants:
 - a. Architect.
 - b. Contractor, including superintendent.
 - c. Installer, including project manager and supervisor.
 - d. If requested, Manufacturer's qualified technical representative.
 - e. Installers of other construction interfaced with Work.
 2. Minimum Agenda: Installer shall demonstrate understanding of the Work required by describing detailed procedures for preparing, installing, and cleaning the Work. Demonstration shall include, but not be limited to, following topics:
 - a. Tour representative areas of Work, inspect and discuss condition of substrate, and other preparatory work performed by other trades.
 - b. Review Contract Document requirements.
 - c. Review approved submittals.
 - d. Review inspection and testing requirements.
 - e. Review environmental conditions and procedures for coping with unfavorable conditions.
 - f. Resolve deviations or differences between Contract Documents and the manufacturer's specifications.
 3. Record discussions, including decisions and agreements, and prepare report.

1.6 PROJECT CONDITIONS

- A. Ambient Conditions: Install below slab vapor retarder within range of ambient and substrate temperatures and moisture conditions as recommended by manufacturer. Protect substrates from environmental conditions that affect performance. Do not apply to a damp or wet substrate or during high humidity conditions including snow, rain, fog, or mist.

1.7 COORDINATION

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND PRODUCTS

- A. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to Conditions of the Contract and Division 01 Section "Substitution Procedures".
- B. Available Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, manufacturers offering products that may be incorporated into Work include but are not limited to those listed.

2.2 MATERIALS, GENERAL

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

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2.3 PERFORMANCE REQUIREMENTS

- A. General Performance: Comply with performance requirements specified, as determined by testing of products and systems representing those indicated for this Project, without failure due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Material Compatibility: Provide materials that are compatible with one another under conditions of service and application required, as demonstrated by manufacturer based on testing and field experience.

2.4 BELOW SLAB VAPOR RETARDERS

- A. Vapor Retarder for Typical Concrete Slab-on-Grade Conditions:
 - 1. Product Quality Standard: ASTM E 1745, Class A, except water vapor permeance property shall not exceed 0.03 perms according to ASTM E 96, Method B.
 - 2. Description: Prefabricated, flexible, lightweight material manufactured from raw or virgin polyethylene or polyolefin resins (post-consumer, recycled resins are not permitted); not less than **15 mil (0.4 mm)** thick.
 - 3. Manufacturers and Products:
 - a. Barrier-Bac; VB-350
 - b. Fortifiber Building Product Systems; Moistop Ultra 15
 - c. W. R. Meadows, Inc.; Perminator, 15-mil
 - d. Raven Industries; VaporBlock 15
 - e. Reef Industries, Inc.; Griffolyn 15-mil Green
 - f. Reef Industries, Inc.; Vaporguard
 - g. Stego Industries LLC; Stego Wrap, 15-mil
- B. Vapor Retarder for Structured Concrete Slab Conditions:
 - 1. Product Quality Standard: ASTM E 1745, Class A, except water vapor permeance property shall not exceed 0.03 perms according to ASTM E 96, Method B.
 - 2. Description: Prefabricated, flexible or semi-flexible, material manufactured of one of following compositions; with one face suited for integral bonding with concrete; not less than **20 mil (0.05 mm)** thick.
 - a. Raw or virgin polyethylene or polyolefin resins (post-consumer, recycled resins are not permitted).
 - b. Multiple ply board composed of a proprietary core with bituminous impregnated material and glass-mat liners, with polyethylene facers.
 - 3. Manufacturers and Products:
 - a. Barrier-Bac; VBC-350
 - b. Grace Construction Products; Florprufe 120
 - c. W. R. Meadows, Inc.; Premoulded Membrane Vapor Seal with Plasmatic Core (PMCP), with felt face toward concrete
 - d. Polyguard Products, Inc.; Underseal
 - e. Stego Industries LLC; Stego Wrap, 15-mil

2.5 ACCESSORIES

- A. Barrier Seaming and Sealing Tape: Manufacturer's standard one-sided or two-sided pressure-sensitive tape of type, material and size for sealing membrane joints and for sealing membrane to other adjacent structures; provided by vapor retarder manufacturer.
- B. Penetration Accessories: Manufacturer's standard pre-molded products or mastic for sealing penetrations; provided by vapor retarder manufacturer.

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PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions: Examine subgrade and foundation surfaces to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

3.2 INSTALLATION, GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform work according to following, unless otherwise specified:
 - 1. ASTM E 1643, except place vapor retarder on top of granular fill.
 - 2. Respective manufacturer's installation written instructions.
 - 3. Accepted submittals.
 - 4. Contract Documents.

3.3 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations, and Project specifications for subgrade preparation. Subgrade surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work. Provide smooth, level, and properly compacted and moisture conditioned subgrade in accordance with Geotechnical Engineer's recommendations.
- B. Ensure that subgrade is smooth and even without sharp or protruding objects that might rip, tear, or puncture vapor retarder membrane.

3.4 BELOW SLAB VAPOR RETARDER INSTALLATION

- A. Install multiple sheets to form continuously sealed below slab vapor retarder over properly prepared subgrade prior to concrete slab reinforcing installation.
 - 1. Place vapor retarder membrane in widest width possible over subgrade with longest dimension parallel with direction of concrete placement with proper face toward concrete; pull taut to eliminate fishmouths, wrinkles, buckles, and kinks.
 - 2. Properly dry and clean mating surfaces of vapor retarder membrane prior to application of seaming tape.
 - 3. Overlap sides and ends of vapor retarder membrane not less than 6 in (150 mm) and apply seaming tape.
 - 4. Ensure vapor retarder membrane is continuous from edge to edge of concrete slab.
 - a. Perimeter Seal: Seal vapor retarder to perimeter wall or footing/grade beam with tape per manufacturer recommended installation instructions.
 - 5. Cut vapor retarder membrane carefully around penetrations and seal with either premolded accessories, or on-site collar fabrications using seaming tape or mastic; if field fabricated, comply with manufacturer's recommended details.
 - 6. Repair rips, tears, or punctures with seaming tape, or by cutting out damaged areas and patching with new vapor retarder membrane, overlapping damaged area minimum 6 in (150 mm) in each direction and apply seaming tape.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Manufacturer's qualified technical representative shall periodically inspect Work to ensure installation is proceeding in accordance with manufacturer's

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designs, recommendations, instructions, and warranty requirements. Representative shall submit written reports of each visit indicating observations, findings, and conclusions of inspection.

1. Manufacturer's Technical Representative Qualifications: Direct employee of technical services department of manufacturer with experience in providing recommendations, observations, evaluations, and problem diagnostics.
- B. Owner Testing Agency: The Owner may employ and pay a qualified independent testing agency to perform field quality control.
- C. Tests and Inspections, General: Tests and inspections shall take place as installation proceeds to determine compliance with specified performance requirements.
 1. Including but not limited to the following:
 - a. Prior to beginning concrete slab reinforcing installation, inspect vapor retarder membrane for rips, tears, and punctures.
 - b. Prior to concrete placement work, inspect concrete installer's tools and notify Contractor to have tools with spikes or other sharp surfaces that could inflict intentional or unintentional damage on the installed vapor retarder membrane removed from work area.
 - c. Immediately prior to concrete placement work, inspect vapor retarder membrane for rips, tears, and punctures, inspect penetrations at columns and mechanical and electrical piping.
 - d. Continuously inspect concrete placement work, watching for damage to vapor retarder membrane.
 - e. Periodically inspect portions of slab that were not placed (block-outs, voids, and leave-outs) for water infiltration of subgrade until concrete is subsequently placed.
 2. Correction of Deficiencies:
 - a. Materials and installation will be considered defective if they do not meet specified requirements.
 - b. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.
 - c. Perform additional tests and inspections, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.
 3. Prepare test and inspection reports.

3.6 PROTECTION

- A. Protection during Concrete Work: Ensure vapor retarder membrane will be without damage or deterioration during in-place fabrication of concrete slab reinforcing and subsequent placement of concrete.
 1. Prevent vehicles from driving over vapor retarder membrane once it has been placed.
 2. Prevent wood or steel stakes from penetrating vapor retarder membrane.
 3. At locations where portions of slab are not placed (block-outs, voids and leave-outs), provide protection to prevent water infiltration into void that would contaminate subgrade below vapor retarder membrane; maintain until concrete is subsequently placed.

END OF SECTION

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SECTION 075013
SINGLE-PLY MEMBRANE ROOFING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Single-ply membrane roofing system and supplementary items necessary for installation.
 - 1. Adhered polyvinyl chloride (PVC) roofing system.
 - 2. Adhered polyvinyl chloride (PVC) roofing system, fleece or felt backing.
 - 3. Adhered thermoplastic polyolefin (TPO) roofing system.
 - 4. Adhered thermoplastic polyolefin (TPO) roofing system, fleece or felt backing.
- B. Related Requirements:
 - 1. Lightweight Insulating Concrete: Refer to Division 03 Section Lightweight Insulating Concrete for embedded insulation board.

1.2 ALLOWANCES

- A. Allowance for Concrete Moisture Barrier/Vapor Retarder: Include allowance to provide Roofing Manufacturer's recommended concrete moisture barrier/vapor retarder for concrete substrates that do not comply with Roofing Manufacturer's concrete moisture content and testing requirements.

1.3 DEFINITIONS

- A. Roofing Terminology: Definitions in ASTM D1079 and glossary in NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to work of this Section.
- B. Roof Edge Regions: Definitions from ANSI/SPRI ED-1 shall be applicable to this project.
- C. PVC: Polyvinyl chloride.
- D. TPO: Thermoplastic polyolefin.

1.4 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
 - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
- B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components and attachments to other work. Distinguish between shop and field-assembled work.
 - 1. Show base flashings and membrane terminations.
 - 2. Show layout and thickness of flat insulation.
 - 3. Show layout and thickness of tapered insulation, including slopes.
 - 4. Show crickets and saddles, including slopes.
 - 5. Show roof plan indicating orientation of membrane roofing and fastener spacing.
 - 6. Show insulation and cover board fastening or adhesive patterns for corner, perimeter, and field-of-roof locations.

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7. Show cold-applied adhesive pattern for insulation and cover board installation; typical pattern of a 100 square foot area.
 8. Include project specific details for typical and non-typical conditions.
- C. Samples for Verification Purposes: For the following products:
1. Roofing membrane, 12 in by 12 in (300 mm by 300 mm) square, of color specified, including side and end lap seam.
 2. Flashing sheets.
 3. Roof insulation and cover board.
 4. Termination bars.
 5. Fasteners of each type, length, and finish.
 6. Walkways, of color required.
- D. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.
1. Decorative Stone or Pavers: Comply with applicable provisions of ANSI-SPRI RP-4.
- 1.5 INFORMATIONAL SUBMITTALS
- A. Manufacturer's Project Acceptance Document: Certification by the manufacturer that its product(s) are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required, and that a warranty will be issued.
1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with Performance Requirements.
 - a. Submit evidence of compliance with performance requirements.
 2. Roofing manufacturer shall review and approve Shop Drawings in writing prior to submission.
- B. Field Quality Control Reports: Written report of testing and inspection required by "Field Quality Control".
- C. Concrete Roof Deck - Moisture Content Measurement: Submit recorded readings when requested.
1. Submit moisture content readings to roofing manufacturer.
- D. Substrate Surface Temperature Readings at Cold Fluid-Applied Insulation Adhesive: Submit recorded readings when requested.
1. Submit surface temperature readings to roofing manufacturer.
- E. Warranty:
1. Provide manufacturer's written warranty covering materials and installation (labor) stating obligations, remedies, limitations and exclusions.
- 1.6 CLOSEOUT SUBMITTALS
- A. Maintenance Data: To include in maintenance manuals.
- 1.7 QUALITY ASSURANCE
- A. Installer Qualifications:
1. Experience: Installer's personnel with not less than 5 years of experience in the successful performance of Work similar in scope of this Project.

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2. Supervision: Installer shall maintain a competent supervisor at Project while the Work is in progress, and who has not less than 5 years of experience installing products and systems similar to scope of this Project.
 3. Manufacturer Acceptance: Installer shall be certified, approved, licensed or acceptable to manufacturer to install products.
- B. Insurance Certification: Assist Owner in preparing and submitting roof installation acceptance certification as necessary in connection with fire and extended-coverage insurance on roofing and associated work.
- C. Quality Standards:
1. Unless otherwise recommended by roofing manufacturer, provide roofing system in accordance with recommendations of the NRCA "Roofing and Waterproofing Manual" for roofing type indicated.
 2. Comply with FMG System Loss Prevention Data Sheets 1-28 and 1-28S for design wind loads and wind uplift pressures on roofs for Windstorm Resistance Classification indicated.
 3. Comply with FMG System Loss Prevention Data Sheet 1-29 for roof deck securement and above deck components for Windstorm Resistance Classification indicated.
 4. Comply with FMG System Loss Prevention Data Sheet 1-49 for perimeter flashing for Windstorm Resistance Classification indicated.

1.8 PRE-INSTALLATION CONFERENCE

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site to comply with requirements of applicable Division 01 Sections.
1. Participants:
 - a. Architect.
 - b. Contractor, including superintendent.
 - c. Installer, including project manager and supervisor (superintendent).
 - d. If requested, Manufacturer's qualified technical representative.
 - e. Installers of other construction interfaced with Work.
 2. Minimum Agenda: Installer shall demonstrate understanding of the Work required by describing detailed procedures for preparing, installing, and cleaning the Work. Demonstration shall include, but not be limited to, following topics:
 - a. Tour representative areas of Work, inspect and discuss condition of substrate, and other preparatory work performed by other trades.
 - b. Review Contract Document requirements.
 - c. Review approved submittals.
 - d. Review inspection and testing requirements.
 - e. Review environmental conditions and procedures for coping with unfavorable conditions.
 - f. Resolve deviations or differences between Contract Documents and the manufacturer's specifications.
 - g. Review deck substrate requirements for conditions and finishes, including flatness, presence of moisture, and fastening.
 - h. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.

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- i. Review governing regulations and requirements for insurance and certificates if applicable.
- j. Review temporary protection requirements for roofing during and after installation.
- k. Review roof observation and repair procedures after roofing installation.

3. Record discussions, including decisions and agreements, and prepare report.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.
- B. Store materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored material from direct sunlight.
 - 1. Discard and legally dispose of material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.10 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.11 COORDINATION

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

1.12 WARRANTY

- A. Manufacturer's Warranty: Furnish manufacturer's written "Total Roofing System" warranty signed by an authorized representative using manufacturer's standard form, without monetary limitation (NDL), agreeing to repair or replace components of roofing system which exhibit defects in materials or workmanship within specified warranty period. "Defects" is defined to include, but not limited to, deterioration or failure to perform as required.
 - 1. Warranty Wind Speed: Minimum 90-mph Peak Gust Wind Speed.
 - 2. Warranty includes roofing, flashings, adhesives, sealants, insulation, fastener systems, cover board, substrate board, roofing accessories and other components of roofing system.
 - 3. Warranty includes lightweight insulating concrete integral with roofing system as specified in Division 03 Section Lightweight Insulating Concrete.
 - 4. Warranty includes roof edge flashings integral with roofing system as specified in Division 07 Section Sheet Metal Flashing and Trim.
 - 5. Warranty Period: Manufacturer shall warrant the products to be free from material and labor Defects for a period of 20 years from date of Substantial Completion.
- B. Installer's Warranty: Furnish installer's written warranty signed by an authorized representative using installer's standard form agreeing to repair or replace components of roofing system

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which exhibit defects in materials or workmanship within specified warranty period. "Defects" is defined to include, but not limited to, deterioration or failure to perform as required.

1. Warranty includes roofing, flashings, adhesives, sealants, insulation, fastener systems, cover boards, substrate board, roofing accessories, and other components of roofing system.
2. Warranty includes lightweight insulating concrete integral with roofing system as specified in Division 03 Section Lightweight Insulating Concrete.
3. Warranty includes roof edge flashings integral with roofing system as specified in Division 07 Section Sheet Metal Flashing and Trim.
4. Warranty Period: Installer shall warrant the installation to be free from workmanship Defects for a period of 2 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND PRODUCTS

- A. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section Substitution Procedures.
- B. Available Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, manufacturers offering products that may be incorporated into the Work include, but are not limited to, those listed.
- C. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other available manufacturers offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.

2.2 MATERIALS, GENERAL

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

2.3 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed roofing system and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roofing system and base flashings shall remain watertight.
 1. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.
 2. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D3746, ASTM D4272/D4272M, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.
- B. Material Compatibility: Provide roofing system materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing system manufacturer based on testing and field experience.
- C. Wind Uplift Resistance: Design roofing system to resist wind uplift pressures when tested according to FM Approvals 4474, UL 580, or UL 1897. Contractor shall obtain required design data and identify requirements accommodated on submittal drawings.

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1. Fire/Windstorm Classification - Field of Roof: Class 1A-90.
 2. Fire/Windstorm Classification - Roof Perimeter / Corner: Class 1A-150 / Class 1A-225.
 3. Hail-Resistance Rating: FM Global Property Loss Prevention Data Sheet 1-34.
 - a. Rating: SH Severe Hail.
 - b. Rating: VSH Very Severe Hail.
- D. SPRI Wind Design Standard for Edge Systems: Provide edge systems tested in accordance with ANSI/SPRI/FM 4435/ES-1 Wind Test Design Standard for Edge Systems Used with Low Slope Roofing Systems and capable of resisting design pressures.
- E. Energy Performance: Provide roofing system that is listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low and steep-slope roof products.
- F. Energy Performance: Provide roofing system with initial solar reflectance not less than 0.70 and emissivity not less than 0.75 when tested according to CRRC-1.
- G. Fire-Test-Response Characteristics: Provide roofing system materials with the fire-test-response characteristics indicated as determined by testing identical products per test method below by UL, FMG, or another testing and inspecting agency acceptable to authorities having jurisdiction. Materials shall be identified with appropriate markings of applicable testing and inspecting agency.
1. Exterior Fire-Test Exposure: ASTM E 108, Class A, for application and roof slopes indicated.
- 2.4 POLYVINYL CHLORIDE (PVC) ROOFING
- A. PVC Membrane Roofing System: ASTM D 4434, Type II glass-fiber reinforced or Type III fabric reinforced membrane.
1. Manufacturers and Products:
 - a. Carlisle SynTec, Inc.; Sure-Flex KEE HP.
 - b. Johns Manville, Inc.; JM PVC - 60 mil MIN.
 - c. Sika Sarnafil Inc.; G410 PVC.
 2. Membrane Thickness: 60 mils (1.5 mm), minimum.
 3. Exposed Face Color: White.
 4. Exposed Face Color: As selected by Architect from manufacturer's standard colors.
 5. Exposed Face Color: Custom color to be determined by Architect.
- B. PVC Membrane Roofing System, Fleece or Felt Backed: ASTM D 4434, Type II glass-fiber reinforced or Type III fabric reinforced membrane, fleece or felt backed.
1. Manufacturers and Products:
 - a. Carlisle Syn Tec, Inc.; FleeceBACK KEE HP.
 - b. Johns Manville, Inc.; JM PVC FB-60 mil MIN.
 - c. Sika Sarnafil Inc.; G410 Feltback PVC.
 2. Membrane Thickness: 60 mils (1.5 mm), minimum.
 - a. Composite Thickness: 115 mils (2.8 mm), nominal.
 3. Membrane Thickness: 80 mils (2.0 mm), minimum.
 - a. Composite Thickness: 135 mils (2.8 mm), nominal.
 4. Exposed Face Color: White.

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5. Exposed Face Color: As selected by Architect from manufacturer's standard colors.
6. Exposed Face Color: Custom color to be determined by Architect.

2.5 THERMOPLASTIC POLYOLEFIN (TPO) ROOFING

- A. TPO Membrane Roofing System: ASTM D 6878, internally fabric or scrim reinforced membrane.
 1. Manufacturers and Products:
 - a. Carlisle SynTec Inc.; Sure-Weld TPO.
 - b. Firestone Building Products Co.; UltraPly TPO.
 - c. Johns Manville, Inc.; JM TPO-60 mil.
 2. Membrane Thickness: 60 mils (1.5 mm), nominal.
 3. Exposed Face Color: White.
 4. Exposed Face Color: As selected by Architect from manufacturer's standard colors.
- B. TPO Membrane Roofing System, Fleece or Felt Backed: ASTM D 6878, internally fabric or scrim reinforced membrane, fleece backed.
 1. Manufacturers and Products:
 - a. Carlisle SynTec Inc.; Sure-Weld FleeceBACK TPO.
 - b. Johns Manville; JM TPO FB 115.
 2. Membrane Thickness: 60 mils (1.5 mm), nominal.
 3. Composite Thickness: 115 mils (2.8 mm), nominal.
 4. Exposed Face Color: White.

2.6 PROTECTION MEMBRANE AT DECORATIVE PAVER OR DECORATIVE STONE ASSEMBLY

- A. Polyvinyl Chloride Protection Membrane: ASTM D 4434, Type III, fabric reinforced 51 mils minimum thickness.
- B. TPO Protection Membrane: ASTM D 6878, internally fabric or scrim reinforced, uniform, flexible TPO sheet, 45 mils minimum thickness.
- C. EPDM Protection Membrane: ASTM D 4637, Type I, non-reinforced, fire-retardant, uniform, flexible EPDM sheet, 45 mils minimum thickness.
- D. KEE Sheet Protection Membrane: ASTM D 6754/D 6754M, fabric reinforced and coated with a proprietary compound utilizing Ketone Ethylene Ester (KEE) as the principle polymer in the hybrid vinyl alloy, 36 mil minimum thickness.

2.7 AUXILIARY ROOFING MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.
 1. Adhesives and Sealants: Comply with VOC limits of authorities having jurisdiction.
- B. "Standing Seam" Extrusions: Surface-applied extrusions that simulate the appearance of a standing seam metal rib roof system; made of same material and color as roofing membrane.
- C. Sheet Membrane Flashing: Manufacturer's standard sheet flashing membrane, of recommended thickness and compatible with roofing membrane, of same color as roofing membrane, and appropriate for Project roofing application.

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- D. Clad Sheet Metal Flashing: Manufacturer's standard clad stainless steel flashing, minimum 24 gauge, of same color as roofing membrane
 - E. Pipe / Stack Flashing: Pre-molded flexible membrane pipe collar with aluminum ring bonded to base as recommended by roofing system manufacturer.
 - F. Bonding Adhesive: Manufacturer's standard bonding adhesive.
 - G. Roof Flashing Adhesive: Manufacturer's standard elastomeric contact adhesive for flashing details.
 - H. Fluid Applied, Reinforced Liquid Flashing: Manufacturer's standard two-component polymethyl-methacrylate-based liquid flashing.
 - 1. Basis of Design: Sika Sarnafil Inc.; Liquid Flashing.
 - I. Water Cutoff Mastic: Manufacturer's standard butyl mastic sealant.
 - J. Metal Termination Bars: ASTM A 666, Type 304 formed stainless steel or extruded alloy 6063 aluminum bars; 2 types, one flat and one flat with upper flange shaped to receive sealant, locations as indicated; 1 in by 1/8 in (25 mm by 3 mm) thick; predrilled at 8 in (200 mm) centers; with corrosive resistant fasteners. No plastic bars allowed.
 - K. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing components to substrate, and acceptable to roofing system manufacturer.
 - 1. All fasteners, anchors, nails, straps, bars and other concrete or wood fasteners shall be stainless steel.
 - L. Miscellaneous Accessories: Preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.
 - M. Lap Sealant: Manufacturer's standard single-component sealant, color to match roofing membrane.
 - N. Sealant Pockets (aka Pitch Pans) at Roof Penetrations: Sealant pockets (aka pitch pans) at roofing penetrations are not allowed and will be considered non-conforming work. Refer to drawings for allowable penetration details.
- 2.8 CONCRETE MOISTURE BARRIER / VAPOR RETARDER
- A. Concrete Moisture Barrier/Vapor Retarder: Products and systems formulated to reduce moisture vapor transmission and surface alkalinity from concrete substrates prior to installation of roofing materials. Concrete moisture barrier shall be recommended and approved in writing by roofing system manufacturer.
- 2.9 SUBSTRATE BOARDS FOR VAPOR RETARDER
- A. Substrate Boards: ASTM C1177/C1177M, glass-mat, water-resistant gypsum board or ASTM C1278/C1278M fiber-reinforced gypsum board.
 - 1. Manufacturers and Products:
 - a. Georgia-Pacific Gypsum LLC; DensDeck Prime.
 - b. USG; SECUROCK Gypsum-Fiber Roof Board.
 - 2. Thickness: Minimum 1/2 in (12 mm).

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2.10 VAPOR RETARDER

- A. Self-Adhering-Sheet Vapor Retarder: Minimum 40-mil- (1.0-mm-) composite consisting of self-adhering rubberized asphalt and laminated film backing, maximum permeance rating of 0.1 perm (6 ng/Pa x s x sq. m). Provide primer when recommended by vapor retarder manufacturer.
1. Basis of Design: Carlisle Syntec Systems; VapAir Seal 725 TR Air and Vapor Barrier/Temporary Roof.
 2. Basis of Design: Sika Sarnafil; Sarnavap 32 Self-Adhered.

2.11 ROOF INSULATION

- A. General: Preformed roof insulation boards manufactured or approved by roof membrane manufacturer. Comply with requirements of referenced standards, selected from manufacturer's standard sizes and of thicknesses. Provide accessories recommended by insulation manufacturer for intended use and compatible with roofing membrane.
1. Provide insulation thickness required to maintain minimum aged R-value as indicated on the Drawings.
 2. Insulation board thickness of individual insulation layers to be 2.6 in (65 mm) maximum.
 3. Insulation board size to be 4 ft by 4 ft (1.22 m by 1.22 m) maximum.
 4. Provide factory, tapered insulation boards where indicated for sloping to drains. Fabricate with 1/4 in (6 mm) per 12 in (300 mm) (1:48) taper, unless otherwise indicated.
 5. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.
- B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 2, Grade 2, coated polymer bonded glass-fiber mat facers on both major surfaces.
1. Compressive Strength: 20 psi (138 kPa).
- C. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 2, Grade 3, coated polymer bonded glass-fiber mat facers on both major surfaces.
1. Compressive Strength: 24 psi (172 kPa)

2.12 INSULATION ACCESSORIES

- A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with other roofing system components.
- B. Cold Fluid-Applied Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:
1. Bead-applied, low-rise, two-component urethane adhesive.
 - a. Basis of Design (Product Standard): OMG Inc.; Olybond 500.
- C. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.

2.13 ROOF COVER BOARDS

- A. Roof Cover Boards: ASTM C1177/C1177M, glass-mat, water-resistant gypsum board or ASTM C1278/C1278M fiber-reinforced gypsum board. Provide in maximum lengths and widths

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available that will minimize short-edge-to-short-edge butt joints and to correspond to support system indicated.

1. Manufacturers and Products:
 - a. Georgia-Pacific Gypsum LLC; DensDeck Prime.
 - b. USG; SECUROCK Gypsum-Fiber Roof Board.
2. Thickness: Minimum **1/2 in (12 mm)**; or as required to meet performance requirements.
3. Thickness at Vertical Cover Boards (Back of Parapet): **5/8 in (16 mm)**.

- B. Roof Cover Boards: ASTM C1177/C1177M, glass-mat, water-resistant gypsum board. Provide in maximum lengths and widths available that will minimize short-edge-to-short-edge butt joints and to correspond to support system indicated.

1. Manufacturers and Products:
 - a. Georgia-Pacific Gypsum LLC; DensDeck StormX Prime.
2. Thickness: Minimum **5/8 in (16 mm)**.

2.14 FLEXIBLE WALKWAYS

- A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, solid-rubber, slip-resisting, surface-textured walkway pads or rolls, approximately **3/16 in (5 mm)** thick, as recommended by roofing system manufacturer.
1. Size: Approximately 36 by 60 inches (914 by 1524 mm).
 2. Color: As selected by Architect.

2.15 FLASHING AND SHEET METAL

- A. Flashing and Sheet Metal: Refer to Division 07 Section Sheet Metal Flashing and Trim.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions, including concrete moisture content, have been corrected in a manner complying with roofing manufacturer recommendations and Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.
1. Verify that roof openings and penetrations are in place and set and braced and that roof drains are securely clamped in place.
 2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thickness of insulation.
 3. Metal Decking Substrates:
 - a. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Division 05 Section Steel Roof Decking.
 4. Cast-in-Place Concrete or Composite Metal Deck Substrates:
 - a. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.

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- b. Concrete Moisture Testing: Perform one or both of the following tests as recommended by roofing manufacturer. Proceed with installation only after concrete substrates pass testing.
 - 1) Concrete Internal Relative Humidity: Not more than 75 percent, or as recommended by NRCA and roofing system manufacturer, when tested according to ASTM F2170.
 - a) Test Frequency: Perform three test probes for the first 1000 sq. ft. (93 sq. m) and one test probe per each 1000 sq. ft. (93 sq. m), or portion thereof, of roof deck, with no fewer than three test probes.
 - b) Submit test reports within 24 hours of performing tests.
 - 2) Manufacturer Concrete Moisture Test: Roofing manufacturer standard moisture test with measurements or results acceptable to roofing manufacturer.
 - c. Concrete Moisture Barrier/Vapor Retarder: For concrete substrates not meeting moisture test standards specified above, install concrete moisture barrier/vapor retarder to concrete substrate in accordance with manufacturer's written instructions.
 - d. Verify that concrete curing compounds that will impair adhesion of roofing components to roof deck have been removed.
5. At lightweight insulating concrete substrates:
- a. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
 - b. Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for capillary moisture by plastic sheet method according to ASTM D 4263 or as recommended by roofing manufacturer.
- B. Substrate Surface Temperature at Cold Fluid-Applied Insulation Adhesive: Confirm that concrete substrate or substrate board surface temperature is a minimum 50 deg F (10 deg C) prior to application of adhesive.
- 3.2 INSTALLATION OF ROOFING, GENERAL
- A. General: Comply with recommendations in FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29.
 - B. Start installation of roofing in presence of roofing system manufacturer's technical personnel and Owner's testing and inspection agency, if applicable.
 - 1. Cooperate with testing and inspecting agencies engaged or required to perform services for installing roofing system.
 - C. Coordinate installation of roofing system so insulation and other components of the roofing system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is forecast.
 - 1. Provide tie-offs at end of each day's work to cover exposed roofing sheets and insulation with a course of coated felt set in roofing cement or hot roofing asphalt, with joints and edges sealed.
 - 2. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system.
 - 3. Remove and discard temporary seals before beginning work on adjoining roofing.

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- D. Install roof membrane and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition and not to void warranty for existing roofing system.
- E. Coordinate installation and transition of roofing system component serving as an air barrier with air barrier specified in other sections.
- F. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
 - 1. Respective manufacturer's written installation instructions.
 - 2. Accepted submittals.
 - 3. Contract Documents.
- G. Control of Corrosion: Prevent galvanic action and other forms of corrosion by isolating metals and other materials from direct contact with incompatible materials.

3.3 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.
- B. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- C. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

3.4 INSTALLATION OF VAPOR RETARDER

- A. Vapor Retarder: Install according to roofing system manufacturer's written instructions.
- B. Self-Adhering-Sheet Vapor Retarder: Prime substrate if required by manufacturer. Install self-adhering-sheet vapor retarder over area to receive vapor retarder, side and end lapping each sheet a minimum of 3-1/2 and 6 inches (90 and 150 mm), respectively.
 - 1. Extend vertically up parapet walls and projections to a minimum height equal to height of insulation and cover board.
 - 2. Continuously seal side and end laps with tape.
- C. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into single-ply roofing.

3.5 INSTALLATION OF INSULATION

- A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.
- B. Install one or more layers of insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2 in (50 mm) or greater, install 2 or more layers with joints of each succeeding layer staggered from joints of previous layer
- C. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.
 - 1. Install base layer of insulation with joints staggered not less than 24 inches (610 mm) in adjacent rows.

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- a. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 - b. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
 - c. Trim insulation so that water flow is unrestricted.
 - d. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
 - e. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
 2. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches (305 mm) from previous layer of insulation.
 - a. Staggered end joints within each layer not less than 24 inches (610 mm) in adjacent rows.
 - b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 - c. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
 - d. Trim insulation so that water flow is unrestricted. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.
 - 1) Install tapered insulation under area of roofing to conform to slopes indicated.
 - e. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
 - f. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
 - g. Adhere each layer of insulation to substrate using the following adhesive setting methods in accordance with manufacturer recommendations and performance requirements.
 - 1) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
 - 2) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.
- D. Installation Over Metal Decking:
1. Mechanically attach base layer of insulation using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to metal decks.
 2. Adhere upper layers of insulation in accordance with manufacturer recommendations and performance requirements.
- E. Installation Over Cast-In-Place Concrete or Composite Metal and Concrete Decks:
1. Adhere base layer of insulation to concrete roof deck in accordance with manufacturer recommendations and performance requirements.
 2. Adhere upper layers of insulation in accordance with manufacturer recommendations and performance requirements.
- 3.6 INSTALLATION OF COVER BOARDS
- A. Install roof cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 in (150 mm) in each direction. Loosely butt roof cover boards together.

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1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
2. At internal roof drains, conform to slope of drain sump.
 - a. Trim cover board so that water flow is unrestricted.
3. Cut and fit cover board tight to nailers, projections, and penetrations.
4. Adhere cover board to insulation using the following adhesive setting methods in accordance with manufacturer recommendations and performance requirements.
 - a. Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
 - b. Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.
5. Score boards, if necessary, to conform to substrate irregularities. Comply with manufacturer's installation recommendations to insure proper adhesion and adhesive set.

3.7 INSTALLATION OF ADHERED ROOF MEMBRANE

- A. Adhere roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.
- B. Unroll roof membrane and allow to relax before installing.
- C. Accurately align roof membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- D. Bonding Adhesive: Apply to substrate and underside of roof membrane at rate required by manufacturer and allow to partially dry before installing roof membrane. Do not apply to splice area of roof membrane.
- E. Fabric-Backed Roof Membrane Adhesive: Apply to substrate at rate required by manufacturer, and install fabric-backed roof membrane.
- F. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations and perimeter of roofing.
- G. Apply roof membrane with side laps shingled with slope of roof deck where possible.
- H. Seams: Clean seam areas, overlap roofing, and hot-air weld side and end laps of roof membrane and sheet flashings to ensure a watertight seam installation.
 1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roof membrane and sheet flashings.
 2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
 3. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.
 4. Tape Seam Installation: Clean and prime both faces of splice areas, apply splice tape, and firmly roll side and end laps of overlapping roofing membranes according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of roofing membrane terminations.
- I. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.
- J. Install membrane roofing and auxiliary materials to tie in to existing roofing to maintain weather-tightness of transition and to not void warranty for existing roofing system.

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3.8 INSTALLATION OF BASE FLASHING

- A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply bonding adhesive to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Seams: Clean seam areas and overlap and firmly roll sheet flashings into the adhesive. Heat weld side and end laps to ensure a watertight seam installation.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.9 INSTALLATION OF STANDING SEAM EXTRUSIONS

- A. Installation of extrusions shall be performed by installation personnel that have completed a mandatory installation and welding training course required by roofing membrane manufacturer.
- B. Install extrusions parallel with roof slope. Roofing membrane surface must be clean so as to obtain a proper weld between the extrusion and roofing membrane.
- C. Pre-assemble extrusions on the roof to the required length. Join individual lengths using connector and push together. Align extrusion with edge of membrane overlap, do not cover overlap. Check membrane seams and re-weld as required prior to extrusion installation.
- D. Install extrusions parallel with roof slope. Roofing membrane surface must be clean so as to obtain a proper hold between the extrusion and roofing membrane.
- E. Pre-assemble extrusions on the roof to the required length. Join individual lengths using connector and push together. Align extrusion with edge of membrane overlap, do not cover overlap. Check membrane seams and re-prime roof membrane as required prior to extrusion installation. Attach extrusions with butyl tape.

3.10 INSTALLATION OF WALKWAYS

- A. Flexible Walkways: Install walkway products according to manufacturer's written instructions.
 - 1. Provide 6-inch (76-mm) clearance between adjoining pads.
 - 2. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.11 PROTECTION MEMBRANE INSTALLATION AT DECORATIVE STONE AND DECORATIVE PAVER OVERBURDEN ASSEMBLY

- A. Loose-Laid Protection Membrane:
 - 1. Loose-lay protection membrane over roofing membrane in accordance with manufacturer's recommendation.
 - 2. Do not apply bonding adhesive to splice area of protection membrane.
 - 3. Roll protection membrane in place in accordance with manufacturer's recommendations.
 - 4. Adhere protection membrane at edges and other locations in accordance with manufacturer's recommended locations and adhesive.
- B. Clean seam areas, overlap protection membrane, and hot-air weld side and end laps of protection membrane according to manufacturer's written instructions.

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- C. Decorative Pavers and Pedestals: Refer to Division 07 Section Roof Paver and Pedestal Assemblies.
- D. Decorative Stone: Apply aggregate uniformly over protection membrane to a minimum depth of 3 in (75 mm).

3.12 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Manufacturer's qualified technical representative shall periodically inspect Work to ensure installation is proceeding in accordance with manufacturer's designs, recommendations, instructions and warranty requirements. Representative shall submit written reports of each visit indicating observations, findings, and conclusions of inspection.
 - 1. Manufacturer's Technical Representative Qualifications: Direct employee of technical services department of manufacturer with experience in providing recommendations, observations, evaluations, and problem diagnostics.
 - 2. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion, in presence of Architect, and to prepare inspection report.
- B. Manufacturer's Cold Fluid-Applied Insulation Adhesive Inspection: Manufacturer's qualified technical representative shall periodically inspect Work to ensure installation is proceeding in accordance with manufacturer's designs, recommendations, instructions and warranty requirements. Representative shall submit written reports of each visit indicating observations, findings, and conclusions of inspection.
 - 1. Test Cuts: The cold fluid-applied insulation adhesive manufacturer shall perform field quality control test cuts of the cold fluid-applied insulation adhesive installation.
- C. Owner Testing Agency: The Owner may employ and pay a qualified independent testing agency to perform field quality control, including infrared inspections on installed roof assemblies.
 - 1. Infrared Thermography: Testing agency shall survey entire roof area using infrared color thermography according to ASTM C1153.
 - a. Perform tests before overlying construction is placed.
 - b. After infrared scan, locate specific areas of leaks by electrical capacitance/impedance testing or nuclear hydrogen detection tests.
 - c. After testing, repair leaks, repeat tests, and make further repairs until roofing and flashing installations are watertight.
 - 1) Cost of retesting is Contractor's responsibility.
 - d. Testing agency shall prepare survey report of initial scan indicating locations of entrapped moisture, if any.
- D. Tests and Inspections, General: Tests and inspections shall take place as installation proceeds to determine compliance with specified performance requirements.
 - 1. Correction of Deficiencies:
 - a. Materials and installation will be considered defective if they do not meet specified requirements.
 - b. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.
 - c. Perform additional tests and inspections, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.

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2. Prepare test and inspection reports.

3.13 REPAIR, CLEANING, AND PROTECTION

- A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

SECTION 07 51 13 – PREMIUM FOUR-PLY BUILT-UP ROOFING

PART 1 - GENERAL

1.1 AREAS COVERED

- A. Refer to roof plans for areas to be included in the scope of work.

1.2 DEFINITIONS

ACM	Asbestos Containing Materials
ANSI	American National Standards Institute
ASCE	American Society of Civil Engineers
ASTM	American Society for Testing and Materials
EPA	Environmental Protection Agency
EPDM	Ethylene Propylene Diene Monomer
EPS	Expanded Polystyrene
EVT	Equiviscous Temperatures
FM	Factory Mutual
IBC	International Building Code
KEE	Ketone Ethylene Ester
NDL	No Dollar Limit
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NRCA	National Roofing Contractors Association
OSHA	Occupational Safety & Health Administration
SBS	Styrene-Butadiene-Styrene
SDI	Steel Deck Institute
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SPRI	Single Ply Roofing Industry
UL	Underwriters Laboratories, Inc.

1.3 REFERENCES (INCLUDING LATEST REVISIONS)

- A. Comply with governing local, state, and federal regulations, safety standards, and codes.
- B. Testing Laboratory Services: Test results shall meet or exceed established standards.
- C. Underwriters Laboratories, Inc. (Roofing Covering): Class A fire hazard classification.
- D. American Society for Testing and Materials (ASTM)
- E. The National Roofing Contractors Association (NRCA) - Roofing and Waterproofing Manual
- F. Sheet Metal and Air Conditioning Contractors National Association (SMACNA) - Architectural Sheet Metal Manual
- G. American Society of Civil Engineers – ASCE 7

1.4 INSTALLER QUALIFICATIONS

- A. Roofing installer must be:
1. Currently prequalified with the Owner in accordance with Owner's prequalification requirements.

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2. Currently in good standing with the manufacturer.
 3. Installer must be an experienced single firm specializing in the type of roofing repair and/or removal and replacement work required, employing only experienced workers for the class of work in which they are employed, having at least five (5) years successful experience on projects similar in size and scope and acceptable as applicators by the Architect.
 4. Contractor must have successfully completed previous projects warranted by the manufacturer.
- B. It shall remain each Bidder's responsibility to determine his current status with the manufacturer's certification plan.

1.5 MANUFACTURER QUALIFICATIONS

- A. A qualified manufacturer is one that is UL listed and has FM approvals for a membrane roofing system similar to that used for this project for a minimum of fifteen (15) years.

1.6 CONTRACT DOCUMENT QUALITY ASSURANCE

- A. In the case of an inconsistency between the drawings and specifications or within either document not clarified by addendum, the better quality or greater quantity of work shall be provided in accordance with the Architect's interpretation.

1.7 SUBMITTALS

- A. Shop Drawings: Provide manufacturer's approved details of all perimeter conditions, projection conditions, and any additional special job conditions which require details other than indicated in the drawings.
1. Shop drawings shall be engineered drawings, digital or CAD. Hand sketches, copies or tracings of project documents are not acceptable. Manufacturer's details are acceptable provided they are project specific and representative of all specified components and actual conditions.
 2. Submit only product data of all materials and/or components specified to be used on project.
- B. Submit samples of Manufacturer's and Contractor's warranty that is to be issued as Specified upon project completion, complete with any addenda necessary to meet the warranty requirements as specified.
- C. Submit copy of manufacturer's warranty application submitted to manufacturer.
- D. Submit a written statement from the roofing materials manufacturer approving the installer, the project's specified warranty, receipt of contractor's warranty application, specifications and drawings as described and/or shown for this project and stating the intent to guarantee the completed project.
- E. Refer to Specification Section 01 33 00 for additional Submittal requirements.

1.8 SYSTEM DESCRIPTION

- A. Four-ply, Built up Roofing System with asphalt flood coat and gravel applied in moppings of hot asphalt over mopped to covered board, mopped to rigid insulation.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original, unopened containers and rolls with all labels intact and legible including labels indicating appropriate warnings, storage conditions, lot numbers, and usage instructions. Materials damaged in shipping or storage shall not be used.
- B. Manufacturer's packaging and/or roll plastic is not acceptable for exterior storage. Tarpaulin with grommets shall be minimum acceptable for exterior coverings. All materials stored as above shall be a minimum of four inches (4") off the substrate, and the tarpaulin tied off with rope.
- C. Deliver materials requiring fire resistance classification to the job with labels attached and packaged as required by labeling service.
- D. Deliver materials in sufficient quantity to allow continuity of work.
- E. Handle and store material and equipment in such a manner as to avoid damage. Liquid products shall be delivered sealed, in original containers.
- F. Handle rolled goods so as to prevent damage to edge or ends.
- G. Select and operate material handling equipment so as not to damage existing construction or applied roofing.
- H. Moisture-sensitive products shall be maintained in dry storage areas and properly covered. Provide continuous protection of materials against wetting and moisture absorption. Store roofing and flashing materials on clean raised platforms with weather protective covering when stored outdoors.
- I. Store rolled goods on end.
- J. Protect materials against damage by construction traffic.
- K. The proper storage of materials is the sole responsibility of the contractor and any wet or damaged roofing materials shall be discarded, removed from the project site, and replaced prior to application.
- L. Comply with fire and safety regulations, especially with materials which are extremely flammable and/or toxic. Use safety precautions indicated on labels.
- M. Products, such as emulsions liable to degrade as a result of being frozen shall be maintained above 40° F in heated storage.
- N. No storage of materials shall be permitted on roof areas other than those materials that are to be installed the same day. Any exception must be in written form.
- O. The contractor is to erect a temporary chain link fence, minimum six feet (6') in height, around work area stage and kettles. Fence is to be secured on a daily basis.

1.10 SITE CONDITIONS

- A. Job Condition Requirements:
 - 1. Coordinate the work of the contractor with the work to be performed by other trades, to ensure proper sequencing of the entire work. The contractor is to schedule his work so that adequate time is allowed for other trades to perform their work.
 - 2. Apply roofing in dry weather.
 - 3. Do not apply roofing when ambient temperature is below 45° F.

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4. Proceed with roofing work only when weather conditions are in compliance with manufacturer's recommended limitations, and when conditions will permit the work to proceed in accordance with specifications.
5. Schedule the work so the building will be left watertight at the end of each day. Do not remove more roofing materials than can be reinstalled in any working day.
6. Load placed on the roof at any point shall not exceed the safe load for which the roof is designed.
7. All surfaces to receive new roofing shall be smooth, dry, and free from dirt, debris, and foreign material before any of this work is installed. Competent operators shall be in attendance at all times equipment is in use. Materials shall be stored neatly in areas designated by the Architect.
8. The contractor is to be aware of the potential for roof leaks on the existing roof as a result of ruptured blisters and/or roof mat damage caused by the vacuum process, foot traffic, or material and equipment storage. The contractor is to take all necessary precautions to prevent damage to the existing roof. All damage to the existing roof that could result in roof leaks is to be repaired on a daily basis by the roofing contractor.
9. The contractor shall follow local, state, and federal regulations, safety standards, and codes for the removal, handling, and disposal of asbestos containing materials, if present. When a conflict exists, follow the stricter document.
10. Due caution should be exercised so as not to alter the structural integrity of the deck. When cutting through any deck, care should be taken so as not to damage the deck or any part of the deck, such as post tension cables, etc.
11. All kettles shall have a fume recovery system, automatic thermostat control, and visible temperature gauge all in working order.
12. The contractor is to verify the location of all interior ducts, electrical lines, piping, conduit, and/or similar obstructions. The contractor is to perform all work in such a manner as to avoid contact with the above mentioned items.
13. Surface and air temperatures should be a minimum 40° F during applications of cleaner and waterproof coating and remain above 40° F for a minimum of four (4) hours following applications. Verify compatibility of cleaner with coatings, paints, primers and joint sealers specified. Advise Project Manager/Architect of any problems in this regard prior to commencing cleaning operations.
14. Temporary Sanitary Facilities:
 - a. The contractor shall furnish and maintain temporary sanitary facilities for employees use during this project, including temporary toilets, wash facilities, and drinking water fixtures.
 - b. Toilet units shall be self-contained, single-occupant, of the chemical, aerated recirculation, or combustion type, properly vented and fully enclosed with a glass fiber reinforced polyester shell or similar nonabsorbent material.
 - c. Facilities shall be installed where they will best service the project's needs, with Owner's/Owner's Representative's approval.
 - d. Contractor shall provide toilet tissue, paper towels, paper cups, and similar disposable materials for each facility. Provide covered waste containers for used material.
 - e. All portable facilities shall comply with local laws, codes, and regulations.
 - f. Contractor shall be responsible to see that the units are removed in a timely manner after the completion of the project.

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- B. Protection of Work and Property:
1. Work: The contractor shall maintain adequate protection of all his work from damage and shall protect the Owner's and adjacent property from injury or loss arising from this contract. Contractor shall provide and maintain at all times any OSHA required danger signs, guards, and/or obstructions necessary to protect the public and his workmen from any dangers inherent with or created by the work in progress. All federal, state, and city rules and requirements pertaining to safety and all EPA standards, OSHA standards, NESHAP regulations pertaining to asbestos as required shall be fulfilled by the contractor as part of his proposal.
 2. Property: Protect existing planting and landscaping as necessary or required to provide and maintain clearance and access to the work of this contract. Examples of two categories or degrees of protection are generally as follows: a) removal, protection, preservation, or replacement and replanting of plant materials; b) protection of plant materials in place, and replacement of any damage resulting from the contractor's operations.
 3. Finished roof areas shall be protected from damage by the contractor during construction.
 4. Twenty-four Hour Call: The contractor shall have personnel on call 24 hours per day, seven (7) days per week for emergencies during the course of a job. The Owner/Project Manager/Architect is to have the 24 hour numbers for the contact. Contractor must be able to respond to any emergency call and have personnel on-site within two (2) hours after contact. Numbers available to the Owner/Project Manager/Architect are to be mobile, home and office numbers for:
 - a) Job Foreman
 - b) Job Superintendent
 - c) Owner or Company Officer
- C. Damage to Work of Others: The contractor shall repair, refinish, and make good any damage to the building or landscaping resulting from any of his operation. This shall include, but is not limited to, any damage to plaster, tile work, wall covering, paint, ceilings, floors, or any other finished work. Damage done to the building, equipment, or grounds must be repaired at the successful contractor's expense holding the Owner harmless from any other claims for property damage and/or personal injury.
- D. Measurements: It will be the contractor's responsibility to obtain and/or verify any necessary dimensions by visiting the job site, and the contractor shall be responsible for the correctness of same. Any drawings supplied are for reference only.
- E. Use of Premises:
1. The contractor is advised that the Owner will occupy the building at all times, and the contractor must provide all safeguards required to protect personnel and to keep noise levels as low as reasonably possible for each operation.
 2. The contractor shall:
 - a) Coordinate work in such a manner as to not interfere with the normal operation of the building.
 - b) Assume full responsibility for protection and safekeeping of products stored on premises.
 - c) Agree to hold the Owner harmless in any and all liability of every nature and description which may be suffered through bodily injuries, including death of any persons by reason of negligence of the contractor, agents, employees, or subcontractors.
- F. Cleaning and Disposal of Materials:
1. Contractor shall keep the job clean and free from all loose materials and foreign matter. Contractor shall take necessary precautions to keep outside walls clean and shall allow no roofing materials to remain on the outside walls.

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2. All waste materials, rubbish, etc., shall be removed from the Owner's premises as accumulated. Rubbish shall be carefully handled to reduce the spread of dust. A suitable scrap chute or hoist must be used to lower any debris. At completion, all work areas shall be left broom clean and all contractor's equipment and materials removed from the site.
3. All bituminous or roofing related materials shall be removed from ladders, stairs, railings, and similar parts of the building.
4. Debris shall be deposited at an approved disposal site.

1.11 SEQUENCING AND SCHEDULING

- A. Coordinate roofing schedule with work of other trades.
- B. Plan lay up of roofing membrane with respect to deck slope. Avoid situations where excessive drainage could pass into completed roofing.
- C. Maintain communication with roofing manufacturer's representative to inform of progress and to schedule periodic inspections.
- D. All penetrations shall be made in roof prior to beginning with roof installation.

1.12 PERFORMANCE REQUIREMENTS

- A. Roofing System: Shall prevent water migration into roof assembly or building interior through the roof membrane and/or membrane base flashing.

1.13 QUALITY ASSURANCE

- A. Work of this Section to conform to these specifications, and to the roofing material manufacturer's application instructions. In the event of conflicts between the two, the more stringent requirement shall be observed.
- B. Maintain one copy of each document on site.
- C. Factory Technical Representative: Roofing Contractor is to arrange and schedule the manufacturer's technical representative to be on site the first day of the installation of manufacturer's roofing system. The manufacturer's technical representative shall inspect the work of the contractor at least one time each week during the installation of the roofing system. The manufacturer's technical representative shall perform with the owner's representative and the roofing contractor a final inspection of the roofing system. At the completion of the final inspection, provide to the roofing contractor a list of punch list items (if any) to be correct before technical acceptance of the roofing project and prior to issuance of manufacturer's Twenty (20) Year Full System Warranty. Field reports shall be provided after each inspection within five (5) days of site visit.
- D. Pullout Tests: Conduct pullout test on deck using appropriate fastener prior to roof system installation. Submit pullout results for manufacturer's review to determine specific fastening pattern for this project, minimum uplift requirements shall conform to current ASCE 7 criteria.

1.14 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacture of the products specified, with five (5) years documented experience in the uninterrupted, and unmodified manufacture of the roofing system and component elements of the roofing system specified herein.

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- B. Applicator: Company specializing in the work of this Section, having a minimum of five (5) years documented experience applying modified bitumen roofing systems, and approved by the Manufacturer for not less than three (3) years to install the specified roof system so as to achieve a twenty (20) year no dollar limit warranty.

1.15 REGULATORY REQUIREMENTS

- A. Conform to all applicable local codes for roof assembly fire hazard requirements.
- B. Provide certification of inspection confirming approval of design and installation by authority having jurisdiction.
- C. Fire Hazard Classifications: UL Class A.

1.16 PRE-INSTALLATION CONFERENCE

- A. Convene a preinstallation conference two weeks prior to commencing the Work.
- B. Require attendance of parties directly affecting the Work of this Section.
- C. Review condition of roof deck and installation, installation procedures and coordination with related work.

1.17 ENVIRONMENT REQUIREMENTS

- A. Do not apply roofing during inclement weather.
- B. Do not apply roofing membrane to damp or frozen deck or substrate.

1.18 WARRANTY

- A. Roofing - Manufacturer: Project shall be installed in such a manner that the roofing material manufacturer will furnish a written twenty (20) year NDL type warranty from the date of substantial completion of the completed project.
- B. Roofing - Contractor: The contractor, jointly with any subcontractors employed by him, shall guarantee the work required and performed under this contract will be free from defects in workmanship and materials, and that the building will be and remain waterproof for a two (2) year warranty period, after the Owner accepts the work as substantially complete. The warranty shall be in approved notarized written form, to obligate the contractor and his subcontractors, if any, to make good the requirements of the warranty.
- C. Warranty repairs shall be performed by a certified installer. The repairs shall be performed in accordance with the manufacturer's written instructions and recommended procedures so as to not void the warranty (if applicable). Repair of the system, including materials and labor, shall be done at no cost to the Owner.
- D. Provide twenty (20) year Manufacturer's No-Dollar-Limit (NDL) warranty on the above-deck roofing system. Warranty to cover costs of material and labor to replace roofing material which fails to resist the penetration of water due to failure of either material or workmanship, with no penal sum.
- E. Manufacturer's warranty shall cover above deck roofing components against wind uplift resulting from wind pressures based on the requirements of ASCE 7.

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- F. New work shall be installed so as not to affect or void existing manufacturer's warranty.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Samples of all materials used on the project, which are not supplied by the membrane manufacturer, shall be submitted to the membrane manufacturer for written approval prior to work starting.
- B. All materials used on the project shall be asbestos free.
- C. All materials shall be furnished, specified, or approved in writing by the manufacturer holding the existing warranty. OR All materials shall be compatible with the existing modified bitumen roofing system and in accordance to NRCA recommendations and accepted roofing industry standards.
- D. All materials shall be furnished, specified, or approved in writing by the manufacturer issuing the warranty.

2.2 MANUFACTURERS – SHEET AND BITUMINOUS MATERIALS

- A. Tamko Roofing Products
- B. Johns Manville
- C. GAF
- D. Atlas Roof Corporation
- C. Or prior approved equal by Owner / Project Manager

2.3 ASBESTOS CONTAINING MATERIALS

- A. No asbestos containing materials shall be used on job site or incorporated into work.

2.4 PLY SHEETS

- A. Continuous strand glass fiber mat bonded together with resinous binder and coated with weathering grade asphalt; complies with requirements of ASTM D2178, Type VI or 503, Tam-Ply Premium, or approved equal.

2.5 FLASHING MEMBRANE

- A. Granule surfaced modified bitumen flashing materials with polyester reinforced SBS (styrene butadiene styrene-rubber); suitable for mop application with hot asphalt such as "Dynaflex" by Schuller, or Awaplan by Tamko Roofing Products, Inc., or approved equal.
- B. Thickness: 110 mils minimum.
- C. Color: White.

2.6 BITUMEN

- A. Shall be ASTM D 312 Type IV extra steep asphalt.

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- B. Shall be Low Fuming Perma Mop ASTM D 312-15 modified asphalt, and as acceptable by roofing manufacturer to comply with warranty requirements.

2.7 BASE SHEET FOR USE OVER CONCRETE ROOF DECK

- A. Shall be Underwriters Laboratory approved.
- B. Shall be premium grade, moisture resistant and flame retardant inorganic venting base sheet, asphalt coated on both sides and surfaced on one side with mineral granules, with a series of closely spaced 1/2" perforations spaced on 4" centers, ASTM D4897, Type II and ASTM D3672, Type II.

2.8 ASPHALT ROOF PRIMER

- A. Quick-dry asphalt-based primer for priming of asphalt roof surfaces, as manufactured by Gardner-Gibson, Inc. / GAF, or approved equal.

ASTM	D 41
Flash Point	105° F
Viscosity at 80° F (ASTM D 217)	50-60 K.U.
Weight per gallon	7.4 pounds
Drying time (to touch)	Min. 4 hours

2.9 ASPHALT PLASTIC ROOF CEMENT

- A. Trowel-applied mastic used on flanges of gravel stops, stacks, vents, and similar applications, as manufactured by Gardner-Gibson, Inc. / Johns-Manville, or approved equal.

ASTM	D 4586
Flash Point	105° F
Weight per gallon (approximate)	11 lbs.
Viscosity @ 80° F (ASTM D 217)	270-330
% Non-Volatile (Fed. Test Method 141)	70% Min.
% Specially Processed Bitumen	30% Min.
% Total Solids, by Volume	75% Min.
Dry film thickness of 1 gal./15 sq. ft.	85 Mils
Drying time	2 to 3 days
Service Temperature, Extended Exposure	-20° to +150° F
Resistance to Oils & Solvents	Poor
Resistance to Sunlight	Good
Resistance to Chemicals	Good
Effects of Weathering	Slight chalking
Water Resistance	
Under Good Drainage Conditions	Excellent
Under Continuous Submersion	Fair

2.10 INSULATION

- A. All insulation shall be in compliance with Section 07 22 16 Roof Board Insulation.
- B. All insulation shall be approved in writing by the membrane manufacturer as to thickness, type, and manufacturer. All insulation must be approved for the specific application, Underwriters Laboratory approved

2.11 SUBSTRATE BOARDS

- A. All substrate boards shall be in compliance with Section 07 22 16 Roof Board Insulation

2.12 CANT STRIP

- A. Structural: Shall be wood where used for structural purposes meeting NRCA, FM Global and Underwriters Laboratory guidelines.
- B. Non-structural: Shall be wood fiber where used for non-structural purposes, conforming to ASTM C208 and C209.

2.13 ROUGH LUMBER

- A. All wood nailers, structural cants, curbs, and other miscellaneous rough carpentry, shall be lumber as recommended by NRCA, and Underwriters Laboratory guidelines.
- B. Vertical Wall Shimming Material: Shall be exterior grade plywood unless otherwise accepted by Project Manager/Architect. Thickness shall be as required for attachment or to make material flashing flush or level with offsets and/or transitions, minimum three-fourths inch (3/4"). Proper selection of material is required to achieve UL guidelines.
- C. Where plywood is not used on the back of the parapet contractor to provide a continuous 22 ga. Sheet metal strap over the face of the studs at the through wall flashing location to accommodate the flashing fasteners.

2.14 FASTENERS

- A. All substrate boards shall be in compliance with Section 07 22 16 Roof Board Insulation.
- B. Fasteners and fastening plates or bars shall be listed in the FM Global Approval Guide, and be as recommended by the fastener manufacturer for the specific application.

2.15 FIBERGLASS COATED MEMBRANE

- A. A non-rotting, non-absorbent woven fiberglass membrane having a vinyl coating designed for membrane reinforcement for all roof repairs. Compatible with either tar or asphalt bitumens, having ten (10) open-weave squares per inch.

2.16 ROOF DRAINS

- A. All roof drains shall be in compliance with Division 22- Plumbing.
- B. Lead Flashing: Shall be four pound (4#) lead, minimum thirty inches by thirty inches (30" x 30"), used for flashing of internal drains
- C. Drains shall be placed no closer than 42" apart.

2.17 LEAD JACKS

- A. Shall be four pound (4#) lead, and of dimensions required to completely cover existing plumbing stack.

2.18 LIQUID FLASHING SYSTEM

- A. Liquid flashing system to be manufacturers recommended system comprising a liquid compound and sheet scrim fabric or equivalent.

2.19 PIPE SUPPORTS

- A. To support conduit or pipe sized up to Ø8" when height adjustment is needed use Model # SS1000A Adjustable Pipe Support. 17" circular base with 12 ga. framing channel, 18"L, attached to 17" circular base using ½" threaded rods, 12"L, with washers and nuts. Height of channel can be adjusted along the length of the ½" threaded rods. Strut clamps are suggested to hold piping or conduit in place.
 - 1. Manufacturers:
 - a) Advanced Support Products, Inc.
- B. To support water or gas piping up to Ø8" or when a roller support with height adjustment is needed use Model # SS1000RA Pipe Support with Adjustable Roller. 17" circular base with SBR heavy duty rubber roller assembly attached to 17" circular base using ½" threaded rods, 12"L, with washers and nuts. Height of roller assembly can be adjusted along the length of the ½" threaded rods.
 - 1. Manufacturers:
 - a) Advanced Support Products, Inc.
- C. To support multiple pipe runs, piping up to Ø12" when height adjustment or pipe suspension is needed use Model # SS4000P, SS6000P or SS8000P Adjustable Support Bridge. SS4000P Adjustable Support Bridge is made of four (4) 17" circular bases and 12ga. framing channel formed to make one "H" shaped support with crossbar. SS6000P Adjustable Support Bridge is made of six (6) 17" circular bases and 12ga. framing channel formed to make two "H" shaped supports with crossbar. SS8000P Adjustable Support Bridge is made of eight (8) 17" circular bases and 12ga. framing channel formed to make three "H" shaped supports with crossbar. Crossbar height is adjustable and offered in 18", 24", 36", and 48" lengths. Use Adjustable Support Bridge with strut clamps or roller accessories or use optional hanger supports to suspend water or gas piping at various heights. Optional hanger supports attached to support frame using ½" threaded rods. Hangers offer complete height adjustments along the length of ½" threaded rods.
 - 1. Manufacturers:
 - a) Advanced Support Products, Inc.

2.20 ROOF WALKWAY PADS

- A. Walkway Pads: Manufacturer's standard walkway pads consisting of modified asphalt, reinforcements and fillers with a ceramic granule surface on both sides. Thickness shall be 1/4" min.

2.21 MECHANICAL FASTENERS FOR FLEXIBLE FLASHING

- A. Concrete: Drive Pin having corrosion resistant mandrel with stainless steel pin, factory equipped with metal clad EPDM washer, Rawl Zamac
- B. Concrete Masonry: Hot-dip galvanized, threaded fastener with integral rubber sealing washer, Tap-Con by Rawl.
- C. Brick Masonry: Hot-dip galvanized, threaded fastener with integral rubber sealing washer, Tap-Con by Rawl.

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- D. Wood: Galvanized steel, annular ring roofing nails with integral one inch (1") cap, roofing nail by Simplex.

2.22 ROOF PLAQUE

- A. Contractor shall provide a sixteen inch by sixteen inch (16" x 16") metal plaque on the underside of each of the roof hatches that states the following:
1. Architect name, phone number. As project dictates
 2. School district phone number.
 3. School district emergency phone number,
 4. Contractor name, phone number.
 5. Subcontractor name, phone number.
 6. Roof Consultant, name, phone number.
 7. Roof system, warranty information, and
 8. Roof Manufacturer, phone number.

2.23 EXTERIOR ROOF ACCESS LADDER

- A. Fixed Ladder Design, with the required OSHA Approved fall protection.
- B. Refer to Specification Section 07 72 00 Roof Accessories for further information.

2.24 TERMINATION/PRESSURE BARS

- A. Aluminum strip shall be extruded channel bar with a mill finish, width one inch (1"), thickness 0.100" ± .008", leg height one-fourth inch (1/4") top and bottom, leg angle ninety degrees (90°), for perimeter and curb anchorage, having predrilled holes six inches (6") on center, as manufactured by Olympic Fasteners, or approved equal.

2.25 SELF-ADHERING UNDERLAYMENT FOR TEMPORARY WATERPROOFING

- A. A premium heavyweight, minimum 60 mil, self-adhering high temperature 260 degree min, underlayment, to use as a temporary waterproofing barrier.

2.26 ROOFING AGGREGATE

- A. ASTM D 1863, crushed stone or water worn gravel suitable for use as roof surfacing.
- B. General Characteristics at Time of Application: Hard, durable, with dry surface dry, free of clay, loam, sand, or other foreign substances, and shall conform to size grading and property requirements.
- C. Grading: Aggregate shall conform to sieve analysis as follows:

<u>Sieve</u>	<u>Total Passing</u>
1 inch	<100
3/4 inch	90 to 100
3/8 inch	20 to 55
No. 4	0 to 10
No. 8	0 to 5

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D. Physical Property Requirements:

Moisture, crushed stone and gravel	2.0% max.
Unit Weight (loose) , min.	60 lbs./cu. ft.
Dust	2.0% max.
Hardness, passing 3.35 mm (No. 6) sieve	20% max.

2.27 MULTI-COMPONENT POLYURETHANE SEALANT

- A. Except as otherwise indicated, provide manufacturer's standard, non-modified, 2-or-more-part, polyurethane-based, elastomeric sealant; complying with either ASTM C 920, Type M, Class 25, or FS TT-S-00227E, Class A; self-leveling grade/type where used in joints of surfaces subject to traffic, otherwise non-sag grade/type, as manufactured by Sonneborn, or approved equal.
- B. Durability: Less than 0.5 square inch adhesion/cohesion loss for three (3) samples of both mortar and aluminum; ASTM C 719 test procedure.
- C. Adhesion in Peel: Fifteen pound (15#) peel strength and 10% maximum loss of bond to substrate; ASTM C 794.
- D. Bituminous Modification: Where joint surfaces contain or are contaminated with bituminous materials, provide manufacturer's modified type sealant which is compatible with joint surfaces (modified with coal-tar or asphalt as required).

2.28 EXPANDED POLYETHYLENE JOINT FILLER

- A. Provide flexible, compressible, closed-cell, polyethylene of not less than 10 psi compression deflection (25%); except provide higher compression deflection strength as may be necessary to withstand installation forces and provide proper support for sealants, surface water absorption of not more than 0.1 pounds per square foot, as manufactured by Sonneborn, or approved equal.

2.29 SEALANT BACKER ROD

- A. Provide compressible rod stock of polyethylene foam, polyurethane foam, polyethylene jacketed polyurethane foam, butyl rubber foam, neoprene foam or other flexible, permanent, durable, non-absorptive material as recommended by sealant manufacturer for back-up of and compatibility with sealant. Where used with hot-applied sealant, provide heat-resistant type which will not be deteriorated by sealant application temperature as indicated.

2.30 FLUID APPLIED URETHANE DECK SEALANT SYSTEM

- A. Shall be a two layer, minimum sixty (60) mil dry film thickness, two-component liquid urethane waterproofing system suitable for concrete deck application (exposed), as manufactured by Gates Engineering, UDC-82, or approved equal.

2.31 DELIVERY AND STORAGE

- A. All materials shall be delivered with appropriate carton and can labels indicating appropriate warnings, storage conditions, lot numbers, and usage instructions. Materials damaged in shipping or storage shall not be used.

2.32 PRECAUTIONS

- A. Some of the indicated materials are extremely flammable and/or toxic. Use precautions indicated on can and carton labels.

2.33 OVERNIGHT SEAL

- A. Hot applied asphalt bitumen shall be provided for the purpose of night sealing the roof system.

2.34 MISCELLANEOUS MATERIALS

- A. Other materials shall be as specified or of the best grade for the proposed use as recommended by the manufacturer.

2.35 EXPANSION JOINTS

- A. Provide field fabricated wood expansion joints where shown on the drawings in size as indicated and acceptable to authorities having jurisdiction.
- B. Expansion joint nailers shall extend upward a minimum of eight inches (8") above finish roof height.
- C. Existing expansion joints shall be replaced with curbed expansion joints which extend a minimum of eight inches (8") above the finished roof surface. New expansion joint cover shall be fabricated of sheet metal in accordance with NRCA and/or SMACNA details and flashed in accordance with roofing material manufacturer's recommended procedures.
- D. Expansion joints at walls and field of the roof shall be curbed as outlined in accordance with NRCA and SMACNA guidelines. The curbs will be flashed as outlined above in Curb Flashings.
- E. Provide structural expansion joint in the field of the roof where the roof span exceeds 200'-0" in any direction.

PART 3 – EXECUTION

3.1 GENERAL

- A. In the instance of a conflict between these specifications and those of the manufacturer and/or current NRCA, Underwriters Laboratory and IBC guidelines, the more stringent specifications (better quality or greater quantity of work) shall take precedence.
- B. The manufacturer's Technical Specifications and current NRCA, Underwriters Laboratory and IBC guidelines shall be considered a part of this specification and should be referred to for more specific application procedures and recommendations.
- C. Application of materials shall be in strict accordance with the manufacturer's recommendations and current NRCA, Underwriters Laboratory and IBC guidelines, except where more stringent requirements are shown or specified. In the instance of a conflict between these specifications and those of the manufacturer and/or current NRCA, Underwriters Laboratory and IBC guidelines, the more stringent specifications shall take precedence.
- D. General Installation:
 - 1. Comply with governing local, state, and federal regulations, safety standards, and codes. When conflict exists, the more restrictive document shall govern.

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2. Protect adjacent areas with tarpaulin or other durable materials.
 3. Contractor shall prevent overspray and be responsible for parking lot areas and/or adjoining areas not part of this contract.
 4. Contractor shall be responsible for sealing, as required, all openings that may allow bitumen migration or drippage, i.e., envelopes, and filler strips.
 5. Prepare surfaces according to manufacturer's or applicator's published instructions. All metal that is to receive bitumen, or come in contact with bitumen or adhesive, shall be first primed with appropriate primer. Any prefinished galvanized sheet steel that is to receive bitumen, or come in contact with bitumen or adhesive, shall be scored, scuffed or abraded before receiving primer application.
 6. Use cleaning materials or primers necessary to render an acceptable surface/substrate.
 7. All surfaces/substrates shall be clean and dry prior to application of materials.
 8. Prior to application of felts and or membrane, all foreign matter, gravel, etc., shall be removed from the insulation and/or substrate. Gravel or debris between the insulation/substrate and plies is not acceptable.
 9. Prior to application of flashing membranes, substrate shall be clean and free of any previously installed roofing materials. Contractor shall ensure that all components of substrate be structurally sound before application of flashing materials.
 10. Bitumen kettle shall have a fume recovery system, and visible thermometer to provide positive monitoring of the bitumen temperature when it is heated in accordance with manufacturer's instructions.
 11. Ambient temperature shall be 40° F and rising.
 12. The underlayment plies and field membrane are to be laid in the direction of maximum roof slope, working from bottom of slope toward ridge.
 13. Wrinkles, buckles, kinks, and fish mouths are not acceptable when laying membranes.
 14. Dry voids of membrane on membrane are not acceptable.
 15. All surfaces that are to receive the self-adhered membranes shall be primed with a fast-drying asphaltic primer.
 16. Application of roofing shall immediately follow the application of any insulation as a continuous operation. Under no circumstance is insulation to be left exposed at the end of the day. Insulation left exposed overnight will be removed and replaced at no cost to the Owner.
 17. Masonry and metal surfaces to receive roofing shall be primed with a uniform coating of approved asphalt primer.
 18. Unless otherwise noted, all layers of roofing shall be installed perpendicular to the slope of the deck; completely free of wrinkles, creases or fishmouths. Membrane application by the "mop and flop" technique will not be permitted.
 19. Asphalt kettles or tankers employed under this Contract shall be equipped with functioning, accurately calibrated, readable thermometers.
 20. Asphalt shall be applied in uniform mopping free of voids or holidays, at a rate recommended by the roofing manufacturer and not more than 25° F above the asphalt's listed Equiviscous temperature (EVT).
 21. Perform work of this Section in accordance with best standards of practice relating to trades involved.
- F. Do not apply roofing materials unless asphalt application temperatures can be maintained within the equiviscous temperature (EVT) range; or when water in any form (i.e., rain, dew, ice, frost, snow, etc.) is present on the deck. Do not heat asphalt above finished blowing temperature, flash point or 525 degrees Fahrenheit.
1. The equiviscous temperature (EVT) is defined by the NRCA as the temperature at which a bitumen attains the proper viscosity for built-up membrane application.

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2. The EVT range is defined by the NRCA as the recommended bitumen application temperature range. The range is approximately 25 degrees Fahrenheit above or below the EVT. The EVT range is measured in the mop cart or mechanical spreader just prior to the application of bitumen to the substrate.
 3. The proper viscosity for mop application is 125 centipoise. The proper viscosity for mechanical spreader application is 75 centipoise. If both mop and mechanical application is used, the proper viscosity for both is 75 centipoise.
- G. Consider roof system manufacturer's technical specifications part of this specification and use as reference for specific application procedures and recommendations.
- H. Complete roofing, flashing, sheet metal, and other related items daily with exception taken to flood coat and aggregate.

3.2 EXAMINATION

- A. Examine roof deck and related surfaces and verify that there are not conditions such as inadequate anchorage, foreign materials, moisture, ridges, or other conditions which would prevent satisfactory installation of roofing system.
- B. Correct conditions requiring correction or completion prior to installation of roofing system. Notify Owner's representative (Owner's representative, Contractor Officer) of unacceptable conditions.
- C. Do not proceed until defects are corrected.
- D. Verify location of interior ducts, electrical lines, piping, conduit, and similar obstructions. Perform work in manner to avoid contact with above mentioned items.
- E. Verify debris has been removed.
- F. Start of work under this Part Three constitutes acceptance of deck substrate and site conditions by roofing contractor.

3.3 SUBSTRATE PREPARATION

- A. New Construction: Substrate shall be smooth and free of debris, sharp edges, and other surface irregularities prior to work starting. Substrate repair shall be performed as required to minimum of NRCA standards.
- B. Concrete Decks:
 1. Surface irregularities shall be corrected with quick-setting mortar mix.
 2. Joints should be filled with quick-setting mortar mix to provide a level surface.
 3. Concrete must be primed and allowed to dry before applying any asphalt.
 4. The following shall be used and passed as an acceptable means of testing the dryness of a concrete roof deck:
 - a) Use approximately one (1) pint of bitumen that is specified for use in the roof membrane, heated to a temperature that will ensure an application temperature of 400° F.
 - b) Pour the bitumen on the surface of the deck. If the bitumen foams, the deck is NOT dry enough to roof.
 - c) After the bitumen has cooled, an attempt should be made to strip the bitumen from the deck surface. If the bitumen strips clean from the deck, the deck is NOT dry enough to roof.
 5. Prestressed, precast concrete slabs require the following preparation:
 - a) If there is a screeded fill over the slabs, the joints of the slabs should be left open.

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- b) If screeded fill is not used to cover the slabs, the joints of the slabs shall be sealed with an elastomeric sealant.
- c) After priming, six inch (6") wide self-adhering membrane strips shall be applied over each joint in the deck before laying the venting base sheet.
- d) Before applying the membrane strips to the joints, a leveling fill of quick-setting mortar must be used whenever slab edges are out of plane by more than one-half inch (1/2").

3.4 ASPHALT HEATING

- A. Use low burner flames during initial melt-downs. Circulate asphalt after initial melt-down.
 - 1. Maximum asphalt temperature shall be 25°F below the flash point.
- B. Avoid prolonged heating of asphalt at high temperatures. Reduce the asphalt temperature to below 500°F if asphalt is not being used for periods of four (4) hours or more.
- C. Kettle shall be free of contaminants.
- D. Application rates: Bitumen quantities for waterstop/tie-offs, flashings, miscellaneous detail applications, and minimum kettle capacity are not included in application rates. To account for these factors, add approximately 25 percent additional bitumen on a total job average basis.

3.5 ROUGH CARPENTRY

- A. All rough carpentry shall be in compliance with Section 06 10 53 Miscellaneous Carpentry.
- B. Nailers shall be installed according to NRCA, Underwriters Laboratory, and IBC guidelines.
- C. Wooden nailers shall be installed at Metal edges, drip edges, expansion joints, and on outside perimeter of building.
- D. Metal Edge and drip edge nailers shall be the same height as the new insulation being installed where required.
- E. Nailers shall be raised if necessary by anchoring an additional nailer of appropriate height to the existing nailer if the existing nailer is not to be replaced.
- F. Expansion joint nailers shall extend upward a minimum of eight inches (8") above finish roof height.
- G. Where parapet wall exists, specified vertical wall shimming material shall be installed beginning at roof height up to a minimum of twelve inches (12") above finished roof surface, or as detailed, to provide substrate for horizontal termination of roof to wall flashing system.
- H. Any lumber or shimming required for attachment, or to make material flashing flush or level with offsets and/or transitions, shall be incorporated in these specifications.

3.6 CANTS

- A. Provide 45 degree cant strips (no partials) at all vertical and horizontal surfaces, such as walls, parapet walls, curbs, expansion joints, etc., and as recommended by membrane manufacturer.
- B. Cants shall provide a four (4) inch rise above the roof's surface.
- C. Toe of cant shall be level with the surface to receive new roof membrane and in all cases anchored according to NRCA, Underwriters Laboratory, and IBC guidelines.

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- D. Cant strips shall be installed at the intersection of the deck and all vertical surfaces.
- E. If a wood cant is used where insulation exists, cant shall be toe nailed into treated wood nailer the same height as insulation.

3.7 ADHERED BASE SHEET OVER SUBSTRATE

- A. Substrate shall be covered with specified base sheet adhered as follows:
 - 1. The concrete deck shall be primed with concrete primer in accordance with manufacturer's recommended procedures and allowed to dry. Following the application of the primer, adhesion shall conform to the ASCE 7 criteria for wind uplift as dictated by wind zone applicable to location of project. Securement shall be determined by building height, location and geographical area of the United States. It is the contractor's responsibility to consult current codes, publications, literature, and bulletins of IBC and the adhesive manufacturer that are in effect at the time of this project.
- B. If slope dictates, underlayment plies shall be installed using the strapped method going with the slope as required by membrane manufacturer.

3.8 PULLOUT TESTS

- A. Conduct pullout test on deck using appropriate fastener prior to roof system installation. Submit pullout results for manufacturer's review to determine specific fastening pattern for this project, minimum uplift requirements shall conform to current ASCE 7 criteria.

3.9 INSULATION

- A. All insulation shall be in compliance with Section 07 22 16 Roof Board Insulation.
- B. All insulation shall be approved in writing by the membrane manufacturer as to thickness, type, and manufacturer. All insulation must be approved for the specific application, Underwriters Laboratory approved

3.10 ROOF MEMBRANE INSTALLATION

- A. Install roof membrane materials in accordance with manufacturer's current published application instructions.
- B. Asphalt: Apply asphalt bitumen in accordance with EVT concept. Asphalt temperature shall be within 25 degrees of EVT at point of application. If this approximate temperature cannot be maintained at point of application, operations shall be discontinued. Asphalt shall not be heated above finished blowing temperature or maximum temperature of 525 degrees Fahrenheit.
- C. Embed four plies of roofing felt in shingle fashion (starter sheets required), lapping 30" inches into uniform moppings of steep appropriate grade hot asphalt bitumen. Plies may be left exposed as approved by roofing membrane manufacturer. Fiberglass Rolls are 40" inches
- D. Apply roofing felt by mechanically attaching felt layer or by rolling into hot bitumen applied by machine or hand mopping. Shingle felt in, free of buckles and fishmouths. Lay each ply so that flow of water is over or parallel to (but never against) lap. End laps shall be six inches (6") minimum and at least twelve inches (12") apart.

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- E. Embed full 40" width of each ply in steep Type IV asphalt bitumen. Apply asphalt uniformly at nominal rate of 25 pounds per 100 square feet (minimum of 23 pounds and maximum of 45 pounds). Total asphalt requirement for each ply per square (25 pounds) is based upon one hundred (100) square feet of felt. Bitumen shall be sufficiently hot to ensure complete bond of ply to ply. Fiberglass Rolls are 40" inches wide
- F. "Brooming in" is required under normal conditions for both felt layer and hand mopping. Brooming is essential in cold weather and must be done promptly and effectively to eliminate voids and to ensure adequate adhesion. Moderately soft commercial broom or squeegee (40" wide) should be used for this purpose. Broom should be pulled while walking off felts.
- G. Backnailing:
 - 1. Provide wood nailer strips secured to deck in areas where decking slope exceeds two inches (2") per foot.
 - 2. Nailer strips shall match thickness of roof insulation and provide securement for both insulation and roof membrane.
 - 3. Place nailer strips and backnail roof membrane in accordance with manufacturer's recommendations based upon slope and location.
- H. Foot and equipment traffic over felt should be held to absolute minimum during application and until asphalt has sufficiently cooled to prevent bitumen displacement.

3.11 BACKNAILING/STRAPPING

- A. On slopes greater than one inch (1") in twelve inches (12"), refer to NRCA and/or manufacturer's guidelines for backnailing procedures and follow the more stringent guidelines for all specified materials.

<u>Slope</u>	<u>Interply& Top Pour</u>	<u>Backnail</u>	<u>Strap</u>
0 - ½" per 12"	Type IV	No	No
½" - 2" per 12"	Type IV	Yes	Strap if possible
2" - 3" per 12"	Type IV	Yes	Yes

3.12 MODIFIED BITUMEN BASE FLASHING

- A. Place cant strips on top of roof insulation or nailer. Nail to deck and to wall or vertical nailer where possible. If not possible to nail, secure by applying plastic roof cement.
- B. Apply flashings only after built-up roofing membrane is in place.
- C. All flashings shall be constructed of flashings of two plies; one ply of SBS modified asphalt glass reinforced base sheet and one ply of modified bitumen flashing membrane.
- D. Overall minimum height of top of flashing membrane above top of roof surface is eight inches (8"); maximum height is fourteen inches (14") unless otherwise noted on drawings. Flashing membrane must extend horizontally a minimum of four inches (4") onto field of roof surface beyond bottom edge or cant strip or as shown on drawings. Side laps shall be four inches (4") minimum and strip in vertical lamps with a four inch (4") wide strip of fiberglass mesh embedded in flashing grade cement.
- E. Set SBS modified base sheet layer and SBS modified granulated bitumen flashing membrane in separate moppings of hot Type IV asphalt at 25 pound per 100 square feet minimum.

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- F. Mechanically attach top edge of modified bitumen membrane flashing with screws, waterproof washers, and aluminum compression bar. Fastener spacing shall be six inches (6") on center. Nailing top edge of modified bitumen membrane is not accepted. Three (3) course with plastic cement and fiberglass fabric to seal.
- G. Prime flashing surfaces with asphalt primer and permit to dry prior to application of modified bitumen membrane flashing. Apply asphalt primer at one gallon per 100 square feet minimum.
- H. Metal surfaces are not acceptable for application of base flashing membrane.
- I. Inside and Outside Corners: Cut out and install oval boot at inside and outside corners in accordance with manufacturer's requirements.
- J. Extend hot asphalt one-half inch (1/2") minimum beyond side, field, or end lap.
- K. Fully bond flashing to substrate. Ensure flashing material conforms and adheres to vertical cant and horizontal substrates.
- L. All vertical seams of the new base flashing assembly shall be addressed with a 4" inch strip of the granulated modified membrane.

All vertical seams to be treated with a three course application of mastic and membrane.
- M. Bond flashing materials to substrate 100 percent.

3.13 CANTS

- A. Provide full 45 degree cant strips (no partials) at all intersections of vertical and horizontal surfaces, such as walls, parapet walls, curbs, expansion joints, etc., and as recommended by membrane manufacturer.
- B. Cants shall provide a four (4) inch rise above the roof's surface. (Vertical, not diagonal)
- C. Toe of cant shall be level with the surface to receive new roof membrane and in all cases anchored according to NRCA, Underwriters Laboratory, and IBC guidelines.
- D. Cant strips shall be installed at the intersection of the deck and all vertical surfaces.
- E. If a wood cant is used where insulation exists, cant shall be toe nailed into treated wood nailer under cant the same height as insulation.

3.14 PROJECTION FLASHINGS

- A. Plumbing Vents: Soil vent stack pipes shall receive new lead flashings installed in strict accordance with practices set forth in the NRCA Roofing Manual. The lead shall be carried up and over the top of the stack, and crimped down into the pipe to form a watertight seal. Projections that cannot be sealed thus should be boxed in and flashed as recommended by the roof membrane manufacturer.
- B. Square Projections: Cut a slit in the membrane to correspond with the position of the projection, and lay the membrane in hot asphalt. Apply another layer of membrane in exactly the same fashion, but from the opposite direction. For metal flange-type projections, after doing above, strip in with six inch (6") strips of membrane.

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- C. Round Projections: Cut membrane square and eighteen inches (18") from perimeter of projection. Slit square membrane with an "X" of proper size to ensure a close fit and positive seal. Place over projection, and adhere to clean membrane already on the roof.

3.15 CURB FLASHINGS

- A. The flashing substrate shall be free of any dirt and loose material.
- B. The underlayment ply or plies shall be brought to two inches (2") past the top of the cant strip and adhered.
- C. Starting on the roof at least six inches (6") from the toe of the cant of the cant strip, adhere one (1) ply of modified base sheet extending over the cant and up the vertical a minimum of eight inches (8"). Each lap of the membrane shall be a minimum of three inches (3").
- D. Over the top of the modified base sheet starting on the roof at least eight inches (8") from the toe of the cant strip, adhere the finished membrane extending over the cant and up the vertical a minimum of eight inches (8"). Each lap of the finished membrane shall be a minimum of three inches (3"), and shall not coincide with the laps of the underlayment sheet.
- E. All Vertical seams of the new base flashing assembly shall be addressed with a 4" inch strip of the granulated modified membrane.
- E. Fasten the top edge of the flashings on six inch (6") centers using approved termination bar and fasteners. Cover termination bar with 3 course and mastic to seal leading edge of the finished membrane watertight.
- F. An NRCA-approved metal counterflashing shall extend down over the flashing a minimum of four inches (4").

3.16 PIPING/CONDUIT

- A. To support conduit or pipe sized up to Ø8" when height adjustment is needed use Model # SS1000A Adjustable Pipe Support. 17" circular base with 12 ga. framing channel, 18"L, attached to 17" circular base using ½" threaded rods, 12"L, with washers and nuts. Height of channel can be adjusted along the length of the ½" threaded rods. Strut clamps are suggested to hold piping or conduit in place.
 - 1. Manufacturers:
 - a) Advanced Support Products, Inc.
- B. To support water or gas piping up to Ø8" or when a roller support with height adjustment is needed use Model # SS1000RA Pipe Support with Adjustable Roller. 17" circular base with SBR heavy duty rubber roller assembly attached to 17" circular base using ½" threaded rods, 12"L, with washers and nuts. Height of roller assembly can be adjusted along the length of the ½" threaded rods.
 - 1. Manufacturers:
 - a) Advanced Support Products, Inc.

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- C. To support multiple pipe runs, piping up to Ø12" when height adjustment or pipe suspension is needed use Model # SS4000P, SS6000P or SS8000P Adjustable Support Bridge. SS4000P Adjustable Support Bridge is made of four (4) 17" circular bases and 12ga. framing channel formed to make one "H" shaped support with crossbar. SS6000P Adjustable support Bridge is made of six (6) 17" circular bases and 12ga. framing channel formed to make two "H" shaped supports with crossbar. SS8000P Adjustable support Bridge is made of eight (8) 17" circular bases and 12ga. framing channel formed to make three "H" shaped supports with crossbar. Crossbar height is adjustable and offered in 18", 24", 36", and 48" lengths. Use Adjustable Support Bridge with strut clamps or roller accessories or use optional hanger supports to suspend water or gas piping at various heights. Optional hanger supports attached to support frame using ½" threaded rods. Hangers offer complete height adjustments along the length of ½" threaded rods.
 - 1. Manufacturers:
 - a) Advanced Support Products, Inc.
- D. All gas lines, piping, and conduits shall be coated with industrial grade yellow paint

3.17 ROOF DRAINS

- A. All roof drains shall be in compliance with Division 22- Plumbing.
- B. All drain work, including installation of bowl and lines, shall be performed by a licensed professional master plumber.
- C. Drain installation shall comply with local plumbing codes.
- I. Inspect every drain after roofing to ensure proper seal to leader line.
- J. Verify in writing to Architect that all drains and lines are free flowing and watertight prior to substantial completion.

3.18 DRAIN FLASHINGS

- A. Build a sump to the drain and create a smooth transition by installing tapered insulation around the drain. The slope of the drain sump shall not exceed one inch (1") per horizontal foot (8%). The drain sump should be eight foot by eight foot (8' x 8') sump minimum per roof plans.
- B. All drains shall receive new lead flashings. Flashings shall be installed in strict accordance with manufacturer's recommendations and with practices as set forth in the NRCA Roofing Manual.
- C. Drain shall be covered with the roofing membrane and underlayment plies as specified, slitting the membranes over the drain hole and plies extending past the compression ring a minimum of two inches. Cut excess material away from the interior of the drain bowl.
- D. Lead flashings as specified shall be installed and primed with asphalt base primer and allowed to dry prior to application of flashing layers. Prime lead sheet on both sides and cut lead to extend into the drain bowl a minimum of one-inch.
- E. Lead flashing shall be set in plastic roof cement and covered with flashing membranes consisting of one layer of SBS modified base sheet and one layer of SBS modified granule membrane set in hot asphalt. The modified membrane layer shall be installed in a solid bed of asphalt bitumen as specified and shall extend a minimum of six inches (6") past the outer edges of the three by three foot (3' x 3') lead flashing. The modified cap sheet shall be installed in the same manner and extend a minimum of six inches (6") past the proceeding layer. Flashing membranes and lead flashing shall be neatly trimmed one inch (1") past the compression ring.

3.19 EXPANSION JOINTS

- A. Expansion material shall be formed and centered over the roof to roof structural EJ locations as shown on the drawings.
- B. Coordinate the location of the expansion joint framing with Structural, Architectural and Roof drawings.
- C. Framing of the expansion shall be in accordance with the details and as field conditions dictate.
- D. Expansion material shall be formed and located adjacent to roof to rise wall structural EJ locations as shown on the drawings.
- E. Wood Cants shall provide a four inch (4") rise above the roof's surface and extend a minimum of four inches (4") horizontally.
- F. Vertical wood framing shall be attached over horizontal wood blocking as shown and detailed.
- G. Taper the top of the expansion joint as required at tapered roof areas to maintain a minimum height of 8" above finished roof surface.
- H. Provide a field-built wood, structural expansion joint in the field of the roof where the roof span exceeds 200'-0" in any direction.

3.20 METAL FLANGE FLASHINGS

- A. Sheet metal flanges shall be four inches (4") wide and flat, without creases or bends and fully soldered.
- B. Set primed flanges in bed of plastic cement at one gallon per 100 linear foot of four inch (4") wide flange.
- C. Nail flanges three inches (3") on center and stagger.
- D. Prime metal surfaces with asphalt primer on both sides and permit to dry prior to application of modified bitumen flashing strip. Apply asphalt primer at one gallon per one hundred (100) square feet minimum.
- E. All metal flanges covered with flashing membranes consisting of one layer of Type VI fiberglass felt and one layer of the modified membrane. Each layer shall be installed in a solid bed of asphalt bitumen as specified and shall extend a minimum of six inches (6") past the outer edges.

3.21 EDGING FLASHINGS

- A. An NRCA-approved gravel stop/fascia system shall be installed in strict accordance with published instructions.

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- B. The roof membrane shall extend over the roof edge and down to base of nailer, and be fastened six inches (6") on center. A metal edge of proper gauge and dimensions shall be mechanically fastened, using a continuous clip fastened six inches (12") on center, to the wood nailer over the membrane. The metal shall have a minimum of a three inch (3") flange, set in asphalt mastic and fastened into nailer a minimum of six inches (6") on center, and a minimum of a four inch (4") fascia (match existing). The metal edge shall have a minimum of one inch (1") gravel stop, and the bottom edge of the new metal edge shall be the same elevation as existing.

3.22 SURFACING

- A. Prior to surfacing, inspect roof membrane to ensure it is in watertight condition. Roof membrane shall be free of dirt, dust, and moisture with damaged areas repaired before surfacing begins.
- B. Manufacturer's and Owner's inspections must be performed and punch list items complete before surfacing can begin. Obtain manufacturer's and Owner's written approval before applying surfacing.
- C. Flood Coat: Apply uniform mopping of Type IV hot asphalt bitumen not less than 60 pounds per 100 square feet over roof surface.
- D. Gravel:
 - 1. Do not stockpile gravel on roof for spreading.
 - 2. Embed gravel in hot bitumen uniformly applied over roof surface at 500 pounds per one hundred (100) square feet minimum with no less than 300 pounds per 100 square feet adhered.
 - 3. Gravel shall be clean and dry enough to adhere to hot bitumen flood coat when installed.
- E. Apply coating to flashings which do not have factory applied mineral surface in accordance with manufacture's recommendations.

3.23 MEMBRANE PROTECTION

- A. Walk Way Pads: Install manufacturer's walk way pads continuously on each side of each air-handling/mechanical unit on the roof in accordance with the manufacturer's recommended procedures.
- B. Where equipment pads, wood sleepers, or walkway slabs are to be installed over the roofing membrane, an additional layer of the roofing membrane shall be installed between the roofing membrane and the pad, sleeper, or slab. Due caution shall be exercised to prevent roofing membrane damage during placement. Where required, membrane shall be welded to field membrane to prevent slippage.

3.24 ROOF PLAQUE

- A. Metal plaque shall be installed on the underside of each roof hatch or on the inside of the maintenance room door. Location of plaque to be determined by Project Manager/Architect.
- B. Plaque shall be fastened with stainless steel screws to the wall surface as necessary at the base of the internal roof hatch ladder

3.25 ROOF HATCH

- A. Check roof hatch for proper operation. Adjust operating mechanism as required. Clean and lubricate joints and hardware.

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- B. Provide the required structural members necessary to install the hatch into the roof deck. Refer to structural drawings for further information.
- C. Provide crickets on the high side of hatch curb.

3.26 INSTALLATION OF EXTERIOR ROOF ACCESS LADDER

- A. Provide required structural members to properly install the roof hatch.

Examination:

- 1. Coordinate anchorages. Furnish setting drawings, templates, and anchorage structural loads for fastener resistance.
 - 2. Do not begin installation until supporting structure is complete and ladder installation will not interfere with supporting structure work.
 - 3. If supporting structure is the responsibility of another installer, notify Architect of unsatisfactory supporting work before proceeding.
- B. Installation: Install in accordance with manufacturer's instructions and in proper relationship with adjacent construction.
 - C. Protection:
 - 1. Protect installed products until completion of project.
 - 2. Touch-up, repair or replace damaged products before Substantial Completion.

3.27 TERMINATION OF NEW ROOF TO EXISTING

- A. The final juncture of the new roof shall consist of an NRCA recommended area divider suitably flashed and sealed for a permanent watertight installation. A water cutoff shall be incorporated into the termination to prevent water entering the existing roof from migrating into the new roof system.

3.28 DAILY SEAL

- A. Install temporary water cut-offs at completion of each day's work and remove upon resumption of work.
- B. Ensure that water does not flow beneath completed sections of membrane system, including completion of flashings, terminations, and daily seals. When possible, install starting at highest point of project area, working to lowest point.
- C. Temporarily seal loose membrane edge with hot asphalt. Exercise caution to ensure that membrane is sealed near drains in manner to prevent water migration below membrane and not to impede drainage.
- D. Install primary two-ply night seal beneath daily night seal in such manner to seal both new and existing roof system to roof deck to prevent moisture migration from either old roof or new roof.
- E. Install daily night seals by extending new roof membrane beyond insulation and sealing to existing deck surface using hot asphalt.
- F. When work is resumed, remove and dispose of membrane where asphalt or other sealants were previously applied before resuming installation.

3.29 FIELD QUALITY CONTROL

- A. Follow procedures required by roof system manufacturer for samples, at Owner's request.

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- B. Repair sampled areas by filling in cut out area with material to match original construction. Feather in patch consisting of same number of plies as in roof specification following manufacturer's procedures.
- C. Correct deficiencies in roof determined by roof sample analysis and as prescribed by roof system manufacturer. Costs for additional samples required will be borne by Contractor.
- D. Water Testing: Perform water flood test of completed roof areas involved or associated with work under this Contract. Contractor shall, at his expense, correct deficiencies in these areas causing water leakage into facility or water retention on roof surface.

3.30 MANUFACTURER'S FIELD SERVICES

- A. Provide manufacturer's field services as required to qualify for specified warranty.
- B. Roofing materials manufacturer's representative shall visit the site and observe the progress of the Work at a rate of not less than one time per week.
 - 1. Site visits shall be followed up by a written report of findings which is to be transmitted to the Owner's Representative within five (5) days of the site visit.

3.31 ADJUSTING

- A. Restore to original condition or replace work or materials damaged during handling of roofing materials.

3.32 CLEANING

- A. Remove bituminous markings from finished surfaces.
- B. In areas where finished surfaces are marred, or soiled by Work of this Section, consult manufacturer of soiled surface for cleaning advice and conform to their written instructions.
- C. Repair or replace defaced or disfigured finishes caused by Work of this Section.
- D. Roof surface shall be completely cleaned prior to final building move-in. All discharge water to be dealt with in accordance with local EPA requirements.

3.33 PROTECTION OF FINISHED WORK

- A. Protect finished Work under provision of application Section.
- B. Where traffic must continue over finished roof installation, protect surfaces with minimum one-half inch (1/2") wood fiberboard insulation, under five-eighth inch (5/8") thick plywood protective walkways ballasted in place with sandbags or the like.
- C. At all parapet and metal coping cap conditions, provide additional layer of self-adhered underlayment for temporary protection over all parapet and coping caps conditions once roofing has been completed and prior to installation of wood nailers and metal coping cap. Self-adhered underlayment is to cover cavity conditions from roof side of parapet framing to outside of exterior finish to protect cavity from moisture prior to completing parapet cap framing.

END OF SECTION 07 51 13

SECTION 07 62 00 - SHEET METAL AND MISCELLANEOUS ACCESSORIES

PART 1 - GENERAL

1.1 AREAS COVERED

- A. Refer to roof plans for areas to be included in the scope of work.

1.2 DEFINITIONS

ACM	Asbestos Containing Materials
ANSI	American National Standards Institute
ASCE	American Society of Civil Engineers
ASTM	American Society for Testing and Materials
CTEM	Coal-Tar Elastomeric Membrane
EPA	Environmental Protection Agency
EPS	Expanded Polystyrene
EVT	Equiviscous Temperatures
FM	Factory Mutual
IBC	International Building Code
KEE	Ketone Ethylene Ester
NDL	No Dollar Limit
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NRCA	National Roofing Contractors Association
OSHA	Occupational Safety & Health Administration
SBS	Styrene-Butadiene-Styrene
SDI	Steel Deck Institute
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SPRI	Single Ply Roofing Industry
UL	Underwriters Laboratories, Inc.

1.3 REFERENCES (INCLUDING LATEST REVISIONS)

- A. Comply with governing local, state, and federal regulations, safety standards, and codes.
- B. Testing Laboratory Services: Test results shall meet or exceed established standards.
- C. Underwriters Laboratories, Inc. (Roofing Covering): Class A fire hazard classification.
- D. American Society for Testing and Materials (ASTM)
- E. The National Roofing Contractors Association (NRCA) - Roofing and Waterproofing Manual
- F. Sheet Metal and Air Conditioning Contractors National Association (SMACNA) - Architectural Sheet Metal Manual

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G. American Society of Civil Engineers – ASCE 7

1.4 INSTALLER QUALIFICATIONS

- A. Roofing installer must be:
1. Currently prequalified with the Owner in accordance with Owner's prequalification requirements.
 2. Currently in good standing with the manufacturer.
 3. Installer must be an experienced single firm specializing in the type of roofing repair and/or removal and replacement work required, employing only experienced workers for the class of work in which they are employed, having at least five (5) years successful experience on projects similar in size and scope and acceptable as applicators by the Project Manager/Architect.
 4. Contractor must have successfully completed previous projects warranted by the manufacturer.
- B. It shall remain each Bidder's responsibility to determine his current status with the manufacturer's certification plan.

1.5 MANUFACTURER QUALIFICATIONS

- A. A qualified manufacturer is one that is UL listed and has FM approvals for a membrane roofing system similar to that used for this project for a minimum of fifteen (15) years.

1.6 CONTRACT DOCUMENT QUALITY ASSURANCE

- A. In the case of an inconsistency between the drawings and specifications or within either document not clarified by addendum, the better quality or greater quantity of work shall be provided in accordance with the Project Manager's/Architect's interpretation

1.7 SUBMITTALS

- A. Product Data: Provide technical data, installation instructions (as applicable) and general recommendations for each specified sheet material and fabricated product.
- B. Shop Drawings: Showing layout, profiles, jointing methods, fastening details, locations, and installation details.
1. Submit shop drawings, product data and mockups of all sheet metal fabrications to be used on project.
 2. Shop drawings shall be single line profile engineered drawings or CAD drawings of each fabrication component on 8-1/2" x 11" sheet and shall indicate date, project name, project number, Architect/Engineer name, name of component, sheet metal type, finish, gauge, securement, and approximate dimensions of finished product. All dimensions shall be field verified prior to fabrication.
 3. Submit manufacturers and contractor's sample warranty documents.
 4. Submit ES-1 certifications of sheet metal fabrication shop and ES-1 certifications of each applicable sheet metal component. (ie: edge metals, copings, & gutters).
- C. Samples: Submit six inch (6") long samples of shop fabricated and/or factory products illustrating component design, finish, color and configuration.

1.8 QUALITY ASSURANCE

- A. Comply with governing local, state, and federal regulations, safety standards, and codes. Provide products of acceptable manufacturers in satisfactory use in similar service for five (5) years. Use experienced installers. Deliver, handle and store materials in accordance with manufacturer's instructions.
- B. Reference Standards: Applicable portions of ASCE, SMACNA, ASTM, and NAAMM publications.

1.9 PRE-INSTALLATION CONFERENCE

- A. Convene a preinstallation conference two weeks prior to commencing the Work.
- B. Require attendance of parties directly affecting the Work of this Section.
- C. Review condition of roof deck and installation, installation procedures and coordination with related work.

1.10 WARRANTIES

- A. Manufacturer's Product Warranty: Submit manufacturer's ten (10) year labor and material warranty signed by the manufacturer's authorized official, guaranteeing to correct failures in product which may occur during the warranty period, without reducing or otherwise limiting any other rights to correction which the Owner/Project Consultant may have under the contract documents. Failure is defined to include product failure which leads to interruption of a watertight installation. Correction may include repair or replacement of failed product.
- B. Contractor's Warranty Period: For roofing flashing and sheet metal, provide a written warranty which shall warrant work to be free of leaks and defects in materials and workmanship for two (2) years, starting from date of substantial completion.
- C. Defects of the sheet metal occurring during the warranty period shall be promptly corrected by the contractor, and defects of the roofing shall be promptly corrected by the manufacturer at no additional cost to the Owner. Upon notification from the Owner or the Owner's representative that evidence of a defect exists, the responsible party shall immediately inform the Owner's representative of the date on which corrective work will be scheduled, and shall notify the Owner's representative when the corrective work has been completed.

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIAL

- A. Stainless Steel for use as pitch pans: Minimum 24-gauge, commercial quality, ASTM A 653/A 653M.
- B. Hot-dipped Galvanized Steel for use as continuous clips: Minimum 22-gauge, G-90, hot-dipped galvanized metal, commercial quality, ASTM A 653/A 653M.
- C. Prefinished Galvanized Sheet Steel (where visible from the ground): Shall be 24-gauge flat stock, prefinished with Kynar finish meeting ASTM A 446, forty-five and one-half inches to forty-eight inches width by one hundred twenty inches in length (45-1/2" - 48" x 120") for use as new metal edge gravel guard, cover plates, downspouts, gutters, coping and miscellaneous metal.

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- D. Stainless Steel: QQ-S-766, Class 304 or 316; or ASTM A 167, Type 304 or 316; form and condition most suitable for the purpose.
- E. Prefinished Aluminum: Shall be that most suitable for the purpose.
- F. All existing sheet metal shall be replaced with new metal of like gauge and type, or as specified on drawings.
- G. All prefinished metal color shall be as selected by Owner/Architect from manufacturer's full range of colors, including metallics.
- H. TPO Cladded Metal for Pitch Pans: Shall be G-90 galvanized steel with 25 mil TPO membrane.
- I. TPO Cladded Metal: Shall be G-90 galvanized steel with 25 mil TPO membrane lamination; width shall be four feet (4'), length shall be eight feet (8') or ten feet (10').
- J. PVC Cladded Metal: Shall be G-90 galvanized steel with 25 mil PVC membrane lamination; width shall be four feet (4'), length shall be eight feet (8') or ten feet (10').

2.2 FASTENERS

- A. Fasteners shall be same metal as flashing/sheet metal, or other non-corrosive metal as recommended by sheet manufacturer for the specific application. Match finish of exposed heads with material being fastened.
- B. Fasteners and fastening plates or bars shall be listed in the FM Global Approval Guide.
- C. Fastener for Brick: Shall be one-fourth inch by two inches (1/4" x 2"), zinc with plated steel or stainless steel nail, one piece unit, flat head.
- D. Screws: Self-taping sheet metal type with neoprene washer, as appropriate.
- E. Pop Rivets: Full stainless-steel Series 42 or 44, as appropriate.
- F. Continuous Clip: Concealed hold-down clip type; of same materials as coping, gravel guard, sized to suit application. Use a continuous clip, minimum 22-gauge G-90 galvanized.

2.3 RELATED MATERIAL

- A. Plastic Cement: FS SS-C-153, cutback asphalt type.
- B. Solder: QQ-S-571 composition best suited for purpose; use high tin content, minimum 60/40, for stainless steel and monel alloy.
- C. Copper, Sheet, and Strip: QQ-C-576, ASTM B 370, light cold-rolled temper, minimum 16 ounce.
- D. Sealant (for Sheet Metal): One-component polyurethane, conforming to requirements of FS TT-S-230C, non-staining and non-bleeding.

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- E. Miscellaneous Materials:
 - 1. Downspout Boots: Provide and install cast iron by Neenah Foundry Company, or pre-approved equal. Provide powder coating to match adjacent downspout color.
 - 2. Splash Blocks: Concrete, 3000 psi, 28 days. Provide and install with protection pads at all downspouts. Dimensions shall be a minimum eighteen inches wide by thirty-six inches long (18" x 36").
 - 3. Metal Accessories: Provide and install sheet metal clips, straps, anchoring devices, and similar accessory units as required for installation of work, matching or compatible with material being installed, non-corrosive, size, and gauge required for performance.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Verify roof openings, curbs, pipes, sleeves, ducts or vents through roof are solidly set, cant strips and reglets in place, substrates are smooth and clean and nailing strips located.
- B. Verify membrane termination and base flashings are in place, sealed and secure, prior to metal installation.
- C. Beginning of installation means acceptance of conditions.
- D. Compatibility: Provide materials that are recommended by manufacturers to be fully compatible with indicated substrates or provide separation materials as required to eliminate contact between incompatible materials.

3.2 PREPARATION

- A. Field measure site conditions prior to fabricating work. Provide all shop drawings and mock-ups one month prior to installation to the Owner/Project Consultant for approval.
- B. Install starter and edge strips and cleats before starting installation.

3.3 FABRICATION - GENERAL

- A. Shop-fabricate work to greatest extent possible. Comply with details shown, and with applicable requirements of SMACNA "Architectural Sheet Metal Manual" and other recognized industry practices. Fabricate for waterproof and weather-resistant performance; with expansion provisions for running work, sufficient to permanently prevent leakage, damage or deterioration of the work. Form work to fit substrates. Comply with material manufacturer's instructions and recommendations. Form exposed sheet metal work without excessive oil-canning, buckling, and tool marks, true to line and levels as indicated, with exposed edges folded back to form hems.
- B. Fabricate gravel stops/fascia, gutters/downspouts, counterflashings, expansion joints, and copings with new galvanized sheet metal as specified. Fabricate gravel guard and fascia to size and dimensions as indicated on the drawings. Fabricate light metal coping, gutters and downspouts as indicated.
- C. Fabricate pitch pans with new stainless steel as specified.
- B. Form sheet metal on bending brake.

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- C. Form materials with straight lines, sharp angles and smooth curves.
- D. Fold back edges on concealed side of exposed edge to form hem (1/4" minimum).
- E. Weld or solder joints on parts that are to be permanently and rigidly assembled.
- F. Limit single-piece lengths to ten feet (10').
- G. Fabricate corner pieces with eighteen inch (18") extensions, mitered and sealed by forming as one piece.
- H. Where installing flashing directly to masonry or dissimilar materials, backpaint with bituminous paint.
- I. Install new metal rooftop projections. New rooftop projection details shall be as recommended in NRCA or SMACNA handbooks. All rooftop projections shall be cleaned, all joints sealed, and painted with a rust inhibitive paint.
- J. All sheet metal shall be sealed and watertight.
- K. Metal work should be secured so as to prevent damage from buckling or wind. Where clips are shown, fabricate as detailed.
- L. All metal to receive bitumen or adhesive shall be first primed with asphalt primer.
- M. All prefinished metal shall be sanded and/or abraded prior to receiving primer.
- N. Separations: Provide for separation of metal from non-compatible metal or corrosive substrates by coating concealed surfaces at locations of contact, with bituminous coating or other permanent separation as recommended by manufacturer/fabricator.
- O. Bed flanges of work in a thick coat of bituminous roofing cement where required for waterproof performance.

3.4 INSTALLATION

- A. General: All sheet metal termination to vertical wall shall have a through-wall with receiver installed on masonry walls or prefabricated "Z" bar flashing pre-installed to fluid applied wall finished prior to installation of sheet metal termination. This applies to edge metal, base flashing closures and all vertical surface intersections. Refer to NRCA, SMACNA, and metal manufacturer's guidelines.
- B. Gravel Guard/Fascia:
 - 1. Shall be installed with expansion joints, ten feet (10') on center, one-fourth inch (1/4") expansion leeway, with a cover plate.
 - 2. Form sections identical to profiles as shown or approved similar, to match existing building.
 - 3. Fabricate corner pieces with minimum eighteen inch (18"), maximum forty-eight inch (48") extensions, formed and sealed with rivets and sealant, as one piece.
 - 4. Hem exposed edges one-half inch (1/2") minimum.
 - 5. Backpaint flashing in contact with masonry or dissimilar materials with bituminous paint. Surface sand before applying primers.
 - 6. Integrate flashing in a manner consistent with detailing.
 - 7. Provide and install continuous clip, minimum 22 gauge.
 - 8. Apply sealant at horizontal juncture of gravel guard metal to exterior vertical wall.

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9. Shall be fabricated in accordance with published details.
 10. Install bead of sealant at metal edge juncture at exterior wall surface.
- C. Coping:
1. Install new pre-manufactured metal coping for a permanent watertight installation.
 2. All coping shall be pre-manufactured to include low profile standing metal seam per local code requirements.
 3. Shall be minimum 24-gauge prefinished Kynar installed in ten foot (10') sections maximum.
 4. Vertical fascia shall extend minimum two and one-half inches (2-1/2") or be minimum one and one-half inches (1-1/2") below bottom of nailer, whichever is greater.
 5. Fabricate corner pieces with minimum eighteen inch (18"), maximum forty-eight inch (48") extensions, formed and sealed with rivets and sealant, as one piece.
 6. Hem exposed edges one-fourth inch (1/4") minimum.
 7. Provide and install continuous clip, minimum 22-gauge.
 8. Shall be fabricated in accordance with published details.
- D. Expansion Joint Field and at Wall:
1. Shall be as outlined by details and be in full compliance with these specifications.
 2. Lock seams and end joints.
 3. Fabricate corner pieces with minimum eighteen-inch (18"), maximum forty-eight-inch (48") extensions, formed and sealed with rivets and sealant, as one piece.
 4. Hem exposed edges one-fourth inch (1/4") minimum.
 5. Back paint flashing in contact with masonry or dissimilar materials with bituminous paint. Surface sand before applying primers.
 6. Integrate flashing in a manner consistent with detailing.
 7. Provide and install continuous clip, minimum 22-gauge or one gauge thicker than flashing.
 8. Shall be fabricated in accordance with published details.
- E. Counterflashing:
1. Provide and install new two-piece sheet metal counterflashing as required for a permanent watertight installation.
 2. Saw cut brick mortar joint to receive friction fit reglet and removable counterflashing as detailed in SMACNA 7th Edition Figure 4-4D.
- F. Scupper, Collector Head and Downspout:
1. Fabrication:
 - a) Fabricate scupper, collector head and downspout of profile and size indicated, taking care that the roof drain leader fits properly into the back of the collector head. Seal the pipe to the collector head for water tightness.
 - b) Field measure site conditions prior to fabricating work.
 - c) Fabricate with required connection pieces.
 - d) Fabricate section square, true, and accurate in size, in maximum possible lengths and free of distortion or defects detrimental to appearance or performance.
 - e) Hem exposed edges of metal.
 - f) Form and seal all metal joints; provide for expansion joints per SMACNA.
 2. Installation:
 - a) Install collector head, downspout, and accessories.
 - b) Join lengths with seams pop riveted and sealed watertight. Flash and seal collector head to downspouts and accessories.
 - c) Seal all metal joints watertight for full metal surface contact.
 - d) Collector Head: SMACNA style profile; submit detail for approval.

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- e) Downspouts: Rectangular profile. Seal all joints, six inches by six inches (6" x 6") minimum or as shown on published details.
- f) Support Brackets, Joint Fasteners: Profiled to suit gutters and downspouts.
- g) Anchorage Devices: SMACNA requirements. Type recommended by fabricator.
- h) Collector Head Supports – Kynar.
- i) Downspout Support Straps – Kynar.

G. Pitch Pans – Stainless Steel:

- 1. Install pitch pans of 24-gauge stainless steel according to NRCA standards, minimum of six inches by six inches (6" x 6").
- 2. Pitch pans shall be fabricated to minimum of four inches (4") above the finished roof membrane. Seams of pitch pans shall be soldered inside and out.
- 3. Mastic shall be applied under pitch pan flange a minimum of one-half pound (1/2#) per linear foot.
- 4. All metal flanges shall be primed with asphalt primer prior to flashing installation. Inside of pitch pan shall be cleaned and primed.
- 5. All projections enclosed in pitch pans shall be cleaned in any manner suitable and coated with a rust inhibitive coating as approved by the Owner/Project Consultant. Coating shall be allowed to dry prior to pitch pan fill.
- 6. Base of pitch pans shall be filled around penetration with M-1 sealant. Sprinkle mod bit granules over sealant 1/4" deep.
- 7. Top finish fill shall be coal-tar urethane, with minimum fill to top of pitch pan sides.
- 8. Strip metal flange of pitch pan with modified base sheet set in hot bitumen extending from the outer edge of the flange a minimum of three inches (3") inward to base of pitch pan.

H. Bonnets/Hoods:

- 1. Fabricate and install above all pitch pans, where necessary, or reinstall as applicable, metal bonnets over all pitch pans, NO EXCEPTIONS.
- 2. Bonnets/Hoods shall be manufactured with metal compatible with metal to which bonnet is to be attached.
- 3. On beams and other steel, weld in place bonnets fabricated from one-fourth inch (1/4") steel plate.
- 4. Draw band bonnets fabricated from 22-gauge galvanized steel may be used on circular projections.

3.5 FINISH

- A. Backpaint concealed metal surfaces with bituminous paint where expected to be in contact with cementitious materials or dissimilar metals. Exposed surfaces to be provided with a factory applied fluorocarbon Kynar finish meeting ASTM A 446 and AAMA specification 605.2 for high performance coating.

END OF SECTION 07 62 00

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SECTION 07 72 00 – ROOF ACCESSORIES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Roof curbs
 - 2. Equipment supports
 - 3. Wall mounted access ladders
 - 4. Roof supports

1.3 SUBMITTALS

- A. Shop Drawings: Provide manufacturer's approved details of all pertinent conditions, projection conditions, and any additional special job conditions which require details other than indicated in the drawings.
- B. Refer to Specification Section 01 33 00 for Submittal requirements
Product Data: For each type of roof accessory indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- C. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:
 - 1. Size and location of roof accessories specified in this Section.
 - 2. Method of attaching roof accessories to roof or building structure.
 - 3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.

1.4 QUALITY ASSURANCE

- A. Sheet Metal Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated.
- B. Factory Technical Representative: Roofing Contractor is to arrange and schedule the manufacturer's technical representative to be on site the first day of the installation of manufacturer's roofing system. The manufacturer's technical representative shall inspect the work of the contractor at least one time each week during the installation of the roofing system. The manufacturer's technical representative shall perform with the owner's representative and the roofing contractor a final inspection of the roofing system. At the completion of the final inspection, provide to the roofing contractor a list of punch list items (if any) to be correct before technical acceptance of the roofing project and prior to issuance of manufacturer's Twenty (20) Year Full System Warranty. Field reports shall be provided after each inspection within five (5) days of site visit.

1.5 DELIVERY, STORAGE, AND HANDLING

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- A. Pack, handle, and ship roof accessories properly labeled in heavy-duty packaging to prevent damage.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify required openings for each type of roof accessory by field measurements before fabrication and indicate measurements on Shop Drawings.

1.7 COORDINATION

- A. Coordinate layout and installation of roof accessories with (roofing membrane and base flashing and) interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.
 - 1. With Architect's approval, adjust location of roof accessories that would interrupt (roof drainage routes) (roof expansion joints).

1.8 WARRANTY

- A. The product manufacturer shall provide a one-year full system material warranty necessary to cover replacement of all components of the system against defects in manufacturing. The warranty will not include Acts of God, vandalism, neglect, metal finish or improper spacing of equipment, which would be a result of improper application.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers listed in other Part 2 articles.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers listed in other Part 2 articles.

2.2 METAL MATERIALS

- A. Galvanized Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coated.
- B. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, AZ50 (AZM150) coated.
- C. Prepainted, Metallic-Coated Steel Sheet: Steel sheet metallic coated by hot-dip process and prepainted by coil-coating process to comply with ASTM A 755/A 755M.
 - 1. Galvanized Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coated.
 - 2. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Class AZ50 (Class AZM150) coated.
 - 3. Exposed Finishes: High-Performance Organic Finish (2-Coat Fluoropolymer): Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturer's written instructions.
 - a) Fluoropolymer 2-Coat System: Manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with physical properties and coating performance requirements in (AAMA 2604) (AAMA 2605), except as modified below:
 - (1) Humidity Resistance: 1000 hours.
 - (2) Salt-Spray Resistance: 1000 hours.

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- D. Aluminum Sheet: (ASTM B 209M), alloy and temper recommended by manufacturer for type of use and mill finish.
1. Color: as selected by Architect from the manufacturer's full range of colors including premium and metallics.
 2. Baked-Enamel Finish: AA-C12C42R1x (Chemical Finish: Cleaned with inhibited chemicals; Chemical Finish: Acid-chromate-fluoride-phosphate conversion coating; Organic Coating: As specified below). Apply baked enamel complying with paint manufacturer's written instructions for cleaning, conversion coating, and painting.
 - a) Organic Coating: Thermosetting, modified-acrylic enamel primer/topcoat system complying with AAMA 2603 except with a minimum dry film thickness of 1.5 mil, medium gloss.
 - b) Color and Gloss: As selected by Project Manager from manufacturer's full range.
 3. High-Performance Organic Finish (2-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: Cleaned with inhibited chemicals; Chemical Finish: Conversion coating; Organic Coating: Manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2604 and with coating and resin manufacturer's written instructions.
 - a) Color and Gloss: As selected by Project Manager from manufacturer's full range.
 4. Powder-Coat Finish: Immediately after cleaning and pretreating, electrostatically apply manufacturer's standard baked-polymer thermosetting powder finish. Comply with resin manufacturer's written instructions for application, baking, and minimum dry film thickness.
 - a) Color and Gloss: As selected by Project Manager from manufacturer's full range.
- E. Aluminum Extrusions and Tubes: ASTM B 221 (ASTM B 221M), alloy and temper recommended by manufacturer for type of use, mill finished.
- F. Stainless-Steel Shapes or Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304 or Type 316, No. 2D finish.
- G. Steel Shapes: ASTM A 36/A 36M, hot-dip galvanized to comply with ASTM A 123/A 123M, unless otherwise indicated.
- H. Steel Tube: ASTM A 500, round tube, baked-enamel finished.
- I. Galvanized Steel Tube: ASTM A 500, round tube, hot-dip galvanized to comply with ASTM A 123/A 123M.
- J. Galvanized Steel Pipe: ASTM A 53/A 53M.

2.3 MISCELLANEOUS MATERIALS

- A. Acrylic Glazing: ASTM D 4802, thermoformable, monolithic sheet, category as standard with manufacturer, Type UVA (formulated with UV absorber), Finish 1 (smooth or polished).
- B. Polycarbonate Glazing: Thermoformable, monolithic polycarbonate sheets manufactured by extrusion process, burglar-resistance rated per UL 972 with an average impact strength of 12 to 16 ft-lbf/in. of width when tested according to ASTM D 256, Method A (Izod).
- C. Cellulosic-FiberBoard Insulation: ASTM C 208, Type II, Grade 1, one inch (1") thick.
- D. Glass-FiberBoard Insulation: ASTM C 726, one inch (1") thick.

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- E. Polyisocyanurate Board Insulation: ASTM C 1289, one inch (1") thick.
- F. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, complying with AWPA C2; not less than one and one-half inches (1-1/2") thick.
- G. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
- H. Polyethylene Sheet: 6-mil thick, polyethylene sheet complying with ASTM D 4397.
- I. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
 - 1. Slip Sheet: Rosin-sized paper, minimum 3 pounds per 100 square feet.
- J. Fasteners: Same metal as metals being fastened, or nonmagnetic stainless steel or other noncorrosive metal as recommended by roof accessory manufacturer. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners.
- K. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, or PVC; or flat design of foam rubber, sponge neoprene, or cork.
- L. Elastomeric Sealant: ASTM C 920, polyurethane sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- M. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant, polyisobutylene plasticized, and heavy bodied for hooked-type expansion joints with limited movement.
- N. Roofing Cement: ASTM D 4586, nonasbestos, fibrated asphalt cement designed for trowel application or other adhesive compatible with roofing system.

2.4 ROOF CURBS

- A. Roof Curbs: Provide metal roof curbs, internally reinforced and capable of supporting superimposed live and dead loads, including equipment loads and other construction to be supported on roof curbs. Fabricate with welded or sealed mechanical corner joints and integral formed mounting flange at perimeter bottom. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.
 - 1. Manufacturers:
 - a) ThyCurb; Div. of Thybar Corporation.
 - b) Uni-Curb, Inc.
 - c) Vent Products Company, Inc.
 - 2. Load Requirements: Insert load requirements.
 - 3. Material: Galvanized steel sheet, 0.052 inch thick.
 - 4. Material: Aluminum sheet, 0.090 inch thick.
 - 5. Material: Stainless-steel sheet, 0.078 inch thick.
 - a) Finish: Prime painted.
 - b) Finish: Mill.
 - 6. Liner: Same material as curb, of manufacturer's standard thickness and finish.
 - 7. Factory install wood nailers at tops of curbs.
 - 8. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
 - 9. Factory insulate curbs with one and one-half inch (1-1/2") glass fiberboard insulation.

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10. Curb height may be determined by adding thickness of roof insulation and minimum base flashing height recommended by roofing membrane manufacturer. Fabricate units to minimum height of fourteen inches (14"), unless otherwise indicated.
11. Sloping Roofs: Where slope of roof deck exceeds 1:48, fabricate curb units with water diverter or cricket and with height tapered to match slope to level tops of units.

2.5 WALL MOUNTED ACCESS LADDERS

- A. Fixed Ladder Design, as manufactured by O'Keefe's, Inc., or approved equal.
 1. Ladder safety devices or fall-arrest systems are required on ladders over 24 feet.
 2. Ladder safety devices or fall-arrest systems are required on all ladders in high or hazardous areas.
 3. Landing platforms are required at 50 feet above the bottom of the ladder.
 4. Rail and harness fall arrest system as alternate to landing platforms shall be a permissible manufacturer's option.
 - a) Fixed Ladder Bottom Bracket.
 - b) Bottom floor supported bracket.
 - c) Bottom wall supported bracket.
 - d) Bracket as drawn.
- B. Fixed Access Ladder
 1. Tubular Rail Low Parapet Access Ladder with Platform and Return.
 - a) Model 503, as manufactured by O'Keefe's Inc.
- C. Ship Ladder
 1. Ship Ladder with Platform.
 - a) Model 521, as manufactured by O'Keefe's Inc.
 2. Ship Ladder with Platform and Return.
 - a) Model 522, as manufactured by O'Keefe's Inc.
- D. Materials
 1. Aluminum Sheet: Alloy 5005-H34 to comply with ASTM B209.
 2. Aluminum Extrusions: Alloy 6063-T6 to comply with ASTM B221.
- E. Finishes
 1. Mill finish. As extruded.
 2. Clear Anodic Finish: AA-M10C22A41 Mechanical finish as fabricated. Architectural Class I, clear coating 0.018 mm or thicker.
 3. Paint. Urethane over chemically pretreated substrate.
 - a) Fire Red (RAL 2002).
 - b) Alert Orange (RAL 2003).
 - c) Warning Blue (RAL 5005).
 - d) Caution Yellow (RAL 1018).
 - e) Safety Green (RAL 6001).
 - f) As scheduled on drawings.
 4. Furnish touchup kit for each type and color of paint finish provided.
- F. Fabrication
 1. Rungs: Not less than 1-1/4 inches in section and 18-3/8 inches long, formed from tubular aluminum extrusions. Squared and deeply serrated on all sides.
 - a) Rungs shall withstand a 1,500 pound load without deformation or failure.
 2. Channel Side Rails: Not less than 1/8 inch wall thickness by 3 inches wide.

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3. Heavy Duty Tubular Side Rails: Assembled from two interlocking aluminum extrusions no less than 1/8 inch wall thickness by 3 inches wide. Construction shall be self-locking stainless steel fasteners, full penetration TIG welds and clean, smooth and burr-free surfaces.
4. Ship Ladders: Not less than 1-1/4 inches high, 4-1/8 inch deep and 2 feet wide; tread spacing shall be 1 foot on center. Handrails shall be aluminum pipe, not less than 1-1/2 inches in diameter with hemispheric end caps.
5. Walk-Through Rail and Roof Rail Extension: Not less than 3 feet 6 inches above the landing and shall be fitted with deeply serrated, square, tubular grab rails.
6. Landing Platform: 1-1/2 inches or greater diameter, tubular aluminum guardrails and decks of serrated aluminum treads.
7. Security Doors: Formed 1/8 inch thick aluminum sheet. Security panels shall extend on both sides, perpendicular to the door face, to within 2 inches of the wall. Security door shall be furnished with continuous aluminum piano hinge and heavy duty forged steel locking hasps.
8. Ship Ladder Seismic Bottom Support: Manufacturer's standard; two isolation bearings per stringer.
9. Ladder Safety Post: Retractable hand hold and tie off.
10. Rail and Harness Fall Arrest System: Supplied where specified as alternate to safety cage and landing platforms, in accordance with OSHA regulation 1910.28; permanently mounted to ladder rungs and complete with necessary components.

2.6 EQUIPMENT SUPPORTS

- A. To support HVAC Duct use Model # SS2000D Duct Support. SS2000D is two 17" circular bases with 12 ga. framing channel formed to make an "H" shaped support. Framing channel is adjustable in both height and width.
 1. Manufacturers:
 - a). Advanced Support Products, Inc.
- B. To support heavier HVAC equipment use equipment platform Model # HV0505B Base Platform designed by manufacturer to support the weight of the equipment and load requirements. Equipment platform shall consist of (a) 17" circular bases supporting a structural steel frame OR (b) galvanized steel plates, with four holes for approved anchoring per engineering data, supporting a structural steel frame.
 1. Manufacturers:
 - a). Advanced Support Products, Inc.

2.7 ROOF PIPE SUPPORTS

- A. To support conduit or pipe sized up to Ø8" when height adjustment is needed use Model # SS1000A Adjustable Pipe Support. 17" circular base with 12 ga. framing channel, 18"L, attached to 17" circular base using 1/2" threaded rods, 12"L, with washers and nuts. Height of channel can be adjusted along the length of the 1/2" threaded rods. Strut clamps are suggested to hold piping or conduit in place.
 1. Manufacturers:
 - a) Advanced Support Products, Inc.
- B. To support water or gas piping up to Ø8" or when a roller support with height adjustment is needed use Model # SS1000RA Pipe Support with Adjustable Roller. 17" circular base with SBR heavy duty rubber roller assembly attached to 17" circular base using 1/2" threaded rods, 12"L, with washers and nuts. Height of roller assembly can be adjusted along the length of the 1/2" threaded rods.
 1. Manufacturers:
 - a) Advanced Support Products, Inc.

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- C. To support multiple pipe runs, piping up to Ø12" when height adjustment or pipe suspension is needed use Model # SS4000P, SS6000P or SS8000P Adjustable Support Bridge. SS4000P Adjustable Support Bridge is made of four (4) 17" circular bases and 12ga. framing channel formed to make one "H" shaped support with crossbar. SS6000P Adjustable Support Bridge is made of six (6) 17" circular bases and 12ga. framing channel formed to make two "H" shaped supports with crossbar. SS8000P Adjustable Support Bridge is made of eight (8) 17" circular bases and 12ga. framing channel formed to make three "H" shaped supports with crossbar. Crossbar height is adjustable and offered in 18", 24", 36", and 48" lengths. Use Adjustable Support Bridge with strut clamps or roller accessories or use optional hanger supports to suspend water or gas piping at various heights. Optional hanger supports attached to support frame using 1/2" threaded rods. Hangers offer complete height adjustments along the length of 1/2" threaded rods.
1. Manufacturers:
 - a) Advanced Support Products, Inc.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of work.
1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored and is ready to receive roof accessories.
 2. Verify dimensions of roof openings for roof accessories.
 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install roof accessories according to manufacturer's written instructions. Anchor roof accessories securely in place and capable of resisting forces specified. Use fasteners, separators, sealants, and other miscellaneous items as required for completing roof accessory installation. Install roof accessories to resist exposure to weather without failing, rattling, leaking, and fastener disengagement.
- B. Install roof accessories to fit substrates and to result in watertight performance.
- C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
1. Coat concealed side of uncoated aluminum roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
 2. Underlayment: Where installing exposed-to-view components of roof accessories directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet, or install a course of polyethylene underlayment.
 3. Bed flanges in thick coat of asphalt roofing cement where required by roof accessory manufacturers for waterproof performance.
- D. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.

3.3 ROOF CURB INSTALLATION:

1. Set roof curb so top surface of roof curb is level.

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2. Curb height to maintain a minimum of 10" above finished roof surface,
3. Attach roof curb according to manufacturer's written instructions

3.4 PIPE AND EQUIPMENT SUPPORT INSTALLATION:

1. Install support systems in accordance with manufacturer's instructions and approved shop drawings.
2. Accurately locate and align pre-fabricated pipe supports in locations specified as per approved shop drawings or as required herein and by site conditions to limit pipe and/or conduit deflection to $L/240$, not to exceed 10' (3m) on center. No Isolation pads are required under the 17" circular bases.
3. Should the roofing manufacturer require a separation sheet between the roof and the support system, place a separation sheet or protective pad conforming to the existing roof manufacturer's system under 17" circular bases. Do not adhere to the roof system or 17" circular bases.
4. If required, insert frame structures into 17" circular bases as indicated by manufacturer's instructions.
5. Adjust height of each strut or channel and hanger or roller to its required height and tighten with nut, but do not over-tighten. Check each support for equal weight disbursement. Correct if necessary.
6. Remove any unused materials and packaging from job site. All gas lines, piping, and conduit must be supported on specified stands or hangars.
7. Supports shall be attached to pipes with oversized strapping.
8. Designated pipe/equipment supports shall be removed and replaced with new.
9. Verify that roof surface is smooth and clean to extent needed to receive materials. Surface shall be cleaned by removing any loose gravel and any foreign matter.
10. Install support systems in accordance with manufacturer's instructions and approved shop drawings. Accurately locate and align pre-fabricated pipe supports in locations specified as per approved shop drawings. Pipe supports shall be placed not to exceed ten feet (10') on center and within two feet (2") of all elevation changes, intersections, and corners.
11. Supports shall be set on a double layer of membrane, adhered to the roof surface using specified silyl-terminated polyester sealant, unless noted otherwise by support manufacturer.
12. Provide bond breaker between dissimilar metals.

3.5 INSTALLATION OF EXTERIOR ROOF ACCESS LADDER

- A. Examination:
 1. Coordinate anchorages. Furnish setting drawings, templates, and anchorage structural loads for fastener resistance.
 2. Do not begin installation until supporting structure is complete and ladder installation will not interfere with supporting structure work.
 3. If supporting structure is the responsibility of another installer, notify Architect of unsatisfactory supporting work before proceeding.
- B. Installation: Install in accordance with manufacturer's instructions and in proper relationship with adjacent construction.
- C. Protection:
 1. Protect installed products until completion of project.
 2. Touch-up, repair or replace damaged products before Substantial Completion.

3.6 TOUCH UP

- A. Touch up factory-primed surfaces with compatible primer ready for field painting in accordance with Division 9 painting Sections.

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- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

3.7 CLEANING

- A. Clean exposed surfaces according to manufacturer's written instructions.

END OF SECTION 07 72 00

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SECTION 07 72 00 – ROOF ACCESSORIES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Roof curbs
 - 2. Equipment supports
 - 3. Wall mounted access ladders
 - 4. Roof supports

1.3 SUBMITTALS

- A. Shop Drawings: Provide manufacturer's approved details of all pertinent conditions, projection conditions, and any additional special job conditions which require details other than indicated in the drawings.
- B. Refer to Specification Section 01 33 00 for Submittal requirements
Product Data: For each type of roof accessory indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- C. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:
 - 1. Size and location of roof accessories specified in this Section.
 - 2. Method of attaching roof accessories to roof or building structure.
 - 3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.

1.4 QUALITY ASSURANCE

- A. Sheet Metal Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated.
- B. Factory Technical Representative: Roofing Contractor is to arrange and schedule the manufacturer's technical representative to be on site the first day of the installation of manufacturer's roofing system. The manufacturer's technical representative shall inspect the work of the contractor at least one time each week during the installation of the roofing system. The manufacturer's technical representative shall perform with the owner's representative and the roofing contractor a final inspection of the roofing system. At the completion of the final inspection, provide to the roofing contractor a list of punch list items (if any) to be correct before technical acceptance of the roofing project and prior to issuance of manufacturer's Twenty (20) Year Full System Warranty. Field reports shall be provided after each inspection within five (5) days of site visit.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Pack, handle, and ship roof accessories properly labeled in heavy-duty packaging to prevent damage.

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1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify required openings for each type of roof accessory by field measurements before fabrication and indicate measurements on Shop Drawings.

1.7 COORDINATION

- A. Coordinate layout and installation of roof accessories with (roofing membrane and base flashing and) interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.
 - 1. With Architect's approval, adjust location of roof accessories that would interrupt (roof drainage routes) (roof expansion joints).

1.8 WARRANTY

- A. The product manufacturer shall provide a one-year full system material warranty necessary to cover replacement of all components of the system against defects in manufacturing. The warranty will not include Acts of God, vandalism, neglect, metal finish or improper spacing of equipment, which would be a result of improper application.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers listed in other Part 2 articles.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers listed in other Part 2 articles.

2.2 METAL MATERIALS

- A. Galvanized Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coated.
- B. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, AZ50 (AZM150) coated.
- C. Prepainted, Metallic-Coated Steel Sheet: Steel sheet metallic coated by hot-dip process and prepainted by coil-coating process to comply with ASTM A 755/A 755M.
 - 1. Galvanized Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coated.
 - 2. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Class AZ50 (Class AZM150) coated.
 - 3. Exposed Finishes: High-Performance Organic Finish (2-Coat Fluoropolymer): Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturer's written instructions.
 - a) Fluoropolymer 2-Coat System: Manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with physical properties and coating performance requirements in (AAMA 2604) (AAMA 2605), except as modified below:
 - (1) Humidity Resistance: 1000 hours.
 - (2) Salt-Spray Resistance: 1000 hours.
- D. Aluminum Sheet: (ASTM B 209M), alloy and temper recommended by manufacturer for type of use and mill finish.

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1. Color: as selected by Architect from the manufacturer's full range of colors including premium and metallics.
 2. Baked-Enamel Finish: AA-C12C42R1x (Chemical Finish: Cleaned with inhibited chemicals; Chemical Finish: Acid-chromate-fluoride-phosphate conversion coating; Organic Coating: As specified below). Apply baked enamel complying with paint manufacturer's written instructions for cleaning, conversion coating, and painting.
 - a) Organic Coating: Thermosetting, modified-acrylic enamel primer/topcoat system complying with AAMA 2603 except with a minimum dry film thickness of 1.5 mil, medium gloss.
 - b) Color and Gloss: As selected by Project Manager from manufacturer's full range.
 3. High-Performance Organic Finish (2-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: Cleaned with inhibited chemicals; Chemical Finish: Conversion coating; Organic Coating: Manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2604 and with coating and resin manufacturer's written instructions.
 - a) Color and Gloss: As selected by Project Manager from manufacturer's full range.
 4. Powder-Coat Finish: Immediately after cleaning and pretreating, electrostatically apply manufacturer's standard baked-polymer thermosetting powder finish. Comply with resin manufacturer's written instructions for application, baking, and minimum dry film thickness.
 - a) Color and Gloss: As selected by Project Manager from manufacturer's full range.
- E. Aluminum Extrusions and Tubes: ASTM B 221 (ASTM B 221M), alloy and temper recommended by manufacturer for type of use, mill finished.
- F. Stainless-Steel Shapes or Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304 or Type 316, No. 2D finish.
- G. Steel Shapes: ASTM A 36/A 36M, hot-dip galvanized to comply with ASTM A 123/A 123M, unless otherwise indicated.
- H. Steel Tube: ASTM A 500, round tube, baked-enamel finished.
- I. Galvanized Steel Tube: ASTM A 500, round tube, hot-dip galvanized to comply with ASTM A 123/A 123M.
- J. Galvanized Steel Pipe: ASTM A 53/A 53M.

2.3 MISCELLANEOUS MATERIALS

- A. Acrylic Glazing: ASTM D 4802, thermoformable, monolithic sheet, category as standard with manufacturer, Type UVA (formulated with UV absorber), Finish 1 (smooth or polished).
- B. Polycarbonate Glazing: Thermoformable, monolithic polycarbonate sheets manufactured by extrusion process, burglar-resistance rated per UL 972 with an average impact strength of 12 to 16 ft-lbf/in. of width when tested according to ASTM D 256, Method A (Izod).
- C. Cellulosic-FiberBoard Insulation: ASTM C 208, Type II, Grade 1, one inch (1") thick.
- D. Glass-FiberBoard Insulation: ASTM C 726, one inch (1") thick.
- E. Polyisocyanurate Board Insulation: ASTM C 1289, one inch (1") thick.
- F. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, complying with AWPA C2; not less than one and one-half inches (1-1/2") thick.

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- G. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
- H. Polyethylene Sheet: 6-mil thick, polyethylene sheet complying with ASTM D 4397.
- I. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
 - 1. Slip Sheet: Rosin-sized paper, minimum 3 pounds per 100 square feet.
- J. Fasteners: Same metal as metals being fastened, or nonmagnetic stainless steel or other noncorrosive metal as recommended by roof accessory manufacturer. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners.
- K. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, or PVC; or flat design of foam rubber, sponge neoprene, or cork.
- L. Elastomeric Sealant: ASTM C 920, polyurethane sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- M. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant, polyisobutylene plasticized, and heavy bodied for hooked-type expansion joints with limited movement.
- N. Roofing Cement: ASTM D 4586, nonasbestos, fibrated asphalt cement designed for trowel application or other adhesive compatible with roofing system.

2.4 ROOF CURBS

- A. Roof Curbs: Provide metal roof curbs, internally reinforced and capable of supporting superimposed live and dead loads, including equipment loads and other construction to be supported on roof curbs. Fabricate with welded or sealed mechanical corner joints and integral formed mounting flange at perimeter bottom. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.
 - 1. Manufacturers:
 - a) ThyCurb; Div. of Thybar Corporation.
 - b) Uni-Curb, Inc.
 - c) Vent Products Company, Inc.
 - 2. Load Requirements: Insert load requirements.
 - 3. Material: Galvanized steel sheet, 0.052 inch thick.
 - 4. Material: Aluminum sheet, 0.090 inch thick.
 - 5. Material: Stainless-steel sheet, 0.078 inch thick.
 - a) Finish: Prime painted.
 - b) Finish: Mill.
 - 6. Liner: Same material as curb, of manufacturer's standard thickness and finish.
 - 7. Factory install wood nailers at tops of curbs.
 - 8. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
 - 9. Factory insulate curbs with one and one-half inch (1-1/2") glass fiberboard insulation.
 - 10. Curb height may be determined by adding thickness of roof insulation and minimum base flashing height recommended by roofing membrane manufacturer. Fabricate units to minimum height of fourteen inches (14"), unless otherwise indicated.
 - 11. Sloping Roofs: Where slope of roof deck exceeds 1:48, fabricate curb units with water diverter or cricket and with height tapered to match slope to level tops of units.

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2.5 WALL MOUNTED ACCESS LADDERS

- A. Fixed Ladder Design, as manufactured by O'Keefe's, Inc., or approved equal.
 - 1. Ladder safety devices or fall-arrest systems are required on ladders over 24 feet.
 - 2. Ladder safety devices or fall-arrest systems are required on all ladders in high or hazardous areas.
 - 3. Landing platforms are required at 50 feet above the bottom of the ladder.
 - 4. Rail and harness fall arrest system as alternate to landing platforms shall be a permissible manufacturer's option.
 - a) Fixed Ladder Bottom Bracket.
 - b) Bottom floor supported bracket.
 - c) Bottom wall supported bracket.
 - d) Bracket as drawn.
- B. Fixed Access Ladder
 - 1. Tubular Rail Low Parapet Access Ladder with Platform and Return.
 - a) Model 503, as manufactured by O'Keefe's Inc.
- C. Ship Ladder
 - 1. Ship Ladder with Platform.
 - a) Model 521, as manufactured by O'Keefe's Inc.
 - 2. Ship Ladder with Platform and Return.
 - a) Model 522, as manufactured by O'Keefe's Inc.
- D. Materials
 - 1. Aluminum Sheet: Alloy 5005-H34 to comply with ASTM B209.
 - 2. Aluminum Extrusions: Alloy 6063-T6 to comply with ASTM B221.
- E. Finishes
 - 1. Mill finish. As extruded.
 - 2. Clear Anodic Finish: AA-M10C22A41 Mechanical finish as fabricated. Architectural Class I, clear coating 0.018 mm or thicker.
 - 3. Paint. Urethane over chemically pretreated substrate.
 - a) Fire Red (RAL 2002).
 - b) Alert Orange (RAL 2003).
 - c) Warning Blue (RAL 5005).
 - d) Caution Yellow (RAL 1018).
 - e) Safety Green (RAL 6001).
 - f) As scheduled on drawings.
 - 4. Furnish touchup kit for each type and color of paint finish provided.
- F. Fabrication
 - 1. Rungs: Not less than 1-1/4 inches in section and 18-3/8 inches long, formed from tubular aluminum extrusions. Squared and deeply serrated on all sides.
 - a) Rungs shall withstand a 1,500 pound load without deformation or failure.
 - 2. Channel Side Rails: Not less than 1/8 inch wall thickness by 3 inches wide.
 - 3. Heavy Duty Tubular Side Rails: Assembled from two interlocking aluminum extrusions no less than 1/8 inch wall thickness by 3 inches wide. Construction shall be self-locking stainless steel fasteners, full penetration TIG welds and clean, smooth and burr-free surfaces.
 - 4. Ship Ladders: Not less than 1-1/4 inches high, 4-1/8 inch deep and 2 feet wide; tread spacing shall be 1 foot on center. Handrails shall be aluminum pipe, not less than 1-1/2 inches in diameter with hemispheric end caps.
 - 5. Walk-Through Rail and Roof Rail Extension: Not less than 3 feet 6 inches above the landing and shall be fitted with deeply serrated, square, tubular grab rails.
 - 6. Landing Platform: 1-1/2 inches or greater diameter, tubular aluminum guardrails and decks of serrated aluminum treads.

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7. Security Doors: Formed 1/8 inch thick aluminum sheet. Security panels shall extend on both sides, perpendicular to the door face, to within 2 inches of the wall. Security door shall be furnished with continuous aluminum piano hinge and heavy duty forged steel locking hasps.
8. Ship Ladder Seismic Bottom Support: Manufacturer's standard; two isolation bearings per stringer.
9. Ladder Safety Post: Retractable hand hold and tie off.
10. Rail and Harness Fall Arrest System: Supplied where specified as alternate to safety cage and landing platforms, in accordance with OSHA regulation 1910.28; permanently mounted to ladder rungs and complete with necessary components.

2.6 EQUIPMENT SUPPORTS

- A. To support HVAC Duct use Model # SS2000D Duct Support. SS2000D is two 17" circular bases with 12 ga. framing channel formed to make an "H" shaped support. Framing channel is adjustable in both height and width.
 1. Manufacturers:
 - a). Advanced Support Products, Inc.
- B. To support heavier HVAC equipment use equipment platform Model # HV0505B Base Platform designed by manufacturer to support the weight of the equipment and load requirements. Equipment platform shall consist of (a) 17" circular bases supporting a structural steel frame OR (b) galvanized steel plates, with four holes for approved anchoring per engineering data, supporting a structural steel frame.
 1. Manufacturers:
 - a). Advanced Support Products, Inc.

2.7 ROOF PIPE SUPPORTS

- A. To support conduit or pipe sized up to Ø8" when height adjustment is needed use Model # SS1000A Adjustable Pipe Support. 17" circular base with 12 ga. framing channel, 18"L, attached to 17" circular base using 1/2" threaded rods, 12"L, with washers and nuts. Height of channel can be adjusted along the length of the 1/2" threaded rods. Strut clamps are suggested to hold piping or conduit in place.
 1. Manufacturers:
 - a) Advanced Support Products, Inc.
- B. To support water or gas piping up to Ø8" or when a roller support with height adjustment is needed use Model # SS1000RA Pipe Support with Adjustable Roller. 17" circular base with SBR heavy duty rubber roller assembly attached to 17" circular base using 1/2" threaded rods, 12"L, with washers and nuts. Height of roller assembly can be adjusted along the length of the 1/2" threaded rods.
 1. Manufacturers:
 - a) Advanced Support Products, Inc.
- C. To support multiple pipe runs, piping up to Ø12" when height adjustment or pipe suspension is needed use Model # SS4000P, SS6000P or SS8000P Adjustable Support Bridge. SS4000P Adjustable Support Bridge is made of four (4) 17" circular bases and 12ga. framing channel formed to make one "H" shaped support with crossbar. SS6000P Adjustable Support Bridge is made of six (6) 17" circular bases and 12ga. framing channel formed to make two "H" shaped supports with crossbar. SS8000P Adjustable Support Bridge is made of eight (8) 17" circular bases and 12ga. framing channel formed to make three "H" shaped supports with crossbar. Crossbar height is adjustable and offered in 18", 24", 36", and 48" lengths. Use Adjustable Support Bridge with strut clamps or roller accessories or use optional hanger supports to suspend water or gas piping at various heights. Optional hanger supports attached to support frame using 1/2" threaded rods. Hangers offer complete height adjustments along the length of 1/2" threaded rods.

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1. Manufacturers:
 - a) Advanced Support Products, Inc.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of work.
 1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored and is ready to receive roof accessories.
 2. Verify dimensions of roof openings for roof accessories.
 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install roof accessories according to manufacturer's written instructions. Anchor roof accessories securely in place and capable of resisting forces specified. Use fasteners, separators, sealants, and other miscellaneous items as required for completing roof accessory installation. Install roof accessories to resist exposure to weather without failing, rattling, leaking, and fastener disengagement.
- B. Install roof accessories to fit substrates and to result in watertight performance.
- C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
 1. Coat concealed side of uncoated aluminum roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
 2. Underlayment: Where installing exposed-to-view components of roof accessories directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet, or install a course of polyethylene underlayment.
 3. Bed flanges in thick coat of asphalt roofing cement where required by roof accessory manufacturers for waterproof performance.
- D. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.

3.3 ROOF CURB INSTALLATION:

1. Set roof curb so top surface of roof curb is level.
2. Curb height to maintain a minimum of 10" above finished roof surface,
3. Attach roof curb according to manufacturer's written instructions

3.4 PIPE AND EQUIPMENT SUPPORT INSTALLATION:

1. Install support systems in accordance with manufacturer's instructions and approved shop drawings.
2. Accurately locate and align pre-fabricated pipe supports in locations specified as per approved shop drawings or as required herein and by site conditions to limit pipe and/or conduit deflection to L/240, not to exceed 10' (3m) on center. No Isolation pads are required under the 17" circular bases.
3. Should the roofing manufacturer require a separation sheet between the roof and the support system, place a separation sheet or protective pad conforming to the existing roof manufacturer's system under 17" circular bases. Do not adhere to the roof system or 17" circular bases.

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4. If required, insert frame structures into 17" circular bases as indicated by manufacturer's instructions.
5. Adjust height of each strut or channel and hanger or roller to its required height and tighten with nut, but do not over-tighten. Check each support for equal weight disbursement. Correct if necessary.
6. Remove any unused materials and packaging from job site. All gas lines, piping, and conduit must be supported on specified stands or hangars.
7. Supports shall be attached to pipes with oversized strapping.
8. Designated pipe/equipment supports shall be removed and replaced with new.
9. Verify that roof surface is smooth and clean to extent needed to receive materials. Surface shall be cleaned by removing any loose gravel and any foreign matter.
10. Install support systems in accordance with manufacturer's instructions and approved shop drawings. Accurately locate and align pre-fabricated pipe supports in locations specified as per approved shop drawings. Pipe supports shall be placed not to exceed ten feet (10') on center and within two feet (2") of all elevation changes, intersections, and corners.
11. Supports shall be set on a double layer of membrane, adhered to the roof surface using specified silyl-terminated polyester sealant, unless noted otherwise by support manufacturer.
12. Provide bond breaker between dissimilar metals.

3.5 INSTALLATION OF EXTERIOR ROOF ACCESS LADDER

- A. Examination:
 1. Coordinate anchorages. Furnish setting drawings, templates, and anchorage structural loads for fastener resistance.
 2. Do not begin installation until supporting structure is complete and ladder installation will not interfere with supporting structure work.
 3. If supporting structure is the responsibility of another installer, notify Architect of unsatisfactory supporting work before proceeding.
- B. Installation: Install in accordance with manufacturer's instructions and in proper relationship with adjacent construction.
- C. Protection:
 1. Protect installed products until completion of project.
 2. Touch-up, repair or replace damaged products before Substantial Completion.

3.6 TOUCH UP

- A. Touch up factory-primed surfaces with compatible primer ready for field painting in accordance with Division 9 painting Sections.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

3.7 CLEANING

- A. Clean exposed surfaces according to manufacturer's written instructions.

END OF SECTION 07 72 00

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SECTION 078413
PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes penetration firestopping systems for openings and penetrations through smoke and fire-resistance-rated assemblies, and supplementary items necessary to complete their installation.
 - 1. Penetrations in fire-resistance-rated walls.
 - 2. Penetrations in horizontal assemblies.
 - 3. Penetrations in smoke barriers.

1.2 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
 - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
- B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency..
 - 1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

1.3 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Project Acceptance Document: Certification by the manufacturer that its product(s) are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required, and that a warranty will be issued.
- B. Field Quality Control Reports: Written report of testing and inspection required by "Field Quality Control".

1.4 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Experience: Installer's personnel with not less than 5 years of experience in the successful performance of Work similar to scope of this Project.
 - 2. Supervision: Installer shall maintain a competent supervisor at Project while the Work is in progress, and who has not less than 5 years of experience installing products and systems similar to scope of this Project.
 - 3. Manufacturer Acceptance: Installer shall be certified, approved, licensed, or acceptable to manufacturer to install products.

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- B. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

1.6 PRE-INSTALLATION CONFERENCE

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Where products and systems are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication.
- B. Environmental Limitations: Do not install firestopping systems when ambient or substrate temperatures are outside limits permitted by firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- C. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.
- B. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.
- C. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate firestopping systems.
- D. Notify Owner's inspecting agency at least seven days in advance of firestopping system installations; confirm dates and times on days preceding each series of installations.
- E. Do not cover up firestopping system installations that will become concealed behind other construction until Owner's inspecting agency and building inspector, if required by authorities having jurisdiction, have examined each installation.

PART 2 - PRODUCTS

2.1 FIRESTOPPING, GENERAL

- A. Acceptable Manufacturers: Manufacturer is "acceptable" if firestopping system has been tested and listed by UL or other testing and inspection agency acceptable to authorities having jurisdiction and manufacturer can evidence product compliance with requirements of the Contract Documents.
- B. Compatibility: Provide firestopping systems that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating firestopping systems, under conditions of service and application, as demonstrated by firestopping system manufacturer based on testing and field experience.
- C. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials and approved by the qualified testing and inspection agency for firestopping systems indicated.

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2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Comply with performance requirements specified, as determined by testing of products and systems representing those indicated for this Project, without failure due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Assemblies: Provide firestopping systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly penetrated.
- C. Fire-Test-Response Characteristics:
 - 1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Test per testing standards referenced. Provide rated systems complying with the following requirements:
 - a. Penetration firestopping systems shall bear classification marking of a qualified testing agency acceptable to authorities having jurisdiction.
 - 1) UL Fire Resistance Directory.
 - 2) Intertek Group Directory of Listed Building Products.
 - 3) FM Global Building Materials Approval Guide.

2.3 PENETRATION FIRESTOP SYSTEMS

- A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
 - 1. Classified in Underwriters Laboratories (UL) Fire Resistance Directory, Section XHEZ - Penetration Firestop System", and/or Section XHHW - Fill Void or Cavity Materials for specific project conditions.
- B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479.
 - 1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479.
 - 1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
 - 2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
 - a. Penetrations located outside wall cavities.
 - b. Penetrations located outside fire-resistive shaft enclosures.
 - c. Penetrations located in construction containing fire-protection-rated openings.
 - 3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.
- D. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479.

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1. L-Rating: Not exceeding 5.0 cfm/sq. ft. (0.025 cu. m/s per sq. m) of penetration opening at and no more than 50-cfm (0.024-cu. m/s) cumulative total for any 100 sq. ft. (9.3 sq. m) at both ambient and elevated temperatures.
- E. Penetrations in Fire-Resistance-Rated Smoke Barriers: In addition to penetration firestopping systems with L-Ratings determined per UL 1479, provide F-Ratings and T-Ratings determined per ASTM E 814 or UL 1479.
- F. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E 84.
- G. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.
 1. Permanent forming/damming/backing materials.
 2. Substrate primers.
 3. Collars.
 4. Steel sleeves.

2.4 FILL MATERIALS

- A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
- B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture
- C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.
- E. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.
- F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
- H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.
- I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.
- K. Additional Application Requirements:
 1. Firestops exposed to view and/or are scheduled to receive finishes shall be paintable or capable of receiving finish materials.

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2. Firestops exposed to traffic, moisture, and physical damage shall be products that do not deteriorate when exposed to these conditions.
 3. Firestops for water piping penetrations, of any type, shall be moisture-resistant products.
 4. Firestops for floor penetrations with annular spaces exceeding 4 in (100 mm) or more in width and exposed to possible loading and traffic shall be products capable of supporting the floor loads involved either by installing floor plates or by other means.
 5. Firestops for penetrations involving insulated piping shall be products that do not require removal of insulation.
 6. Firestops for cable trays and future penetrations shall be reusable pillows or bags.
- L. Provide firestops within fire resistive walls and partitions containing flush mounted devices such as outlet boxes, electrical cabinets and mechanical cabinets mounted back to back and spaced less than 24 inches on center in accordance with UL Fire Resistance Directory "Wall Opening Protective Materials", Category CLIV.

2.5 MIXING

- A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

3.2 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.
- B. Surface Cleaning: Before installing fire-resistive penetration systems, clean penetrations immediately to comply with fire-resistive joint system manufacturer's written instructions and the following requirements.
1. Remove foreign materials from surfaces of openings, joints and penetrating items that could interfere with adhesion of firestopping.
 2. Clean opening and joint substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with firestopping. Remove loose particles remaining from cleaning operation.
 3. Remove laitance and form release agents from concrete.
- C. Priming: Prime substrates where recommended by firestopping manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- D. Masking Tape: Use masking tape to prevent firestopping from contacting adjoining surfaces that will remain exposed upon completion of Work and that would otherwise be permanently

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stained or damaged by such contact or by cleaning methods used to remove smears from firestopping materials. Remove tape as soon as it is possible to do so without disturbing firestopping's seal with substrates.

3.3 INSTALLATION, GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
 - 1. Respective manufacturer written installation instructions.
 - 2. Accepted submittals.
 - 3. Contract Documents.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by isolating metals and other materials from direct contact with incompatible materials.

3.4 INSTALLATION OF PENETRATION FIRESTOPS

- A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.
- C. Install fill materials for penetration firestop systems by proven techniques to produce the following results:
 - 1. Completely fill voids and cavities formed by openings, forming materials, accessories, and penetrating items.
 - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 - 3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.5 IDENTIFICATION

- A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches (76 mm) high and with minimum 0.375-inch (9.5-mm) strokes.
 - 1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet (4.57 m) from end of wall and at intervals not exceeding 30 feet (9.14 m).
- B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
 - 1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 - 2. Contractor's name, address, and phone number.
 - 3. Tested System or Engineered Judgement Number.
 - 4. Date of installation.

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5. Manufacturer's name.
6. Installer's name.

3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Manufacturer's qualified technical representative shall periodically inspect Work to ensure installation is proceeding in accordance with manufacturer's designs, recommendations, instructions, and warranty requirements. Representative shall submit written reports of each visit indicating observations, findings, and conclusions of inspection.
 1. Manufacturer's Technical Representative Qualifications: Direct employee of technical services department of manufacturer with experience in providing recommendations, observations, evaluations, and problem diagnostics.
- B. Special Inspections: Owner will engage a qualified special inspector to perform special inspections and prepare reports as required by the Building Code and Authorities Having Jurisdiction according to ASTM E 2174:
 1. Installation of penetration firestopping.
 2. Testing agency will report test results promptly and in writing to Contractor and Architect.
- C. Tests and Inspections, General: Tests and inspections shall take place as installation proceeds to determine compliance with specified performance requirements.
 1. Correction of Deficiencies:
 - a. Materials and installation will be considered defective if they do not meet specified requirements.
 - b. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.
 - c. Perform additional tests and inspections, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.
 2. Prepare test and inspection reports.

3.7 CLEANING

- A. Clean off excess fill materials and sealants adjacent to openings and joints as work progresses by methods and with cleaning materials approved by manufacturers of firestopping system products and of products in which opening and joints occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

END OF SECTION

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SECTION 078446
FIRE RESISTIVE JOINT FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes firestopping systems for joints at perimeter and through smoke and fire-resistance-rated assemblies, and supplementary items necessary to complete their installation.
 - 1. Joints in or between fire-resistance-rated constructions.
 - 2. Joints at exterior curtain-wall/floor intersections.
 - 3. Joints in smoke barriers.

1.2 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
 - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
- B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.
 - 1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

1.3 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Project Acceptance Document: Certification by the manufacturer that its product(s) are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required, and that a warranty will be issued.
- B. Field Quality Control Reports: Written report of testing and inspection required by "Field Quality Control".

1.4 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Experience: Installer's personnel with not less than 5 years of experience in the successful performance of Work similar to scope of this Project.
 - 2. Supervision: Installer shall maintain a competent supervisor at Project while the Work is in progress, and who has not less than 5 years of experience installing products and systems similar to scope of this Project.
 - 3. Manufacturer Acceptance: Installer shall be certified, approved, licensed, or acceptable to manufacturer to install products.

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- B. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."
- C. Compatibility and Adhesion Testing: Manufacturer of fire stopping material shall be responsible for testing samples of materials that will contact or affect firestopping materials.
 - 1. Use manufacturer's standard test methods to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of fill materials to joint substrates.
 - 2. Perform tests under environmental conditions replicating those that will exist during installation.
 - 3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 - 4. For materials failing tests, obtain fire-resistant joint sealants manufacturer's written instructions for corrective measures, including the use of specially formulated primers.

1.6 PRE-INSTALLATION CONFERENCE

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Where products and systems are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication.
- B. Environmental Limitations: Do not install firestopping systems when ambient or substrate temperatures are outside limits permitted by firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- C. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.
- B. Coordinate construction of joints to ensure that joint firestopping systems can be installed according to specified firestopping system design.
- C. Coordinate sizing of joints to accommodate joint firestopping systems.
- D. Notify Owner's inspecting agency at least seven days in advance of firestopping system installations; confirm dates and times on days preceding each series of installations.
- E. Do not cover up firestopping system installations that will become concealed behind other construction until Owner's inspecting agency and building inspector, if required by authorities having jurisdiction, have examined each installation.

PART 2 - PRODUCTS

2.1 FIRESTOPPING, GENERAL

- A. Acceptable Manufacturers: Manufacturer is "acceptable" if firestopping system has been tested and listed by UL or other testing and inspection agency acceptable to authorities having jurisdiction and manufacturer can evidence product compliance with requirements of the Contract Documents.

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1. FM Global: Manufacturer to provide firestopping products in compliance with FM Global requirements as indicated in "Quality Assurance" Article.
- B. Compatibility: Provide firestopping systems that are compatible with one another and the substrates forming openings, under conditions of service and application, as demonstrated by firestopping system manufacturer based on testing and field experience.
- C. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials. Use only components specified by firestopping system manufacturer and approved by the qualified testing and inspecting agency for firestopping systems indicated.

2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Comply with performance requirements specified, as determined by testing of products and systems representing those indicated for this Project, without failure due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Assemblies: Provide firestopping systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly in which firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gasses.
- C. Fire-Test-Response Characteristics:
 1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
 2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Joint firestopping systems shall bear classification marking of a qualified testing agency.
 - 1) UL in its "Fire Resistance Directory.
 - 2) Intertek Group in its Directory of Listed Building Products.
 - 3) FM Global in its "Building Materials Approval Guide.

2.3 JOINT FIRESTOPPING SYSTEMS.

- A. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E 1966 or UL 2079.
 1. F-Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.
- B. Joints at Exterior Curtain-Wall/Floor Intersections: Provide joint firestopping systems with rating determined per ASTM E 2307.
 1. F-Rating: Equal to or exceeding the fire-resistance rating of the floor assembly.
- C. Joints in Smoke Barriers: Provide fire-resistive joint systems with ratings determined per UL 2079 based on testing at a positive pressure differential of 0.30-inch wg (74.7 Pa).
 1. L-Rating: Not exceeding 5.0 cfm/ft. (0.00775 cu. m/s x m) of joint at both ambient and elevated temperatures.
- D. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

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- E. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.
- F. Joints, required for control of movement, at intersection between Rated Wall Assemblies and Nonrated Horizontal Assemblies: Provide joint firestopping with ratings determined by ASTM E 2837.
- G. Perimeter Fire Containment System: Provide systems for establishment of a fire resistive barrier at the portion of perimeter exterior wall (spandrel) that is adjacent to edge of structural floor or roof slabs, which provides and maintains a resistance to the passage of fire from one floor to the floor above. Provide fire resistive rating with movement capabilities equaling or exceeding the rating of the adjacent floor or roof assembly, as determined by ASTM E 2307.
 - 1. Integrity Rating: Measure of system's ability to withstand fire exposure without permitting passage of flame through openings or occurrence of flaming on any element of the unexposed surface of the fill material or floor or on the interior surface of the wall above the fill material.
 - 2. Expansion and Contraction: Perimeter fire containment systems shall accommodate movement of the exterior wall due to thermal expansion and contraction.

2.4 TOP-OF-WALL JOINT FIRESTOPPING

- A. Safing Insulation: Semi rigid board insulation produced by combining slag-wool fibers with thermosetting resin binders and complying with the following:
 - 1. ASTM C 612, Type 1A and 1B.
 - 2. Nominal density of 4 lb/cu. ft.
 - 3. ASTM E119 Fire rating indicated, but not less than 2 hours.
- B. Coating Material: Manufacturers standard fill material or spray applied product for sealing surface of safing insulation and adjacent construction against penetration of fire and smoke.
- C. Fire Resistive Sealants: Intumescent single-component, water based, high solids, elastomeric sealants. Nonsag formulation for openings in vertical and other surfaces requiring a nonslumping, gunnable sealant.

2.5 PERIMETER FIRE CONTAINMENT SYSTEM - EDGE OF SLAB

- A. Safing Insulation: Semi rigid board insulation produced by combining slag-wool fibers with thermosetting resin binders and complying with the following:
 - 1. ASTM C 612, Type 1A and 1B.
 - 2. Nominal density of 4 lb/cu. ft.
 - 3. ASTM E119 Fire rating indicated, but not less than 2 hours.
- B. Coating Material: Manufacturers standard fill material or spray applied product for sealing surface of safing insulation and adjacent construction against penetration of fire and smoke.

2.6 PERIMETER FIRE CONTAINMENT SYSTEM - GLAZED ALUMINUM FRAMING SYSTEMS

- A. Curtainwall Insulation and Mullion Cover: Semi-rigid board insulation produced by combining slag-wool or rock-wool fibers with thermosetting resin binders, aluminum foil scrim backing, and complying with the following:
 - 1. ASTM C 612, Type 3.
 - 2. Nominal density of 8 and 4 lb/cu. ft. as required by test assembly.
 - 3. ASTM E 119 fire rating as indicated, but not less than 2 hours.

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- B. Safing Material: Semi-rigid board insulation produced by combining slag-wool fibers with thermosetting resin binders, unfaced, and complying with to the following:
 - 1. ASTM C 612, Type IA and IB.
 - 2. Nominal density of 4 lb/cu. ft.
 - 3. ASTM E 119 fire rating as indicated, but not less than 2 hours.
- C. Coating Material: Manufacturer's standard fill material or spray applied product for sealing top of safing material.
- D. Impaling Pins: 12 gage steel pins swaged to galvanized steel angles for screw attachment to glazed aluminum wall system aluminum framing.
- E. Reinforcing Angles: Galvanized steel angles of size, thickness, and finish suitable for application.
- F. Curtainwall Insulation Tape: Manufacturer's standard pressure sensitive aluminum foil faced tape product for taping curtainwall insulation joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions

3.2 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.
- B. Surface Cleaning: Before installing fire-resistive joint systems, clean joints immediately to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
 - 1. Remove foreign materials from surfaces of joints that could interfere with adhesion of firestopping.
 - 2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with firestopping. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form release agents from concrete.
- C. Priming: Prime substrates where recommended by firestopping manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- D. Masking Tape: Use masking tape to prevent firestopping from contacting adjoining surfaces that will remain exposed upon completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestopping materials. Remove tape as soon as it is possible to do so without disturbing firestopping's seal with substrates.

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3.3 INSTALLATION - GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
 - 1. Respective manufacturer written installation instructions.
 - 2. Accepted submittals.
 - 3. Contract Documents.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by isolating metals and other materials from direct contact with incompatible materials.

3.4 INSTALLATION OF FIRE-RESISTANT JOINT SEALANTS

- A. General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.
- C. Install fill materials for fire-resistive joint systems by proven techniques to produce the following results:
 - 1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
 - 2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
 - 3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.5 INSTALLATION OF FIRE SAFING PROTECTION

- A. Top of Wall: Install safing insulation to fill gap between top of wall and floor slab above. Cut safing insulation 50 percent wider than gap to be filled to ensure compression fit.

3.6 INSTALLATION OF PERIMETER FIRE CONTAINMENT SYSTEM

- A. Edge of Slab:
 - 1. Edge of Slab: Install safing insulation to fill gap between edge of structural floor/roof slab and back of exterior wall on safing clips spaced as needed to support insulation but not further apart than 24 in (600 mm) o.c. unless not required by tested system. Cut safing insulation 50 percent wider than gap to be filled to ensure compression fit or install vertically as required by tested assembly.
 - 2. Install coating material or smoke seal compound to cover fill material and seal opening.
- B. Glazed Aluminum Framing Systems:
 - 1. Install system to extend the required vertical distance above and below the structural floor/roof slab but not less than to next horizontal mullion.
 - 2. Attach impaling pins to glazed aluminum wall framing, using screws, at corners and around perimeter of glazed unit. Install curtainwall insulation material over impaling pins so that the edges are tight fitting against the aluminum frame and the face of material will be flush with the aluminum frame. Secure units with clinch shields over impaling pins.

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Locate horizontal seams in the curtainwall insulation material, 6 in (150 mm) from top of joint and provide supporting angles as required.

3. Install safing material in the joint between the interior face of aluminum frame (and face of curtainwall insulation material) and the edge of the structural floor or roof slab. Compression fit safing material 50 percent, or as required by tested assembly, into spaces between floor slab and mounting angles. Provide safing clips to support safing material if required by tested system. Install coating material or smoke seal over safing material flush with top of floor/roof slab.
4. Install mullion covers centered over horizontal and vertical aluminum frames within barrier area using the same impaling pins as used to attach the curtainwall insulation material. Secure covers with clinch shields over impaling pins.
5. Install curtainwall insulation tape to seal all meeting edges of insulation with tape centered over the junction of adjacent insulation and all meeting edges of insulation and framing members so that approximately 2 in (50 mm) of tape covers each edge of the adjacent material.

3.7 IDENTIFICATION

- A. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of joint edge so labels are visible to anyone seeking to remove or joint firestopping system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
 1. The words "Warning - Fire-Resistive Joint System - Do Not Disturb. Notify Building Management of Any Damage."
 2. Contractor's name, address, and phone number.
 3. Tested System or Engineered Judgment Number.
 4. Date of installation.
 5. Manufacturer's name.
 6. Installer's name.

3.8 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Manufacturer's qualified technical representative shall periodically inspect Work to ensure installation is proceeding in accordance with manufacturer's designs, recommendations, instructions, and warranty requirements. Representative shall submit written reports of each visit indicating observations, findings, and conclusions of inspection.
 1. Manufacturer's Technical Representative Qualifications: Direct employee of technical services department of manufacturer with experience in providing recommendations, observations, evaluations, and problem diagnostics.
- B. Special Inspections: Owner will engage a qualified special inspector to perform special inspections and prepare reports as required by the Building Code and Authorities Having Jurisdiction according to ASTM E 2393:
 1. Installation of penetration firestopping.
 2. Testing agency will report test results promptly and in writing to Contractor and Architect.
- C. Tests and Inspections, General: Tests and inspections shall take place as installation proceeds to determine compliance with specified performance requirements.
 1. Correction of Deficiencies:
 - a. Materials and installation will be considered defective if they do not meet specified requirements.

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- b. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.
- c. Perform additional tests and inspections, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.

2. Prepare test and inspection reports.

3.9 CLEANING

- A. Clean off excess fill materials and sealants adjacent to openings and joints as work progresses by methods and with cleaning materials approved by manufacturers of firestopping system products and of products in which joints occur.
- B. Provide final protection and maintain conditions during and after installation that ensure joint firestopping systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

END OF SECTION

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SECTION 079200
JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Joint sealants, backing materials, and supplementary items necessary for installation.
- B. Related Requirements:
 - 1. Refer to Division 01 Section Field Test for Air and Water Leakage.

1.2 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
 - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
- B. Samples for Verification Purposes: Samples for each kind and color of joint sealants in 1/2 in (12 mm) wide joints formed between two 6 in (150 mm) long strips of material matching appearance of exposed surfaces adjacent to joint sealants.
- C. Joint-Sealant Schedule: Include the following information:
 - 1. Joint-sealant application, joint location, and designation.
 - 2. Joint-sealant manufacturer and product name.
 - 3. Joint-sealant formulation, primers and backers.
 - 4. Joint-sealant color.

1.3 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Project Acceptance Document: Certification by the manufacturer that its product(s) are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required, and that a warranty will be issued.
- B. Preconstruction Laboratory Test Schedule: Include the following information for each joint sealant and substrate material to be tested:
 - 1. Joint-sealant location and designation.
 - 2. Manufacturer and product name.
 - 3. Type of substrate material.
 - 4. Proposed test.
 - 5. Number of samples required.
- C. Preconstruction Laboratory Test Reports: For each joint sealant and substrate material to be tested from sealant manufacturer, indicating the following:
 - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 - 2. Interpretation of test results and written recommendations for primers and substrate preparation are needed for adhesion.
- D. Preconstruction Field-Adhesion-Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.

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- E. Field Quality Control Reports: Written report of testing and inspection required by "Field Quality Control" Article.
- F. Warranties:
 - 1. Provide manufacturer's and installer's written warranty covering materials and installation (labor) stating obligations, remedies, limitations, and exclusions.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Experience: Installer's personnel with not less than 5 years of experience in the successful performance of Work similar to scope of this Project.
 - 2. Supervision: Installer shall maintain a competent supervisor at Project while the Work is in progress, and who has not less than 5 years of experience installing products and systems similar to scope of this Project.
 - 3. Manufacturer Acceptance: Installer shall be certified, approved, licensed, or acceptable to manufacturer to install products.
- B. Sealant, Waterproofing and Restoration Institute (SWRI) Validation Certificate: Each sealant shall be validated by SWRI Sealant Validation Program.
- C. Mock-Ups: Before beginning Work of this Section, install joint sealants in mock-ups of the various assemblies specified in other Sections indicated to receive joint sealants specified in this Section. Mock-ups shall include each form of product and color required to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution.

1.5 PRECONSTRUCTION TESTING

- A. Pre-Construction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint urethane and silicone sealants:
 - 1. General Requirements: Test materials forming joint substrates and joint sealant backings for compatibility and adhesion with joint sealants.
 - 2. Adhesion Testing: Use ASTM C794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
 - 3. Compatibility Testing: Use ASTM C1087 to determine sealant compatibility when in contact with glazing and gasket materials.
 - 4. Specimen Quantity: Submit manufacturer's recommended number of pieces of each type of material, including joint substrates, joint-sealant backings, and miscellaneous materials.
 - a. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 - 5. Reports: Interpret test results and certify reports indicating requirements for primers and substrate preparation needed.
 - a. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures, including use of specially formulated primer.
 - 6. Equivalent Option to Testing: Testing may not be required if joint-sealant manufacturers submit joint preparation data based on previous testing, not older than 12 months, of sealant products for adhesion to and compatibility with joint substrates and other materials matching those submitted.

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- B. Pre-Construction Stain Testing: Submit samples of joint substrate materials that will contact or affect urethane and silicone joint sealants to respective joint sealant manufacturers for following testing:
1. General Requirements: Test materials forming joint substrates for resistance to staining caused by joint sealants.
 2. Stain Testing: Use ASTM C1248 to determine stain potential of sealant when in contact with substrates, including stone and stone masonry.
 3. Specimen Quantity: Submit manufacturer's recommended number of pieces of each type of material, including joint substrates, joint-sealant backings, and miscellaneous materials.
 - a. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 4. Reports: Interpret test results and certify reports indicating whether joint sealants stain substrate materials.
 - a. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures.
 5. Equivalent Option to Testing: Testing may not be required if joint-sealant manufacturers submit joint preparation data based on previous testing, not older than 12 months, of sealant products for staining joint substrates and other materials matching those submitted.
- C. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:
1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
 2. Conduct field tests for each kind of sealant and joint substrate.
 3. Notify Architect seven days in advance of dates and times when test joints will be erected.
 4. Test Method: Test joint sealants in accordance with Method A, Tail Procedure, in ASTM C1521.
 - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
 6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.6 PRE-INSTALLATION CONFERENCE

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.
1. Participants:
 - a. Architect.
 - b. Contractor, including superintendent.
 - c. Installer, including project manager and supervisor.
 - d. Manufacturer's qualified technical representative.
 - e. Installers of other construction interfaced with Work.

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2. Minimum Agenda: Installer shall demonstrate understanding of the Work required by describing detailed procedures for preparing, installing, and cleaning the Work. Demonstration shall include, but not be limited to, following topics:
 - a. Tour representative areas of Work, inspect and discuss condition of substrate, and other preparatory work performed by other trades.
 - b. Review Contract Document requirements.
 - c. Review approved submittals.
 - d. Review inspection and testing requirements.
 - e. Review environmental conditions and procedures for coping with unfavorable conditions.
 - f. Resolve deviations or differences between Contract Documents and the manufacturer's specifications.
3. Record discussions, including decisions and agreements, and prepare report.

1.7 PROJECT CONDITIONS

- A. Ambient Conditions: Install joint sealants within range of ambient and substrate temperatures and moisture conditions as recommended by manufacturer. Protect substrates from environmental conditions that affect performance.
 1. Do not apply to a damp or wet substrate or during high humidity conditions including snow, rain, fog, or mist.
- B. Weather Conditions Limitation: Proceed with Work only when existing and forecasted weather conditions will permit installation according to manufacturer's instructions and warranty requirements.

1.8 COORDINATION

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

1.9 WARRANTY

- A. Manufacturer's Warranty for Urethane Sealants: Furnish manufacturer's written material warranty signed by an authorized representative using manufacturer's standard form agreeing to furnish materials required to repair or replace work which exhibits material defects caused by manufacture or design of product. "Defects" is defined to include but not limited to deterioration or failure to perform as required.
 1. Warranty Period: Manufacturer shall warrant the products to be free from material Defects for a period of 5 years from date of Substantial Completion.
- B. Manufacturer's Warranty for Silicone Sealants: Furnish manufacturer's written material warranty signed by an authorized representative using manufacturer's standard form agreeing to furnish materials required to repair or replace work which exhibits material defects caused by manufacture or design of product. "Defects" is defined to include but not limited to deterioration or failure to perform as required.
 1. Warranty Period: Manufacturer shall warrant the products to be free from material Defects for a period of 20 years from date of Substantial Completion.
- C. Installer's Warranty: Furnish installer's written warranty signed by an authorized representative using installer's standard form agreeing to provide labor required to repair or replace work which exhibits workmanship defects. "Defects" is defined to include but not limited to deterioration or failure to perform as required.

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1. Warranty Period: Installer shall warrant the products to be free from workmanship Defects for a period of 2 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND PRODUCTS

- A. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to Conditions of the Contract and Division 01 Section "Substitution Procedures".

2.2 MATERIALS, GENERAL

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.
- B. Suitability for Contact with Food: Comply with authorities having jurisdiction for joints in repeated contact with food.
- C. Sealant Color: As scheduled or as indicated in Design Selections.

2.3 PERFORMANCE REQUIREMENTS

- A. General Performance: Comply with performance requirements specified, as determined by testing of products and systems representing those indicated for this Project, without failure due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Material Compatibility: Joint sealants, backings, and other related materials shall be compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint sealant manufacturer based on testing and field experience.

2.4 EXTERIOR ELASTOMERIC SEALANTS

- A. Exterior Pourable Urethane Sealant:
 1. Product Quality Standard: ASTM C 920, Type M, Grade P, Class 25, Use T.
 2. Description: Multi-component, pourable, moisture curing, polyurethane sealant; rated for incline when used on sloped surfaces.
 3. Joint Movement Capability: Plus 25 percent, minus 25 percent.
 4. Primers: Product provided by sealant manufacturer if required by conditions.
 5. Manufacturers and Products:
 - a. Sika Corp.; Sikaflex SL 2.
 - b. Pecora Corp.; Urexpan NR-200.
 - c. Sika Corp., Construction Products Div.; Sikaflex 2c SL.
 - d. Tremco Commercial Sealants & Waterproofing; THC-900/THC-901 or Vulkem 445SSL.
- B. Exterior Non-sag Silicone Sealant:
 1. Product Quality Standard: ASTM C 920, Type S, Grade NS, Class 50 or 100/50.
 2. Description: Single component, non-sag, neutral cure, non-staining as determined by pre-construction stain testing, and non-bleeding, silicone sealant.
 3. Joint Movement Capability:
 - a. Class 50: Plus 50 percent, minus 50 percent.
 - b. Class 100/50: Plus 100 percent, minus 50 percent.

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4. Primers: Product provided by sealant manufacturer if required by conditions.
5. Manufacturers and Products:
 - a. Class 50:
 - 1) Dow; DOWSIL 795 Silicone Building Sealant.
 - 2) Momentive Performance Materials, GE Silicones; Silpruf SCS2000.
 - 3) Pecora Corp.; 864NST.
 - 4) Sika Corp., Construction Products Div.; Sikasil WS-295.
 - 5) Tremco Commercial Sealants & Waterproofing; Spectrem 3.
 - b. Class 100/50:
 - 1) Dow; DOWSIL 790 Silicone Building Sealant.
 - 2) Momentive Performance Materials, GE Silicones; Silpruf LM SCS2700.
 - 3) Pecora Corp.; 890NST.
 - 4) Sika Corp., Construction Products Div.; Sikasil WS-290.
 - 5) Tremco Commercial Sealants & Waterproofing; Spectrem 1.

C. Exterior Air and Water Barrier Silicone Sealant:

1. Description: One part, neutral cure silicone sealant, designed for adhering to low energy surfaces commonly found on sheet air and water barriers.
2. Manufacturers and Products:
 - a. Basis of Design: Dow Corning; Dowsil 758 Silicone Weather Barrier Sealant.

D. Exterior Non-Sag Urethane Sealant for Precast Concrete Seating Bowl:

1. ASTM C 920, Type M, Grade NS, Class 25.
2. Two-part, non-sag, polyurethane rubber sealant. Joint movement capability of +50 percent, -50 percent
3. Acceptable manufacturers and product:
 - a. BASF; MasterSeal NP 2 (Formerly Sonolastic NP 2).
 - b. Pecora Corp.; Dynatrol II.
 - c. Sika Corp., Construction Products Div.; Sikaflex 2c NS
 - d. Tremco Inc.; Dymeric 240 FC.

2.5 INTERIOR ELASTOMERIC SEALANTS

A. Interior Non-sag Silicone Sealant:

1. Product Quality Standard: ASTM C 920, Type S, Grade NS, Class 25.
2. Description: Single component, non-sag, moisture curing, silicone sealant specially formulated with fungicide for use in sanitary non-porous applications.
3. Manufacturers and Products:
 - a. Dow; DOWSIL 786 Silicone Sealant.
 - b. Momentive Performance Materials, GE Silicones; Sanitary SCS1700.
 - c. Pecora Corp.; 898.
 - d. Sika Corp., Construction Products Div.; Sikasil GP
 - e. Tremco Commercial Sealants & Waterproofing; Tremsil 200.

B. Interior Non-sag Urethane Sealant:

1. Product Quality Standard: ASTM C 920, Type S, Grade NS, Class 25 or 35.
2. Description: Single component, non-sag, moisture curing, non-staining as determined by pre-construction stain testing if exposed, polyurethane sealant.

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3. Joint Movement Capability: Plus 25 percent, minus 25 percent, or plus 35 percent, minus 35 percent.
4. Primers: Product provided by sealant manufacturer if required by conditions.
5. Manufacturers and Products:
 - a. Sika Corp.; Sikaflex NP 1.
 - b. Pecora Corp.; Dynatrol I-XL.
 - c. Sika Corp., Construction Products Div.; Sikaflex 1a or Sikaflex Textured Sealant.
 - d. Tremco Commercial Sealants & Waterproofing; Dymonic or Vulkem 116.

C. Interior Non-sag Acrylic Latex Sealant:

1. Product Quality Standard: ASTM C 834, Type and Grade as required by conditions.
2. Description: Single component, non-sag, moisture curing, general purpose, paintable, siliconized acrylic latex sealant.
3. Joint Movement Capability: Plus 7.5 percent, minus 7.5 percent
4. Manufacturers and Products:
 - a. Pecora Corp.; AC 20+.
 - b. Tremco Commercial Sealants & Waterproofing; Tremflex 834.

D. Sprayed Foam Insulating Gap Filler:

1. Description: Low pressure, one-component, expanding, open-cell latex-based insulating foam gap filler; applied with professional hand-held dispensing gun; CFC and HCFC free.
2. Performance Requirements: Class 1 Fire-Retardant per ASTM E 84.
3. Manufacturers and Products:
 - a. Convenience Products; Touch 'N Foam, Easy Fill Latex Foam Sealant.
 - b. DAP Products, Inc.; DAPtex Plus.

E. Acoustical Sealants: As specified in Division 09 Section "Gypsum Board Assemblies".

F. Fire Resistive Sealants: As specified in Division 07 Section "Fire Resistive Joint Firestopping".

2.6 HIGH TEMPERATURE SILICONE SEALANT

A. Exterior/Interior High-Temperature Silicone Sealant:

1. One-component non-slumping silicone sealant for sealing and bonding applications exposed to temperatures as high as 600 deg F (315 deg C).
2. Manufacturer and Product: Dow; DOWSIL 736 Heat Resistant Sealant.

2.7 JOINT SEALANT BACKING

A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

1. Use closed cell (Type C) sealant backing rod at formed sealant joints for typical conditions unless otherwise recommended by sealant manufacturer.
2. Use open cell (Type O) sealant backing rod at interior line of sealant for double sealed condition unless otherwise recommended by sealant manufacturer.

B. Cylindrical Sealant Backings:

1. Product Quality Standard: ASTM C 1330, Type C, Type O, Type B; as approved in writing by joint-sealant manufacturer for joint application indicated.

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2. Description: Extruded polyethylene, polyurethane, or polyolefin in either closed cell structure (Type C), open cell structure (Type O), or bicellular structure with surface skin (Type B) as defined by ASTM Terminology C 717.
3. Size: Diameter approximately 25 percent larger than joint width, unless otherwise directed by manufacturer.
4. Manufacturers and Products:

a. Type C:

- 1) Sika Corp.; MasterSeal 920.
- 2) Nomaco Inc.; Green Rod or HBR.

b. Type O:

- 1) Backer Rod Mfg. Inc.; Denver Foam.
- 2) Nomaco Inc.; Foam-Pak II.

c. Type B:

- 1) Sika Corp.; MasterSeal 921.
- 2) Nomaco Inc.; Dual-Rod or Sof-Rod.

- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials, or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.8 PREFORMED SILICONE SHEETS AND TRANSITIONS

- A. Preformed Cured Silicone Sheet and Transition Strips: Preformed silicone strip and molded pieces designed for flashing and transition applications, including closures between building envelope systems and spanning joints with large and/or dynamic movement.

1. Manufacturers and Products:

- a. Dow; DOWSIL Silicone Transition System.
- b. Momentive Performance Materials, Inc. / GE Silicones; UltraSpan.
- c. Pecora; Sil-Span.
- d. Sika Corp.; Sika Silbridge 400 Transition Sheet.
- e. Tremco Commercial Sealants and Waterproofing; Proglaze Engineered Transition Assembly.

2.9 ACCESSORIES

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Non-porous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent non-porous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Non-staining, non-absorbent material compatible with joint sealants and surfaces adjacent to joints.
- D. Weep Hole Baffles: PVC-coated, reticulated open cell polyurethane foam, 30 - 40ppi sized for installation at 30 to 50 percent compression.

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PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions: Examine substrate surfaces to receive products and systems and associated Work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting Work within a particular area will be construed as acceptance of surface conditions.

3.2 INSTALLATION, GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
1. Respective manufacturer's written installation instructions.
 2. Accepted submittals.
 3. Contract Documents.

3.3 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.
- B. Cleaning of Joints: Clean out joints immediately before installing joint backings and sealants to comply with joint sealant manufacturer's written instructions and following requirements:
1. Remove foreign material that could interfere with adhesion of joint sealant, including, but not limited to, dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air.
 3. Remove laitance and form-release agents from concrete.
 4. Clean non-porous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
 5. Substrate material allowed by sealant's ASTM C 920 Use Classification.
- C. Joint Priming: Prime joint substrates where recommended by joint sealant manufacturer, or as required by pre-construction compatibility and adhesion testing. Apply primer to comply with joint sealant manufacturer's written instructions. Confine primers to areas of joint sealant bond; do not allow spillage or migration onto adjoining surfaces.
- D. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.4 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

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- B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Joint Sealant Backings: Install type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear backings.
 - 3. Remove absorbent sealant backings that have become wet or damaged before sealant application and replace with dry materials.
 - 4. Install closed cell backer rod at exterior joints unless indicated otherwise on Drawings.
 - a. Use open cell backer rod at interior line of sealant for double sealed conditions.
 - 5. Install bond-breaker tape behind sealants where backings are not used between sealants and backs of joints.
- D. Joint Sealants: Install at same time as backings using proven techniques that comply with following:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
 - 4. Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - a. Remove excess sealant from surfaces adjacent to joints.
 - b. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - c. Use masking tape to protect surfaces adjacent to recessed tooled joints.
 - 5. Install joint sealants in accordance with ASTM C 1193 as applicable to materials, applications, conditions indicated, and with the following profile configurations:
 - a. Fillet: Figure 5.
 - b. Bridge: Figure 6.
 - c. Butt: Figure 8A (concave tooling), generally hour-glass shape with 2:1 width-to-depth ratio.
- E. Sprayed Foam Insulating Gap Filler: Apply sprayed foam insulating gap filler within exterior wall assemblies using professional hand-held dispensing gun in accordance with manufacturer's written instructions.
 - 1. Prior to installation of wall finish systems, apply sprayed foam insulating gap filler to gaps, cracks, cavities, openings, and voids in exterior wall back-up, including annular space around piping, ducts, conduits, wiring, and electrical outlets to seal off potential air drafts.
 - 2. After sprayed foam sealant is applied, make flush with face of adjacent wall by using method recommended by manufacturer.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Manufacturer's qualified technical representative shall periodically inspect Work to ensure installation is proceeding in accordance with manufacturer's designs, recommendations, instructions, and warranty requirements. Representative shall

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submit written reports of each visit indicating observations, findings, and conclusions of inspection.

1. Manufacturer's Technical Representative Qualifications: Direct employee of technical services department of manufacturer with experience in providing recommendations, observations, evaluations, and problem diagnostics.
- B. Owner Testing Agency: The Owner may employ and pay a qualified independent testing agency to perform field quality control.
 1. Refer to Division 01 Section Field Test for Air and Water Leakage.
 2. Refer to Owner's Building Enclosure Commissioning Plan for Field Observations and Performance Testing Activities.
- C. Tests and Inspections, General: Tests and inspections shall take place as installation proceeds to determine compliance with specified performance requirements.
 1. Correction of Deficiencies:
 - a. Materials and installation will be considered defective if they do not meet specified requirements.
 - b. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.
 - c. Perform additional tests and inspections, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.
 2. Prepare test and inspection reports.
- D. Contractor Field Adhesion Testing: Field test urethane and silicone sealant adhesion to joint substrates as follows:
 1. General Requirements: Before installation, field test urethane and silicone sealant adhesion to joint substrates as follows
 - a. Locate test joints where indicated or, if not indicated, as directed by Architect.
 - b. Conduct field tests for each kind of urethane and silicone sealants and joint substrates indicated.
 - c. Notify Architect 7 days in advance of dates and times when test joints will be erected.
 2. Extent of Testing: Test completed and cured sealant joints as follows:
 - a. Perform ten tests for the first 1000 feet (300 m) of joint length for each kind of sealant and joint substrate.
 - b. Perform one test for each 1000 feet (300 m) of joint length thereafter or one test per each floor per elevation.
 3. Test Methods: Joint sealant manufacturer's technical representative shall conduct following tests:
 - a. When Joint Substrates are Identical: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521:
 - 1) Install 24 in (600 mm) long test specimens using same materials, methods for joint preparation, and joint sealant installation required for Work. Allow sealants to cure fully before testing.
 - 2) Make horizontal knife cut across width of sealant joint from one substrate to other substrate.

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- 3) Make 2 vertical cuts at both sides of substrates, downward starting at horizontal cut, approximately 3 in (75 mm) long.
 - 4) Grasp 3 in (75 mm) long piece of sealant tab firmly 1 in (25 mm) from its bonded edge and pull at not less than 90 degree angle.
 - 5) Substrate adhesion is acceptable if sealant tears cohesively within itself or elongates to a manufacturer determined extension value from 1 in (25 mm) gauge length before releasing from substrate adhesively.
- b. When Joint Substrates are Different: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521:
- 1) Install 24 in (600 mm) long test specimens using same materials, methods for joint preparation, and joint sealant installation required for Work. Allow sealants to cure fully before testing.
 - 2) Make first horizontal knife cut across width of sealant joint from one substrate to other substrate.
 - 3) Make one vertical cut along one side of substrate, downward starting at horizontal cut, approximately 3 in (75 mm) long.
 - 4) Make second horizontal knife cut across width of sealant joint from one substrate to other substrate at opposite end of 3 in (75 mm) long first cut.
 - 5) Grasp 3 in (75 mm) long piece of sealant flap firmly and pull at not less than 90 degree angle.
 - 6) Substrate adhesion is acceptable if sealant tears cohesively within itself or elongates to a manufacturer determined extension value from 1 in (25 mm) gauge length before releasing from substrate adhesively.
4. Reports: Inspect tested joints and report on the following:
- a. Whether sealants filled joint cavities and are free of voids.
 - b. Whether sealant dimensions and configurations comply with specified requirements.
 - c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.
5. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
6. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

3.6 CLEANING

- A. Remove excess sealant or sealant smears adjacent to joints as Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.7 PROTECTION

- A. Protect during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage

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or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original Work.

3.8 JOINT SEALANT SCHEDULE

A. Exterior Elastomeric Sealant Applications:

1. Exterior Pourable Urethane Sealant:
 - a. Moving joints in exterior concrete walks and drives.
2. Exterior Non-sag Silicone Sealant:
 - a. Moving joints on exterior side of exterior walls.
 - b. Gaps between building materials and components created by items penetrating the primary drainage surface of the exterior building envelope.
 - c. Joints between dissimilar materials on exterior side of exterior walls.
3. Exterior Air and Water Barrier Sealant:
 - a. Exterior moving and non-moving joints sealed to weather barrier materials.
4. Exterior Non-Sag Urethane Sealant:
 - a. Moving joints at precast concrete seating bowl:

B. Interior Elastomeric Sealant Applications:

1. Interior Non-sag Silicone Sealant:
 - a. Non-moving joints in moist or damp areas which are susceptible to mildew.
 - b. Non-moving joints in toilet rooms.
 - c. Non-moving joints in kitchens.
 - d. Non-moving joints in repeated contact with food.
2. Interior Non-sag Urethane Sealant:
 - a. Building joints on interior side of exterior walls where joint movement is anticipated.
3. Interior Non-sag Acrylic Latex Sealant:
 - a. Non-moving joints where another type of sealant is not otherwise specified or scheduled.
 - b. Minimal moving joints due to temperature change.

C. Sprayed Foam Insulating Gap Filler Applications:

1. Exterior non-moving gaps around windows, glazed aluminum walls, doors, and penetrations beneath weather-resistant coverings.
2. Interior non-moving gaps around windows, glazed aluminum walls, doors, and penetrations.

D. Exterior/Interior High-Temperature Silicone Sealant:

1. High-temperature exterior or interior locations.

E. Immersible Elastomeric Sealant Applications:

1. Immersible Non-sag Urethane Sealant:
 - a. Vertical moving and non-moving joints in fountains.
2. Immersible Pourable Urethane Sealant:
 - a. Horizontal moving and non-moving joints in fountains.

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3.9 COLOR SCHEDULE

A. Joint Sealant Colors:

1. Exterior Pourable Urethane Sealant:
 - a. Color Selection:
 - b. Color Selection: As selected from Manufacturer's Standard Colors.
2. Exterior Non-Sag Silicone Sealant:
 - a. Color Selection:
 - b. Color Selection: As selected from Manufacturer's Custom Colors.
 - c. Color Selection: As selected from Manufacturer's Standard Colors.
3. Exterior Non-Sag Urethane Sealant for Precast Concrete Seating Bowl:
 - a. Color Selection:
 - b. Color Selection: As selected from Manufacturer's Custom Colors.
 - c. Color Selection: As selected from Manufacturer's Standard Colors.
4. Interior Non-Sag Silicone Sealant:
 - a. Color Selection: White.
 - b. Color Selection: Transparent.
 - c. Color Selection: As selected from Manufacturer's Standard Colors.
5. Interior Non-Sag Urethane Sealant:
 - a. Color Selection:
 - b. Color Selection: Special Custom Color as selected.
 - c. Color Selection: As selected from Manufacturer's Custom Colors.
 - d. Color Selection: As selected from Manufacturer's Standard Colors.
6. Interior Non-Sag Acrylic Latex Sealant:
 - a. Color Selection:
 - b. Color Selection: As selected from Manufacturer's Custom Colors.
 - c. Color Selection: As selected from Manufacturer's Standard Colors.
7. Immersible Non-Sag Urethane Sealant:
 - a. Color Selection:
 - b. Color Selection: As selected from Manufacturer's Standard Colors.
8. Immersible Pourable Urethane Sealant:
 - a. Color Selection:
 - b. Color Selection: As selected from Manufacturer's Standard Colors.

END OF SECTION

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SECTION 079513
EXPANSION JOINT COVER ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Expansion control assemblies and supplementary items necessary for installation.
 - 1. Floor, wall, and ceiling interior expansion joint covers.
 - 2. Floor / parking deck exterior expansion joint covers.
 - 3. Wall exterior expansion joint covers.
 - 4. Roof / membrane expansion joint covers.
- B. Related Requirements:

1.2 DEFINITIONS

- A. Minimum and Maximum Joint Widths: The extreme joint widths anticipated for an expansion joint.
- B. Nominal Joint Width for Thermal Movement: The anticipated width of an expansion joint at local mean temperature.
- C. Movement Capability: The plus or minus percentage of change relative to the nominal joint width.

1.3 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
 - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
- B. Shop Drawings: Show details of fabrication and installation. Distinguish between shop and field-assembled work.
 - 1. Include plans, elevations, sections, details, splices, block-out requirement, attachments to other work, and line diagrams showing entire route of each expansion joint.
 - a. Provide factory-fabricated closure materials and transition pieces, T-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous expansion joint cover assemblies.
 - 2. Where expansion joint cover assemblies change planes, provide isometric or clearly detailed drawing depicting how factory-fabricated transitions, terminations and other components interconnect and terminate.
- C. Samples for Verification: For each type of expansion joint cover assembly, full width by 6 inches (150 mm) long in size.
- D. Expansion Joint Cover Assembly Schedule: Prepared by or under the supervision of the supplier. Include the following information:
 - 1. Manufacturer and model number for each joint system.
 - 2. Joint system location cross-referenced to Drawings.
 - 3. Nominal joint width.
 - 4. Movement capability.
 - 5. Classification as thermal or seismic.

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6. Materials, colors, and finishes.
7. Product options.
8. Fire-resistance ratings.

1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Project Acceptance Document: Certification by the manufacturer that its product(s) are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required, and that a warranty will be issued.
- B. Field Quality Control Reports: Written report of testing and inspection required by "Field Quality Control".
- C. Warranty:
 1. Provide manufacturer's written warranty covering materials and installation (labor) stating obligations, remedies, limitations, and exclusions

1.5 QUALITY ASSURANCE

- A. Installer Qualifications:
 1. Experience: Installer's personnel with not less than 5 years of experience in the successful performance of Work similar to scope of this Project.
 2. Supervision: Installer shall maintain a competent supervisor at Project while the Work is in progress, and who has not less than 5 years of experience installing products and systems similar to scope of this Project.
 3. Manufacturer Acceptance: Installer shall be certified, approved, licensed, or acceptable to manufacturer to install products.

1.6 MOCKUPS

- A. Mock-ups: Prior to fabrication and installation, build mock-up for each form of construction and finish required to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mock-up using materials indicated for the completed Work.
 1. Build mock-up in the location and of the size indicated or, if not indicated, as directed by Architect. Contractor shall provide structural support framework.
 - a. Show typical components, attachments to building structure, and requirements of installation.
 2. Notify Architect seven days in advance of the dates and times when mock-up will be installed.
 3. Obtain Architect's acceptance of mock-ups before starting fabrication or installation.
 4. Acceptance of mock-ups does not constitute acceptance of deviations from the Contract Documents contained in mock-ups unless such deviations are specifically noted by Contractor and accepted by Architect in writing.
 5. Demolish and remove mock-ups when directed by Architect unless accepted to become part of the completed Work.

1.7 PRE-INSTALLATION CONFERENCE

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.
 1. Participants:
 - a. Architect.
 - b. Contractor, including superintendent.

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- c. Installer, including project manager and supervisor.
 - d. If requested, Manufacturer's qualified technical representative.
 - e. Installers of other construction interfaced with Work.
 - 2. Minimum Agenda: Installer shall demonstrate understanding of the Work required by describing detailed procedures for preparing, installing, and cleaning the Work. Demonstration shall include, but not be limited to, following topics:
 - a. Tour representative areas of Work, inspect and discuss condition of substrate, and other preparatory work performed by other trades.
 - b. Review Contract Document requirements.
 - c. Review approved submittals.
 - d. Review inspection and testing requirements.
 - e. Review environmental conditions and procedures for coping with unfavorable conditions.
 - f. Resolve deviations or differences between Contract Documents and the manufacturer's specifications.
 - 3. Record discussions, including decisions and agreements, and prepare report.
- 1.8 DELIVERY, STORAGE, AND HANDLING
- A. Deliver materials in manufacturer's original undamaged packages or acceptable bulk containers.
 - B. Store packaged materials to protect them from elements or physical damage.
- 1.9 PROJECT CONDITIONS
- A. Field Measurements: Where products and systems are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication.
- 1.10 COORDINATION
- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.
 - B. Coordinate installation of exterior expansion joint assemblies to ensure that transitions are watertight.
- 1.11 WARRANTY
- A. Manufacturer's Warranty for Roofing and Waterproofing Membrane Expansion Joint Systems: Furnish manufacturer's written material warranty signed by an authorized representative using manufacturer's standard form agreeing to furnish materials and labor required to repair or replace work which exhibits material defects caused by manufacture or design of product. "Defects" is defined to include but not limited to deterioration or failure to perform as required.
 - 1. Warranty Period: Manufacturer shall warrant the products to be free from material and labor defects for a period of 20 years from date of Substantial Completion.
 - a. Includes transitions and terminations of expansion joint systems.
 - B. Installer's Warranty for Roof Expansion and Waterproofing Membrane Expansion Joint Systems: Furnish installer's written workmanship warranty signed by an authorized representative using installer's standard form agreeing to provide labor required to repair or replace work which exhibits workmanship defects. "Defects" is defined to include but not limited to deterioration or failure to perform as required.

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1. Warranty Period: Installer shall warrant the installation to be free from workmanship Defects for a period of 2 years from date of Substantial Completion.
 - a. Includes transitions and terminations of expansion joint systems.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND PRODUCTS

- A. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".
- B. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other available manufacturers offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.

2.2 MATERIALS, GENERAL

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

2.3 ASSEMBLY DESCRIPTION

- A. Furnish units in longest practicable lengths to minimize field splicing.
- B. Include factory-fabricated closure materials and transition pieces, T-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous expansion joint cover assemblies.

2.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Comply with performance requirements specified, as determined by testing of products and systems representing those indicated for this Project, without failure due to defective manufacture, fabrication, installation, or other defects in construction.
 1. Exterior and Roof Joint Assemblies: Provide moisture barrier and drainage system as required to maintain continuity and watertightness of exterior building enclosure.
 2. Fire-Resistance-Rated / Smoke Barrier Joint Assemblies: Provide fire barrier as required to maintain fire-resistance rating and integrity of smoke barrier assemblies.
 3. Acoustically Rated Joint Assemblies: Provide acoustical barrier as required to maintain acoustical performance of acoustically rated partitions. Refer to Drawings for partition types and STC ratings.
- B. Structural Loads and Movement: Engineer products and systems to withstand loads and movement within limits of allowable working stresses of the materials involved under conditions indicated including, but not limited to gravity, wind sway, seismic, and thermal movements established by authorities having jurisdiction, applicable building codes, and as indicated.
 1. Expansion Joint Design Criteria: Comply with ASTM E 1399 Standard Test Method for Cyclic Movement and Measuring the Minimum and Maximum Joint Widths of Architectural Joint Systems.
 - a. Type of Movement: Thermal and Wind sway.
 - 1) Nominal Joint Width: As indicated on Drawings.
 - 2) Minimum Joint Width: As indicated on Drawings.

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- 3) Maximum Joint Width: As indicated on Drawings.
 - b. Seismic Movement:
 - 1) Joint Movement: As indicated on Drawings.
 - 2. Load Capacity: Vehicular and Pedestrian Design Load and Load Contact Area as recommended by joint manufacturer in accordance with IBC Table 1607.1.
 - C. Seismic Performance: Systems shall withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7, the building code and authorities having jurisdiction.
 - D. Fire-Resistance Ratings: Provide expansion joint cover assemblies with fire barriers identical to those of systems tested for fire resistance according to UL 2079 or ASTM E1966 by a qualified testing agency acceptable to authorities having jurisdiction.
 - 1. Fire-Resistance Rating: Provide manufacturer's standard fire barrier assembly, not less than that indicated on Drawings and adjacent construction.
 - E. Accessibility Requirements for Floor Expansion Joint Systems: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines (ADAAG)" and ICC A117.1.
- 2.5 ARCHITECTURAL JOINT SYSTEMS, GENERAL
- A. General: Provide architectural joint systems of design, basic profile, materials, and operation indicated. Provide units with capability to accommodate variations in adjacent surfaces.
 - 1. Furnish units in longest practicable lengths to minimize field splicing. Install with hairline mitered corners where joint changes direction or abuts other materials.
 - 2. Include factory-fabricated closure materials and transition pieces, tee-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous joint systems.
- 2.6 ARCHITECTURAL JOINT SYSTEMS FOR BUILDING INTERIORS
- A. Floor-to-Floor Joint Systems: Manufacturers and Products:
 - 1. Type 01:
 - a. Architectural Art Mfg., Inc.; D Series.
 - b. Balco, Inc.; NBA Series.
 - c. Construction Specialties, Inc. (C/S Group); SJ Series.
 - d. InPro Corporation JointMaster; 721 Series.
 - e. MM Systems Corporation; LASB-NB Series. (Basis of Design)
 - f. Sika Corp.; Watson Bowman Acme FNB Series.
 - 2. Type 02:
 - a. Architectural Art Mfg., Inc.; A Series.
 - b. Balco, Inc.; 6FS Series.
 - c. Construction Specialties, Inc. (C/S Group); ALS Series.
 - d. InPro Corporation JointMaster; 300 Series.
 - e. MM Systems Corporation; HFX Series. (Basis of Design)
 - f. Sika Corp.; Watson Bowman Acme SFS Series.
 - 3. Type 03:
 - a. Architectural Art Mfg., Inc.; B Series.
 - b. Balco, Inc.; 95GFTB Series.
 - c. Construction Specialties, Inc. (C/S Group); SGR Series.

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- d. InPro Corporation JointMaster; 222 Series.
 - e. MM Systems Corporation; FDT Series. (Basis of Design)
 - f. Sika Corp.; Watson Bowman Acme TSF Series.
4. Type 04:
- a. Construction Specialties, Inc. (C/S Group); GFT Series.
 - b. InPro Corporation JointMaster; 120 Series.
 - c. MM Systems Corporation; FSNE Series. (Basis of Design)
 - d. Sika Corp.; Watson Bowman Acme CWF Series.
5. Type 05:
- a. Balco, Inc.; 75FP Series.
 - b. Construction Specialties, Inc. (C/S Group); GFT Series.
 - c. InPro Corporation JointMaster; 101 Series.
 - d. MM Systems Corporation; FS Series. (Basis of Design)
 - e. Sika Corp.; Watson Bowman Acme CWF Series.
6. Type 08:
- a. MM Systems Corporation; HFP Series. (Basis of Design)
 - b. Sika Corp.; Watson Bowman Acme HDH Series.
7. Type 09:
- a. Balco, Inc.; CR Series.
 - b. Construction Specialties, Inc. (C/S Group); FYW Series.
 - c. InPro Corporation JointMaster; 516 Series.
 - d. MM Systems Corporation; HSL Series. (Basis of Design)
 - e. Sika Corp.; Watson Bowman Acme AFJ Series.
8. Type 10:
- a. Balco, Inc.; Pan Series.
 - b. Construction Specialties, Inc. (C/S Group); SSR Series.
 - c. InPro Corporation JointMaster; 501 Series.
 - d. MM Systems Corporation; PDS Series. (Basis of Design)
 - e. Sika Corp.; Watson Bowman Acme SPJ Series.
- B. Floor-to-Wall Joint (Corner) Systems: Manufacturers and Products:
1. Type 06:
- a. Balco, Inc.; 95GFVTB Series.
 - b. MM Systems Corporation; FDTE Series. (Basis of Design)
 - c. Sika Corp.; Watson Bowman Acme TSF Series.
2. Type 07:
- a. Construction Specialties, Inc. (C/S Group); GFT Series.
 - b. InPro Corporation JointMaster; 120 Series.
 - c. MM Systems Corporation; FSNE Series. (Basis of Design)
 - d. Sika Corp.; Watson Bowman Acme LPF Series.
3. Type 12:
- a. MM Systems Corporation; HSC-C Series. (Basis of Design)
 - b. Sika Corp.; Watson Bowman Acme HDH-C Series.
4. Type 13:

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- a. Construction Specialties, Inc. (C/S Group); SSRW Series.
 - b. InPro Corporation JointMaster; 501 Series.
 - c. MM Systems Corporation; PDSE Series. (Basis of Design)
 - d. Sika Corp.; Watson Bowman Acme SPJ Series.
- 5. Type 14:
 - a. Balco, Inc.; NBAL-EW Series.
 - b. MM Systems Corporation; LASBE-NBR Series. (Basis of Design)
- 6. Type 15:
 - a. Balco, Inc.; 2H6FVS Series.
 - b. InPro Corporation JointMaster; 300 Series.
 - c. MM Systems Corporation; HFXE Series. (Basis of Design)
 - d. Sika Corp.; Emseal SFS Series.
- C. Wall-to-Wall Joint Systems: Manufacturers and Products:
 - 1. Type 22:
 - a. Architectural Art Mfg., Inc.; J Series.
 - b. MM Systems Corporation; KX Series. (Basis of Design)
 - c. Sika Corp.; Emseal Wabo CorridorWrap.
 - 2. Type 23:
 - a. InPro Corporation JointMaster; 101 Series.
 - b. MM Systems Corporation; FSWP Series. (Basis of Design)
 - c. Sika Corp.; Emseal Wabo CorridorWrap.
 - 3. Type 24:
 - a. Architectural Art Mfg., Inc.; G Series.
 - b. Balco, Inc.; WD Series.
 - c. Construction Specialties, Inc. (C/S Group) ASM Series.
 - d. InPro Corporation JointMaster; 811 Series.
 - e. MM Systems Corporation; X-M Series. (Basis of Design)
 - f. Sika Corp.; Emseal Wabo FastWall.
 - 4. Type 25:
 - a. Architectural Art Mfg., Inc.; H Series.
 - b. Balco, Inc.; 6GW Series.
 - c. Construction Specialties, Inc. (C/S Group); AFW Series.
 - d. MM Systems Corporation; FX-K Series. (Basis of Design)
 - e. Sika Corp.; Emseal Wabo Contour II (CTR).
- D. Wall-to-Wall (Corner) Joint Systems: Manufacturers and Products:
 - 1. Type 21:
 - a. Architectural Art Mfg., Inc.; J Series.
 - b. InPro Corporation JointMaster; 101 Series.
 - c. MM Systems Corporation; FSWPL Series. (Basis of Design)
 - d. Sika Corp.; Emseal Wabo CorridorWrap.
 - 2. Type 28:
 - a. Architectural Art Mfg., Inc.; G Series.
 - b. Balco, Inc.; WD Series.

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- c. Construction Specialties, Inc. (C/S Group); ASM Series.
 - d. InPro Corporation JointMaster; 811 Series.
 - e. MM Systems Corporation; X-N4M Series. (Basis of Design)
 - f. Sika Corp.; Emseal Wabo FastWall.
3. Type 29:
- a. Architectural Art Mfg., Inc.; H Series.
 - b. Balco, Inc.; 6GWC Series.
 - c. Construction Specialties, Inc. (C/S Group); AFW Series.
 - d. MM Systems Corporation; FX-L Series. (Basis of Design)
 - e. Sika Corp.; Emseal Wabo Contour II (CTR).
4. Type 30:
- a. Architectural Art Mfg., Inc.; R Series.
 - b. InPro Corporation JointMaster; 114 Series.
 - c. MM Systems Corporation; VSWL Series. (Basis of Design)
 - d. Sika Corp.; Watson Bowman Acme CWW Series.
- E. Ceiling-to-Wall (Corner) Joint Systems: Manufacturers and Products:
1. Type 26:
- a. Architectural Art Mfg., Inc.; R Series.
 - b. InPro Corporation JointMaster; 114 Series.
 - c. MM Systems Corporation; VSGL Series. (Basis of Design)
 - d. Sika Corp.; Watson Bowman Acme FSC Series.
 - e. Sika Corp.; Emseal Wabo CorridorWrap (CWCA).
2. Type 27:
- a. Architectural Art Mfg., Inc.; J Series.
 - b. InPro Corporation JointMaster; 101 Series.
 - c. MM Systems Corporation; FSWPL Series. (Basis of Design)
 - d. Sika Corp.; Emseal Wabo CorridorWrap.
3. Type 32:
- a. Architectural Art Mfg., Inc.; G Series.
 - b. Balco, Inc.; WD Series.
 - c. Construction Specialties, Inc. (C/S Group); ASM Series.
 - d. InPro Corporation JointMaster; 811 Series.
 - e. MM Systems Corporation; X-N4M Series. (Basis of Design)
 - f. Sika Corp.; Emseal Wabo FastWall (EWH).
4. Type 33:
- a. Architectural Art Mfg., Inc.; H Series.
 - b. Balco, Inc.; 6GWC Series.
 - c. Construction Specialties, Inc. (C/S Group); AFW Series.
 - d. MM Systems Corporation; FX-L Series. (Basis of Design)
 - e. Sika Corp.; Emseal Wabo Contour II (CTR).
5. Type 34:
- a. Construction Specialties, Inc. (C/S Group); HCW Series.
 - b. InPro Corporation JointMaster; 821 Series.
 - c. MM Systems Corporation; DX Series. (Basis of Design)
 - d. Sika Corp.; Emseal Wabo CorridorWrap (CWCA).

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- 6. Type 35:
 - a. Architectural Art Mfg., Inc.; J Series.
 - b. Balco, Inc.; ACL Series.
 - c. Construction Specialties, Inc. (C/S Group); FCSC Series.
 - d. MM Systems Corporation; CX Series for 1 inch and 2 inch joints; VSG Series for joints 2 inches through 5 inches. (Basis of Design)
 - e. Sika Corp.; Emseal Wabo CorridorWrap (CWCA).

F. Ceiling-to-Ceiling Joint Systems: Manufacturers and Products:

- 1. Type 31:
 - a. Architectural Art Mfg., Inc.; J Series.
 - b. InPro Corporation JointMaster; 101 Series.
 - c. MM Systems Corporation; FSWP Series. (Basis of Design)
- 2. Type 36:
 - a. Architectural Art Mfg., Inc.; G Series.
 - b. Balco, Inc.; WD Series.
 - c. Construction Specialties, Inc. (C/S Group); ASM Series.
 - d. InPro Corporation JointMaster; 811 Series.
 - e. MM Systems Corporation; X-M Series. (Basis of Design)
- 3. Type 37:
 - a. Architectural Art Mfg., Inc.; H Series.
 - b. Balco, Inc.; 6GW Series.
 - c. Construction Specialties, Inc. (C/S Group); AFW Series.
 - d. MM Systems Corporation; FX-K Series. (Basis of Design)
- 4. Type 38:
 - a. Construction Specialties, Inc. (C/S Group); HC Series.
 - b. InPro Corporation JointMaster; 821 Series.
 - c. MM Systems Corporation; DX Series. (Basis of Design)
 - d. Sika Corp.; Watson Bowman Acme CES Series.
- 5. Type 39:
 - a. Architectural Art Mfg., Inc.; J Series.
 - b. Balco, Inc.; AC Series.
 - c. Construction Specialties, Inc. (C/S Group); FCS Series.
 - d. MM Systems Corporation; CX Series. (Basis if Design)
 - e. Sika Corp.; Watson Bowman Acme CEB Series.
- 6. Type 40:
 - a. Architectural Art Mfg., Inc.; J Series.
 - b. MM Systems Corporation; KX Series. (Basis of Design)

2.7 FLOOR / PARKING DECK EXTERIOR EXPANSION JOINT COVERS

- A. Exterior Elastomeric-Seal Floor / Parking Deck Joint Cover (Winged Seal): Assembly consisting of elastomeric seal anchored to surface-mounted frames fixed to sides of joint gap.
 - 1. Basis-of-Design Product: Balco; a CSW Industrials Company; RB Series Rubber Block Seal.
 - 2. Manufacturers and Products:

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- a. Architectural Art Mfg., Inc.; W Series.
 - b. Balco; a CSW Industrials Company; RB Series Rubber Block Seal.
 - c. InPro Corporation; CR Series.
 - d. Sika Corp.; Watson Bowman Acme ME GEN II Series.
3. Application: As indicated on Drawings.
4. Color: As selected by Architect from manufacturer's standards.
- B. Exterior Preformed Foam Floor / Parking Deck Joint Seals: Manufacturer's standard joint seal consisting of pre-compressed hydrophobic foam backer seal impregnated with a nondrying, water-repellent agent, and factory pre-coated silicone cover to fit joint widths based on design criteria indicated, with factory- or field-applied adhesive for bonding to substrates.
 1. Basis-of-Design Product: Sika EMSEAL; DSM or Emshield DFR Series System Watertight Expansion Joint.
 2. Manufacturers and Products:
 - a. Construction Specialties, Inc. (C/S Group); HF or HFR Series.
 - b. InPro Corporation; 1175 Series Foam Seal.
 - c. Sika EMSEAL; DSM or Emshield DFR Series System Watertight Expansion Joint.
 - d. Sika Corp.; Watson Bowman Acme Wabo FireShield FSH Horizontal Series.
 3. Application: As indicated on Drawings.
 4. Color: As selected by Architect from manufacturer's standards.
- C. Exterior Preformed Foam Floor with Interior Metal Cover Plate: Manufacturer's standard joint seal consisting of pre-compressed hydrophobic foam backer seal impregnated with a nondrying, water-repellent agent, and factory pre-coated silicone cover to fit joint widths based on design criteria indicated, with factory- or field-applied adhesive for bonding to substrates.
 1. Basis-of-Design Product: Sika Corp.; Emseal Emshield SJS-FR with Coverplate.
 2. Manufacturers and Products:
 - a. Sika Corp.; Emseal Emshield SJS-FR with Coverplate.
 3. Application: As indicated on Drawings.
 4. Color: As selected by Architect from manufacturer's standards.
- D. Exterior Metal-Plate Floor / Parking Deck Joint Cover: Assembly consisting of sliding metal cover plate in continuous contact with gaskets mounted on metal frames fixed to sides of joint gap.
 1. Basis-of-Design Product: Balco; a CSW Industrials Company; SBNB Series Shallow Blockout No Bump.
 2. Manufacturers and Products:
 - a. Balco; a CSW Industrials Company; SBNB Series Shallow Blockout No Bump.
 - b. MM Systems Corporation; SSS Series.
 - c. Sika Corp.; Watson Bowman Acme APx Series.
 3. Application: As indicated on Drawings.
 4. Exposed Metal and/or Color: As selected by Architect from manufacturer's standards.
 5. Cover-Plate Design: As selected by Architect from manufacturer's standards.
- E. Exterior Seismic-Pan Floor Joint Cover: Seismic pan assembly with sloped sides allowing extension of unit above floor plane during joint contraction and equipped with springs to return unit back into alignment during joint expansion. Provide manufacturer's recommended sealant at pan edge with an integral gutter system.
 1. Basis-of-Design Product: Balco; a CSW Industrials Company; PJC Series Pan System.

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2. Manufacturers and Products:
 - a. Balco; a CSW Industrials Company; PJC Series Pan System.
 - b. Sika Corp.; Emseal Wabo SPJ Series.
3. Application: As indicated on Drawings.
4. Exposed Metal and/or Color: As selected by Architect from manufacturer's standards.
5. Cover-Plate Design: As selected by Architect from manufacturer's standards.

2.8 WALL EXTERIOR EXPANSION JOINT COVERS

- A. Exterior Elastomeric-Seal Wall Joint Cover: Assembly consisting of continuous elastomeric primary seal and backup seal anchored to frames, fixed to sides of joint gap.
 1. Basis-of-Design: Balco; a CSW Industrials Company; FCVS Series Elastomeric Face Seal Systems.
 2. Manufacturers and Products:
 - a. Balco; a CSW Industrials Company; FCVS Series Elastomeric Face Seal Systems.
 - b. Construction Specialties, Inc. (C/S Group); SC Series.
 - c. InPro Corporation; 615 or 616 Series.
 - d. MM Systems Corporation; VSS Series.
 - e. Sika Corp.; Watson Bowman Acme WeatherSeam Exterior WSW Series.
 3. Application: As indicated on Drawings.
 4. Exposed Metal and/or Color: As selected by Architect from manufacturer's standards.
- B. Exterior Preformed Foam Wall Joint Seals: Manufacturer's standard joint seal consisting of pre-compressed hydrophobic foam backer seal impregnated with a nondrying, water-repellent agent and factory pre-coated silicone cover to fit joint widths based on design criteria indicated, with factory- or field-applied adhesive for bonding to substrates.
 1. Basis-of-Design Product: Sika EMSEAL; Seismic Colorseal Series. Watertight Expansion Joint.
 2. Manufacturers and Products:
 - a. Construction Specialties, Inc. (C/S Group); VF Series.
 - b. InPro Corporation; 1200 Series Foam Seal.
 - c. Sika EMSEAL; Seismic Colorseal Series. Watertight Expansion Joint.
 3. Application: As indicated on Drawings.
 4. Color: As selected by Architect from manufacturer's standards.

2.9 ROOF / MEMBRANE EXTERIOR EXPANSION JOINT COVERS

- A. Membrane Roof / Vegetative Roof Expansion Assemblies: Assembly consisting of a dual-seal, double-flanged, extruded thermoplastic rubber member with provisions for anchoring and sealing to roofing/waterproofing membrane.
 1. Basis-of-Design Product: Sika Corp.; EMSEAL RoofJoint Series.
 - a. Flange Members: Nitrile; as required for roofing membrane.
 2. Application: As indicated on Drawings.
 3. Color: As selected by Architect from manufacturer's standards.
- B. Split Slab Membrane Plaza Deck / Parking Deck Expansion Assemblies: Assembly consisting of a flanged, extruded thermoplastic rubber member anchored to frames with provisions for anchoring and sealing to roofing/waterproofing membrane.
 1. Basis-of-Design Product: Sika Corp.; EMSEAL Migutan-FP Series.

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- a. Flange Members: PVC thermoplastic alloy or TPV (thermoplastic vulcanizate); as required for roofing membrane.
 2. Manufacturers and Products:
 - a. Construction Specialties, Inc. (C/S Group); PDA Series.
 - b. Sika EMSEAL; Migutan-FP Series.
 3. Application: As indicated on Drawings.
 4. Exposed Metal and/or Color: As selected by Architect from manufacturer's standards.
- C. Metal-Plate Roof / Seismic Joint Cover: Assembly consisting of sliding metal cover plate in continuous contact with gaskets mounted on metal frames fixed to sides of joint gap.
1. Basis-of-Design Product: Balco; a CSW Industrials Company; FR / FRE-Straight Curb Series or LPR / LPRE - Canted Curb Series.
 - a. Extruded-Aluminum Covers:
 - 1) Covers less than 15 in (375 mm) Wide: Minimum 0.080 in (2 mm) thick.
 - 2) Covers 15 in (375 mm) and Wider: Minimum 0.125 in (3 mm) thick.
 2. Manufacturers and Products:
 - a. Architectural Art Mfg., Inc.; L Series Roof Expansion Covers.
 - b. Balco; a CSW Industrials Company; FR / FRE-Straight Curb Series or LPR / LPRE - Canted Curb Series.
 - c. Construction Specialties, Inc. (C/S Group); Models SRJ and SRJW.
 - d. MM Systems Corporation; Styles RXH / RXJ.
 - e. Sika Corp.; Watson Bowman Acme Models RFC / RFC-C or RFL / RFL-C.
 3. Application: As indicated on Drawings.
 4. Exposed Metal and/or Color: As selected by Architect from manufacturer's standards.
- 2.10 FLEXIBLE GUTTER AND DRAIN TUBE SYSTEM
- A. Description: Manufacturer standard secondary moisture control and collection system consisting of flexible, reinforced neoprene gutter profile that satisfies the required design movement and compresses without damage during full joint closure. Gutter profile shall contain and drain excess amounts of collected moisture through a drain tube that exhibits similar flexibility. System secures to underside of concrete slab substrate by utilizing anchored retainer profile.
1. Basis of Design: Sika Corp.; Watson Bowman Acme WaboGutterFlex, Model USG; total joint opening sizes as required to meet specific joint movement criteria.
 2. Gutter Profile Materials: 0.062 in (1.5 mm) thick single ply fabric reinforced neoprene sheet. Width of profile shall be governed by joint type and movement requirements.
 3. Drain Tube: 1-1/2 in (38 mm) inside diameter by 1/8 in (3 mm) thick wall clear PVC flexible tubing. Length shall be as required for final connection.
 4. Transition Element: Premolded 0.060 in (1.5 mm) thick EPDM tapered profile with pre-taped flange and adhesive for proper bonding to underside of gutter profile.
 5. Retainer Profile: 3/16 in (5 mm) thick aluminum 5052-H32 alloy, mill finish, preformed to receive a continuous bead of edge sealant and pre-drilled for anchors at 16 in (400 mm) on center.
 6. Edge Sealant: Manufacturer recommended one-part polyurethane moisture cure sealant.
 7. Anchors: Manufacturer's standard 1/4 in (6 mm) diameter by 1-3/4 in (44 mm) long countersunk flathead concrete screw anchor. Carbon steel anchor shall receive factory fluoropolymer coating.

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- B. Locations: Exterior floor, roof, plaza deck and parking deck joint cover assemblies.

2.11 MATERIALS

- A. Aluminum: **ASTM B221** (**ASTM B221M**), Alloy 6063-T5 for extrusions; **ASTM B209** (**ASTM B209M**), Alloy 6061-T6 for sheet and plate.
1. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious materials.
- B. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304 for plates, sheet, and strips.
- C. Elastomeric Seals: Manufacturer's standard preformed elastomeric membranes or extrusions to be installed in metal frames.
- D. Fire Barriers: Any material or material combination, when fire tested after cycling, designated to resist the passage of flame and hot gases through a movement joint and to comply with performance criteria for required fire-resistance rating.
- E. Moisture Barrier: Manufacturer's standard, flexible elastomeric material.

2.12 ALUMINUM FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish designations prefixed by "AA" conform to the system established by the Aluminum Association for designating aluminum finishes.
- D. Mill Finish for Floor Covers: AA-M10 (Mechanical Finish: as fabricated; no other applied finish unless buffing is required to removed scratches, welding, or grinding produced in fabrication process).
- E. Clear Anodic Finish for Wall and Ceiling Covers: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

2.13 STAINLESS STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
1. Run grain of directional finishes with long dimension of each piece.
 2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 3. Directional Satin Finish: No. 4.
- C. Bright, Cold-Rolled, Unpolished Finish: No. 2B.

2.14 ACCESSORIES

- A. Moisture Barriers: Manufacturer's standard continuous, waterproof membrane within joint and attached to substrate on sides of joint.
1. Provide at exterior joint assemblies and where indicated on Drawings.
- B. Fasteners and Anchors: Manufacturer's recommended standard or stainless steel fasteners and attachment devices: suitable for application and load capacity. Include anchors, clips,

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fasteners, set screws, spacers, and other accessories compatible with material in contact, as indicated or required for complete installations.

- C. Roofing Cement: ASTM D 4586, Type II.
- D. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and to remain watertight as recommended by manufacturer.
 - 1. Refer to Division 7 Section Joint Sealants.
- E. Mineral-Fiber Blanket Insulation: ASTM C 665.
 - 1. Refer to Division 7 Thermal Insulation.
- F. Silicone Extrusions: Classified according to ASTM D 2000, UV stabilized, and do not propagate flame.
- G. Epoxy Grout Fill:
 - 1. General: Use epoxy grout fill in accordance with manufacturer's application limitations, precautions, and directions for use, including but not limited to surface preparation, mixing, placing, curing, and compatibility with substrate conditions.
 - 2. Description: Multi-component, high strength epoxy grout.
 - 3. Manufacturers and Products:
 - a. BASF Construction Chemicals; MasterFlow 648.
 - b. Laticrete; L&M EpoGrout 758 Epoxy Structural Grout.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

3.2 INSTALLATION, GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
 - 1. Respective manufacturer's written installation instructions.
 - 2. Accepted submittals.
 - 3. Contract Documents.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by isolating metals and other materials from direct contact with incompatible materials.

3.3 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.
- B. Prepare substrates according to expansion joint cover assembly manufacturer's written instructions.

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1. Repair concrete slabs and blockouts using manufacturer's recommended repair grout of compressive strength adequate for anticipated structural loadings.
 - C. Coordinate and furnish anchorages, setting drawings, and instructions for installing joint systems. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of joint systems.
- 3.4 INSTALLATION
- A. Comply with manufacturer's written instructions for storing, handling, and installing expansion joint cover assemblies and materials unless more stringent requirements are indicated.
 - B. Metal Frames: Perform cutting, drilling, and fitting required to install joint systems.
 1. Install in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
 2. Adjust for differences between actual structural gap and nominal design gap due to ambient temperature at time of installation. Notify Architect where discrepancies occur that will affect proper joint installation and performance.
 3. Cut and fit ends to accommodate thermal expansion and contraction of metal without buckling of frames.
 4. Install frames in continuous contact with adjacent surfaces.
 - a. Shimming is not permitted unless specifically allowed by the manufacturer in writing for this installation.
 5. Locate anchors at interval recommended by manufacturer, but not less than 3 in (75 mm) from each end and not more than 24 in (600 mm) on center.
 - C. Elastomeric Seals in Metal Frames: Install elastomeric seals and membranes in frames to comply with manufacturer's written instructions. Install with minimum number of end joints.
 1. Provide in continuous lengths for straight sections.
 2. Seal transitions. Vulcanize or heat-weld field-spliced joints as recommended by manufacturer.
 3. Mechanically lock seals into frames or adhere to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.
 - D. Preformed Foam Joint Seals: Install in compliance with manufacturer's written instructions. Install with minimum number of end joints.
 1. Install each length of seal immediately after removing protective wrapping.
 2. Firmly secure compressed joint seals to joint gap side to obtain full bond using exposed pressure-sensitive adhesive or field-applied adhesive as recommended by manufacturer.
 3. Do not pull or stretch material. Produce seal continuity at splices, ends, turns, and intersections of joints.
 4. For applications at low ambient temperatures, heat foam joint seal material in compliance with manufacturer's written instructions.
 - E. Install with hairline mitered corners where expansion joint cover assemblies change direction or abut other materials.
 - F. Terminate exposed ends of expansion joint cover assemblies with field- or factory-fabricated termination devices.
 - G. Fire-Resistance-Rated Assemblies: Coordinate installation of architectural joint assembly materials and associated work so complete assemblies comply with assembly performance requirements.

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1. Fire Barriers: Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and field splices.
 - H. Moisture Barrier: Provide moisture barrier and drainage at exterior joints and where indicated on Drawings. Provide drainage fittings and connect to drains.
 - I. Roof Expansion Assemblies: Extend assemblies over curbs, parapets, cornices, gutters, valleys, fasciae, and other elements in the construction profile, with factory-fabricated intersections and transitions to provide continuous, uninterrupted, waterproof roof expansion assemblies.
 1. Install factory-fabricated transitions between roof expansion assemblies and building architectural joint systems to provide continuous, uninterrupted, watertight construction.
 2. Splice roof expansion assemblies with materials provided by roof expansion assembly manufacturer for this purpose, according to manufacturer's written instructions, to provide continuous, uninterrupted, waterproof roof expansion assemblies.
 3. Provide uniform profile of roof expansion assembly throughout length of each installation; do not stretch polymeric sheets.
 4. Install mineral-fiber blanket insulation to fill joint space within joint and moisture barrier.
 5. Bed anchorage flanges in roofing cement or sealant recommended by manufacturer and securely nail to curbs and cant strips as recommended by manufacturer but not less than **6 in (150 mm)** on center.
 - J. Flexible Gutter and Drain Tube System: Install in accordance with manufacturer written instructions.
 1. Flexible gutter profile shall be continuous along length of joint.
 2. Seal and anchor flexible gutter system to substrate. Refer to manufacturer instructions for capping ends.
 3. Drain tube assemblies shall be spaced at approximately **25 ft (7.5 m)** center to center along length of joint or as indicated on the Drawings.
 4. Attach drain tube assembly. Using hand roller, apply direct pressure to flange ensuring full contact and proper adhesion.
- 3.5 CONNECTIONS AND TRANSITIONS
- A. Prefabricated Joint Transition Assemblies: Coordinate transitions and terminations of expansion joint covers between each type of application and installation. Provide factory-fabricated units at all joint transitions and terminations, including but not limited to waterproofing, exterior walls, soffits, and roof expansion joint cover assemblies.
- 3.6 FIELD QUALITY CONTROL
- A. Manufacturer's Field Service: Manufacturer's qualified technical representative shall periodically inspect Work to ensure installation is proceeding in accordance with manufacturer's designs, recommendations, instructions, and warranty requirements. Representative shall submit written reports of each visit indicating observations, findings, and conclusions of inspection.
 1. Manufacturer's Technical Representative Qualifications: Direct employee of technical services department of manufacturer with experience in providing recommendations, observations, evaluations, and problem diagnostics.
 - B. Owner Testing Agency: The Owner may employ and pay a qualified independent testing agency to perform field quality control.
 1. Refer to Division 01 Building Enclosure Commissioning for Field Observations and Performance Testing.

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- C. Tests and Inspections, General: Tests and inspections shall take place as installation proceeds to determine compliance with specified performance requirements.
 - 1. Correction of Deficiencies:
 - a. Materials and installation will be considered defective if they do not meet specified requirements.
 - b. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.
 - c. Perform additional tests and inspections, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.
 - 2. Prepare test and inspection reports.

3.7 PROTECTION

- A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.
- B. Provide final protection and maintain conditions in a manner acceptable to manufacturer and Installer that ensures that expansion joint assemblies are without damage or deterioration at time of Substantial Completion.
 - 1. Where construction traffic is anticipated, remove and properly store cover plates or seals and install temporary protection over joints. Reinstall cover plates or seals prior to Substantial Completion of the Work.

END OF SECTION

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SECTION 080610
DOOR SCHEDULE

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes Door Schedule for types of doors, frames and door hardware technically specified in various technical Sections of this Project Manual.

1.2 DOOR SCHEDULE

- A. Attached and included as part of this section: Door Schedule.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION

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SECTION 081113
HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes: Custom hollow metal doors and frames and supplementary items necessary for installation:
 - 1. Interior custom hollow-metal doors and frames.
 - 2. Exterior custom hollow-metal doors and frames.
- B. Related Requirements:
 - 1. Division 08 Section Door Hardware for door hardware for hollow-metal doors.
 - 2. Section 119812 "Detention Doors and Frames" for hollow-metal doors and frames for detention facilities.
 - 3. Division 13 Section Radiation Protection for lead-lined, hollow-metal doors and frames.

1.2 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings in accordance with NAAMM-HMMA 803.
- B. Exterior: Areas exposed to the elements and areas located in unconditioned spaces.
- C. Interior: Areas located in conditioned spaces.

1.3 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
 - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
 - 2. Door core materials and construction.
 - 3. Factory priming or finishing specifications.
 - 4. Indicate scheduled fire doors that cannot qualify for labeling because of design, size, hardware or other reason.
- B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components and attachments to other work. Distinguish between shop and field-assembled work.
 - 1. Door schedule indicating door and frame location, type, size, fire protection rating, and swing.
 - 2. Elevations of each door type.
 - 3. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
 - 4. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 - 5. Locations of reinforcement and preparations for hardware.
 - 6. Details of each different wall opening condition.
 - 7. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
 - 8. Details of anchorages, joints, field splices, and connections.
 - 9. Details of accessories.
 - 10. Details of moldings, removable stops, and glazing.
 - 11. Clearances.
- C. Samples for Verification:

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1. Finishes: For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches (75 by 127 mm).
 2. Fabrication: Prepare Samples approximately 12 by 12 inches (305 by 305 mm) to demonstrate compliance with requirements for quality of materials and construction:
 - a. Doors: Show vertical-edge, top, and bottom construction; core construction; and hinge and other applied hardware reinforcement. Include separate section showing glazing if applicable.
 - b. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow-metal panels and glazing if applicable.
 - D. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.
- 1.4 INFORMATIONAL SUBMITTALS
- A. Oversize Construction Certification: Documentation for assemblies required to be fire rated and exceeding limitations of labeled assemblies.
 - B. Product Test Reports: Written reports based on evaluation of comprehensive tests performed by qualified testing agency indicating that each product complies with requirements.
 1. Product Approvals: Submit Florida Product Approval or Product Control Notice of Acceptance (NOA) issued by Miami-Dade County Building Code Compliance Office (BCCO) or other product approval acceptable to authorities having jurisdiction for systems used at exterior of building.
 - C. Field Quality Control Reports: Written report of testing and inspection required by Field Quality Control.
- 1.5 CLOSEOUT SUBMITTALS
- A. Maintenance Data: To include in maintenance manuals.
 - B. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.
- 1.6 QUALITY ASSURANCE
- A. Installer Qualifications:
 1. Experience: Installer's personnel with not less than 5 years of experience in the successful performance of Work similar to scope of this Project.
 2. Supervision: Installer shall maintain a competent supervisor at Project while the Work is in progress, and who has not less than 5 years of experience installing products and systems similar to scope of this Project.
 - B. Door Inspector Qualifications: Inspector for field quality-control inspections of fire-rated door assemblies complies with qualifications set forth in NFPA 80 and NFPA 101.
 1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.
- 1.7 PRE-INSTALLATION CONFERENCE
- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.

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1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
 - 1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum **4-inch- (102-mm-)** high wood blocking. Provide minimum **1/4-inch (6-mm)** space between each stacked door to permit air circulation.

1.9 PROJECT CONDITIONS

- A. Field Measurements: Where products and systems are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication.

1.10 COORDINATION

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.
- B. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- C. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Comply with performance requirements specified, as determined by testing of products and systems representing those indicated for this Project, without failure due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
 - 1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
 - 2. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than **450 deg F (250 deg C)** above ambient after 30 minutes of standard fire-test exposure.

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- C. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing in accordance with UL 1784 and installed in compliance with NFPA 105.
- D. Fire-Rated, Borrowed-Lite Assemblies: Assemblies complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing in accordance with NFPA 257 or UL 9.
- E. Windborne-Debris-Impact-Resistance Performance: Comply with impact resistance testing requirements for Wind Zone.
- F. Thermally Rated Exterior Door Assemblies: Provide door assemblies with U-factor of not more than $0.40 \text{ deg Btu/F} \times \text{h} \times \text{sq. ft.}$ ($2.27 \text{ W/K} \times \text{sq. m}$) when tested in accordance with ASTM C1363 or ASTM E1423.
- G. Exterior Door Air Infiltration: Maximum air leakage of 0.20 cfm/sf (0.09 L/s per sq m) when tested according to ASTM E 283 at a minimum static-air-pressure difference of 1.57 lbf/sf (75 Pa).

2.3 INTERIOR CUSTOM HOLLOW-METAL DOORS AND FRAMES

- A. Interior Commercial Doors and Frames: NAAMM-HMMA 861; ANSI/SDI A250.4, Physical Performance Level A.
 - 1. Locations:
 - a. Interior doors and frames.
 - 2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: $1\text{-}3/4 \text{ inches}$ (44.5 mm).
 - c. Face: Uncoated steel sheet, minimum thickness of 0.042 inch (1.0 mm).
 - d. Door Edge Construction: Seamless, continuously welded with no visible seam.
 - 1) End Channels: Close top and bottom edges with continuous flush channels, minimum thickness of 0.053 inch (1.3 mm), fabricated from same material as face sheets and spot welded to face sheets.
 - e. Core Construction: Steel stiffened.
 - 1) Welded Vertical Steel Stiffeners: Manufacturer's standard vertical steel stiffener extending full-door height, spot welded to face sheets. Fill spaces between stiffeners with mineral-fiber insulation.
 - f. Fire-Rated Core Construction: Manufacturer's standard vertical steel stiffener core for fire-rated doors.
 - 3. Frames:
 - a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch (1.3 mm), except 0.067 inch (1.7 mm) for openings exceeding 4 feet (1219 mm) wide.
 - b. Sidelite and Transom Frames: Fabricated from same material as adjacent door frame.
 - c. Construction: Close contact edges of corner joints tight with mitered faces; full profile, continuously welded.
 - 1) Knocked down frame construction not permitted.
 - 4. Exposed Finish: Prime.

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2.4 EXTERIOR CUSTOM HOLLOW-METAL DOORS AND FRAMES

- A. Exterior Commercial Doors and Frames: NAAMM-HMMA 861; ANSI/SDI A250.4, Physical Performance Level A.
1. Locations:
 - a. Exterior doors and frames.
 - b. All doors and frames in parking garages.
 - c. All doors and frames in central energy plants.
 2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches (44.5 mm).
 - c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.30 mm), with minimum G60 or A60 (ZF180) coating.
 - d. Door Edge Construction: Seamless, continuously welded with no visible seam.
 - 1) End Channels: Close top and bottom edges with continuous flush channels, minimum thickness of 0.053 inch (1.3 mm), fabricated from same material as face sheets and spot welded to face sheets.
 - e. Top Edge Closures: Seal joints against water penetration.
 - f. Bottom Edge Closures: Provide weep hole openings in bottoms of exterior doors to permit moisture to escape.
 - g. Core Construction: Steel stiffened.
 - 1) Welded Vertical Steel Stiffeners: Manufacturer's standard vertical steel stiffener extending full-door height, spot welded to face sheets. Fill spaces between stiffeners with mineral-fiber insulation.
 3. Frames:
 - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.067 inch (1.7 mm), with minimum G60 or A60 (ZF180) coating.
 - b. Construction: Close contact edges of corner joints tight with mitered faces; full profile, continuously welded.
 - 1) Knocked down frame construction not permitted.
 4. Exposed Finish: Prime.

2.5 BORROWED LITES

- A. Borrowed Lite Frames: Fabricate from same materials, construction, and finish as door frame assemblies.
- B. Construction: Close contact edges of corner joints tight with mitered faces; full profile, continuously welded.
1. Knocked down frame construction not permitted.
- C. Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as metal as frames.
- D. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

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2.6 HOLLOW-METAL PANELS

- A. Provide hollow-metal panels of same materials, construction, and finish as adjacent door assemblies.

2.7 FRAME ANCHORS

A. Jamb Anchors:

1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
 - a. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 in (1.10 mm) thick.
 - b. Masonry Type: Adjustable Z-clip type or T-shaped anchors to suit frame size, not less than 0.042 in (1.10 mm) thick, with corrugated or perforated straps not less than 2 in (50 mm) wide by 10 in (250 mm) long.
 2. Quantity and Location:
 - a. Stud-Wall Type: Locate anchors not more than 18 in (450 mm) from top and bottom of frame. Space anchors not more than 32 in (800 mm) on centers and as follows:
 - 1) Three anchors per jamb up to 60 in (1500 mm) high.
 - 2) Four anchors per jamb from 60 to 90 in (1500 to 2250 mm) high.
 - 3) Five anchors per jamb from 90 to 96 in (2250 to 2400 mm) high.
 - 4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 in (600 mm) or fraction thereof above 96 in (2400 mm) high.
 - 5) Two anchors per head for frames above 42 in (1050 mm) wide and mounted in metal-stud partitions.
 - b. Masonry Type: Locate anchors not more than 18 in (450 mm) from top and bottom of frame. Space anchors not more than 32 in (800 mm) on centers and as follows:
 - 1) Two anchors per jamb up to 60 in (1500 mm) high.
 - 2) Three anchors per jamb from 60 to 90 in (1500 to 2250 mm) high.
 - 3) Four anchors per jamb from 90 to 120 in (2250 to 3000 mm) high.
 - 4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 in (600 mm) or fraction thereof above 120 in (3000 mm) high.
 3. Postinstalled Expansion Anchor for In-Place Concrete or Masonry: Countersunk, flat or oval head exposed screws and bolts, Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.
- B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor; fabricated from same material as frames and welded to bottom of jambs and mullions, minimum thickness 0.0428 in (1.10 mm), terminate bottom of frames at top of finish floor.
1. Monolithic Concrete Slabs: Clip type anchors, with two holes to receive fasteners.
- C. Floor Anchors for Concrete Slabs with Underlayment/Topping: Adjustable-type anchors with extension clips, allowing not less than 2-inch (51-mm) height adjustment. Terminate bottom of frames at top of underlayment.
- D. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.

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1. For anchors built into exterior walls and other exterior locations, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized in accordance with ASTM A153/A153M, Class B.

2.8 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum **G60 (Z180)** or **A60 (ZF180)** metallic coating. Thickness indicated is for uncoated steel.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized in accordance with ASTM A153/A153M.
- E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
 1. Available Manufacturers:
 - a. Construction Materials, Inc.
 - b. Heckman Building Products, Inc.
 - c. Hilti Corp.
 - d. ITW Ramset/Red Head.
 - e. Powers Fasteners.
 - f. Simpson Strong Tie Anchor Systems.
 2. Post-Tensioned Concrete: For post-tensioned concrete, fasteners shall not exceed 1 in (25 mm) embedment. Obtain Structural Engineer's written approval for all proposed fasteners in post-tensioned concrete prior to installation.
- F. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.
- G. Glazing: Comply with requirements in Division 08 Section Glazing.
- H. Bituminous Frame Back Coating for Grouted Frames: Cold-applied asphalt mastic, compounded for **15-mil (0.4-mm)** dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.9 FABRICATION

- A. General Requirements: Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Factory fit and assemble units in manufacturer's plant.
 1. Manufacturing Standards: ANSI/NAAMM-HMMA 861.
- B. Hollow-Metal Doors: Fabricate doors not less than 1-3/4 in (44 mm) thick, seamless hollow metal construction unless otherwise indicated. Construct doors with smooth surfaces and without visible joints or seams on exposed faces.
- C. Door Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum **3/4 inch (19 mm)**

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beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.

- D. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
1. Sidelite and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding.
 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- E. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping in accordance with ANSI/SDI A250.6, the Door Hardware Schedule, and templates.
1. Reinforce doors and frames to receive non-templated, mortised, and surface-mounted door hardware. Minimum Reinforcing Thickness for Door Hardware:
 - a. Hinges and Pivots: 0.167 in (4.2 mm) thickness by 1-1/2 in wide by 6 in (38 mm by 150 mm) longer than hinge.
 - b. Locks, Strikes, Flush Bolts and Closers: 0.093 in (2.3 mm) thickness.
 - c. Surface Mounted Hold Open Arms and Panic Devices: 0.093 in (2.3 mm) thickness.
 - d. Other Surface Applied Hardware: 0.067 in (1.7 mm) thickness.
 2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.
 3. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections
- F. Glazed Lites: Provide continuous frame for glazed openings between face sheets; miter corners, weld frame to face sheets, and grind smooth. Provide stops and moldings around glazed lites. Form corners of stops and moldings with butted or mitered hairline joints.
1. Provide stops and moldings around glazed lites, flush with face of door, and with square stops unless otherwise indicated.
 - a. Use same materials as door face sheet for frame and loose stop for flush glazing
 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
 3. Provide fixed formed frame on outside of exterior and on secure side of interior doors and frames. Provide loose stops and moldings on inside of hollow-metal doors and frames.
 - a. Do not overlap frame molding on face of door.
 4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
 5. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.

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2.10 STEEL FINISHES

- A. Comply with NAAMM's Metal Finishes Manual for Architectural and Metal Products for recommendations for cleaning, treating, priming, and when specified, finishing.
- B. Uncoated Steel Surface Preparation: Clean surfaces to comply with SSPC-SP 1, Solvent Cleaning; remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 3, Power Tool Cleaning, or SSPC-SP 6/NACE No. 3, Commercial Blast Cleaning.
- C. Metallic-Coated Steel Surface Preparation: Clean surfaces with non-petroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating compatible with primer. Clean welds, mechanical connections, abraded areas and apply galvanizing repair paint.
 - 1. Galvanizing Repair Paint: High-zinc-dust-content paint for re-galvanizing welds and other surfaces; comply with SSPC-Paint 20.
- D. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
 - 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.
- E. Field Applied Coatings: Comply with Division 09 Section Painting for substrate preparation and painting requirements.

2.11 LOUVERS

- A. Provide louvers for interior doors, where indicated, which comply with SDI 111, with blades or baffles formed of **0.020-inch- (0.5-mm-)** thick, cold-rolled steel sheet set into **0.032-inch- (0.8-mm-)** thick steel frame.
 - 1. Sightproof Louver: Stationary louvers constructed with inverted-V or inverted-Y blades.
 - 2. Fire-Rated Automatic Louvers: Louvers constructed with movable blades closed by actuating fusible link and listed and labeled for use in fire-rated door assemblies of type and fire-resistance rating indicated by same qualified testing and inspecting agency that established fire-resistance rating of door assembly.
- B. Fabricate louvers and mount flush into doors without overlapping moldings on surface of door face sheets. Provide internal support recommended by manufacturer. Provide louvers with minimum of 50% free air area unless indicated otherwise.
- C. Form corners of moldings with hairline joints. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

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3.2 INSTALLATION, GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
1. Respective manufacturer's written installation instructions.
 2. Accepted submittals.
 3. Contract Documents.

3.3 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.
- B. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.
- C. Drill and tap doors and frames to receive non-templated, mortised, and surface-mounted door hardware.

3.4 INSTALLATION

- A. General: Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.
- B. Hollow-Metal Frames: Comply with NAAMM-HMMA 840.
1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
 - a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
 - b. Install frames with removable stops located on secure side of opening.
 2. Fire-Rated Openings: Install frames in accordance with NFPA 80.
 3. Floor Anchors: Secure with post-installed expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of post-installed expansion anchors if so indicated and approved on Shop Drawings.
 4. Sound Rated Partitions: Solidly pack mineral-fiber insulation inside frames.
 5. Exterior Walls: Solidly fill space between frames wall construction with mineral-fiber insulation unless indicated otherwise.
 6. In-Place Concrete or Masonry Construction: Secure frames in place with post-installed expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 7. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
 - a. Squareness: Plus or minus **1/16 inch (1.6 mm)**, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus **1/16 inch (1.6 mm)**, measured at jambs on a horizontal line parallel to plane of wall.

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- c. Twist: Plus or minus **1/16 inch (1.6 mm)**, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus **1/16 inch (1.6 mm)**, measured at jambs at floor.
- C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.
 - 1. Non-Fire-Rated Steel Doors: Comply with NAAMM-HMMA 841 and NAAMM-HMMA guide specification indicated.
 - 2. Fire-Rated Doors: Install doors with clearances in accordance with NFPA 80.
 - 3. Smoke-Control Doors: Install doors in accordance with NFPA 105.
- D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

3.5 FIELD QUALITY CONTROL

- A. Contractor Inspection Agency: Engage a qualified inspector to perform inspections and to furnish reports to Architect.
- B. Tests and Inspections, General: Tests and inspections shall take place as installation proceeds to determine compliance with specified performance requirements.
 - 1. Correction of Deficiencies:
 - a. Materials and installation will be considered defective if they do not meet specified requirements.
 - b. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.
 - c. Perform additional tests and inspections, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.
 - 2. Prepare test and inspection reports.
 - a. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101.
- C. Contractor Inspections:
 - 1. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80.
 - 2. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements in accordance with NFPA 101.

3.6 ADJUSTMENTS AND REPAIRS

- A. Final Adjustments: Remove and replace defective hollow metal work, including work that is warped, bowed, or otherwise unacceptable.
- B. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish according to manufacturer's written instructions.
 - 1. Inspect hollow metal frames located in wet areas and bathrooms; prepare and reprime damaged areas to prevent rusting and bleed through.
- C. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

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END OF SECTION

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SECTION 081170
STEEL FIRE DOOR AND FRAME ASSEMBLY

PART 1 - GENERAL

1.1 SUMMARY

- A. Work required for this section includes preassembled steel fire doors, frames, hardware and supplementary items necessary to complete their installation.
- B. Standard steel fire doors are specified in Division 8 Section "Hollow Metal Doors and Frames".

1.2 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
 - 1. Include manufacturer's specifications for materials, label compliance, fire-resistance ratings, finishes, construction details, installation instructions, and recommendations for maintenance.
- B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components and attachments to other work. Distinguish between shop and field-assembled work.
- C. Door Schedule: Submit schedule of doors and frames using same reference numbers for details and openings as those on Drawings.
- D. Construction Samples: Approximately 12 in (300 mm) by 12 in (300 mm) representing the required construction of doors for Project.

1.3 CLOSEOUT SUBMITTALS

- A. Maintenance Data: To include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer with not less than 5 years of experience in the successful production and in-service performance of products and systems similar to scope of this Project.
- B. Installer Qualifications:
 - 1. Experience: Installer's personnel with not less than 5 years of experience in the successful performance of Work similar to scope of this Project.
 - 2. Supervision: Installer shall maintain a competent supervisor at Project while the Work is in progress, and who has not less than 5 years of experience installing products and systems similar to scope of this Project.
 - 3. Manufacturer Acceptance: Installer shall be certified, approved, licensed, or acceptable to manufacturer to install products.
- C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL 10B and UBC 7-2 (1997).
 - 1. Test Pressure: After 5 minutes into the test, the neutral pressure level in furnace shall be established at 40 in (1000 mm) or less above the sill.
 - 2. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a testing agency acceptable to authorities having jurisdiction that

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doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.

- D. Handicap: Provide doors and hardware that complies with applicable requirements of Americans with Disabilities Act (ADA), ANSI A117.1 and State Handicap Requirements.

1.5 PROJECT CONDITIONS

- A. Field Measurements: Where products and systems are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication.

1.6 COORDINATION

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver doors and frames to provide protection during transit and storage. Do not use nonvented plastic.
- B. Inspect doors and frames, on delivery, for damage. Minor damage may be repaired provided refinished items match new work otherwise, remove and replace damaged items.
- C. Store doors and frames under cover at building site. Provide wood blocking between stacked doors to permit air circulation.

1.8 WARRANTY

- A. Manufacturer's Warranty: Furnish manufacturer's written material and labor warranty signed by an authorized representative using manufacturer's standard form agreeing to furnish materials and labor required to repair or replace work which exhibits material defects caused by manufacture or design of product. "Defects" are defined to include but not limited to deterioration or failure to perform as required.
 - 1. Warranty Period: Manufacturer shall warrant the products to be free from material and labor Defects for a period of 2 years from date of Substantial Completion.
- B. Installer's Warranty: Furnish installer's written workmanship warranty signed by an authorized representative using installer's standard form agreeing to provide labor required to repair or replace work which exhibits workmanship defects. "Defects" is defined to include but not limited to deterioration or failure to perform as required.
 - 1. Warranty Period: Installer shall warrant the installation to be free from workmanship Defects for a period of 2 years from date of Substantial Completion

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND PRODUCTS

- A. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".
 - 1. Openings – "Total Door".
 - 2. Adams Rite Manufacturing Co. – "The Rite Door".

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2.2 MATERIALS, GENERAL

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials

2.3 MATERIALS

- A. Cold-Rolled Steel Sheets: ASTM A 366, CS commercial quality, level sheet steel.
- B. Electrolytic Zinc-Coated Steel Sheets: ASTM A 591 commercial quality, coating Class C; mill phosphatized; suitable for exposed applications; and stretcher leveled or roller leveled to stretcher-leveled flatness.
- C. Honeycomb Core: Resin-impregnated kraft paper with maximum 1 in (25 mm) cells and minimum 42 psi crushing strength.

2.4 DOOR ASSEMBLY

- A. Face Sheets: One of the following laminated with waterproof adhesive to core.
 - 1. 18 gage electrolytic zinc coated steel sheet.
 - 2. 18 gage cold rolled steel sheet.
- B. Stiles and Rails: One of the following manufacturer's standard.
 - 1. 16 gage continuous latch and hinge stiles with 5-3/4 in (144 mm) top and bottom wood rails.
 - 2. 16 gage continuous top and bottom steel channel rails and welded vertical door edges.

2.5 HARDWARE

- A. Exit Device: Manufacturer's standard, recessed in door face, ADA Compliant, one of the following:
 - 1. Locking channels, bars, and strike blocks latching and control mechanism, 1-5/16 in (33 mm) in closed position, 1/8 in (3 mm) in open position.
 - 2. Top vertical rod only panic device with electronic dogging for 1/2 in (12 mm) in open position and 1-1/8 in (28 mm) in closed position.
- B. Hinges: One of the following, manufacturer's standard.
 - 1. 14 gage continuous semi-concealed steel pivoting and suspension mechanism.
 - 2. One half mortised continuous geared electric hinge.
- C. Lever Trim: Manufacturer's standard, ADA compliant, finish to match project finish hardware.
- D. Magnetic Hold Open: Manufacturer's standard for door pocket installation and connected to building fire alarm system.
- E. Closer: Manufacturer's standard, surface mounted on hinge side of door, finish to match door.
- F. Smoke Seal: Manufacturer's standard to meet positive pressure fire compliance of UL 10B and UBC 7-2 (1997).

2.6 FINISH

- A. After fabrication dress and fill all tool marks and surface imperfections fill and sand as required to make all faces and vertical edges smooth, level and free of all irregularities. Chemically treat to insure maximum paint adhesion and coat exposed surfaces, with a rust inhibitive primer to receive following finish.
 - 1. Factory primed only for field applied finish paint coating.

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2. Factory applied primer and manufacturer's standard polyurethane finish coat.
 - a. Color as scheduled or as indicated in Design Selections.
3. Factory applied high pressure decorative laminate.
 - a. Color as scheduled or as indicated in Design Selections.

2.7 DOOR FRAMES

- A. Provide 16 gage, fully welded construction with same label as door, as specified in Division 8 Section, "Hollow Metal Doors and Frames".

2.8 FABRICATION

- A. Fabricate doors and frames rigid, neat in appearance, and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles. Weld exposed joints continuously; grind, fill, dress, and make smooth, flush, and invisible. Where practical, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory assembled before shipment, to assure proper assembly at Project site.
- B. Hardware Preparation: Prepare doors and frames to receive hardware, including cutouts, reinforcement, mortising, drilling, and tapping. Comply with applicable requirements of ANSI A115 Series specifications for door and frame preparation for hardware.
 1. Reinforce doors and frames to receive surface-applied hardware. Drilling and tapping for surface-applied hardware may be done at Project site.
 2. Locate hardware according to HMMA 831, "Recommended Hardware Locations for Custom Hollow Metal Doors and Frames."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

3.2 INSTALLATION, GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
 1. Respective manufacturer written installation instructions.
 2. Accepted submittals.
 3. Contract Documents.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by isolating metals and other materials from direct contact with incompatible materials.

3.3 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.

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3.4 INSTALLATION

- A. General: Install doors and frames according to DHI A115.IG and manufacturer's written instructions.
- B. Install work in accordance with reviewed shop drawings and these specifications using only factory trained installers.
- C. Frames: Set frames accurately in position; plumb; align, and brace securely until permanent anchors are set. After wall construction is complete, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.
- D. Hang doors and adjust for free swinging operation without binding, sticking, sagging or excessive clearances.
- E. When installation is complete, adjust operating hardware for proper operation and function.
- F. Coordinate installation with fire alarm and smoke detection systems interfacing wiring requirements.
- G. Fire-Rated Doors: Install with clearances as specified in NFPA 80.
- H. Smoke Control Doors: Install according to NFPA 105.

3.5 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items just before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including doors or frames that are warped, bowed, or otherwise unacceptable.
- B. Factory-Finish Touchup: Immediately after erection, sand to feather-edge minor scratched, chipped, or damaged areas and apply touchup of compatible air-drying paint. Minor finish imperfections may be repaired provided finish matches new work finish and is approved by Architect; otherwise, remove and replace.

3.6 FINISH SCHEDULE

- A. Manufacturer's standard polyurethane finish coat.
 - 1. Color: Match Architect's sample.
 - 2. Color: As selected by Architect from manufacturer's standards.
 - 3. Color:
- B. High Pressure Decorative Laminate.
 - 1. Color: Match Architect's sample.
 - 2. Color: As selected by Architect from manufacturer's standards.
 - 3. Color:

END OF SECTION

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SECTION 081426
HOLLOW CORE WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Hollow core wood doors, finishing and supplementary items necessary for installation.
1. Hollow-core flush wood veneer-faced doors for transparent finish.
 2. Hollow-core flush wood doors for opaque finish.
 3. Wood door frames.
 4. Factory priming doors.
 5. Factory finishing doors.
 6. Factory fitting doors to frames and factory machining for hardware.

1.2 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
 2. Door core materials and construction.
 3. Door edge construction.
 4. Door face type and characteristics.
 5. Door frame construction.
 6. Factory-machining criteria.
 7. Factory priming and finishing specifications.
- B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components and attachments to other work. Distinguish between shop and field-assembled work. Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data; and the following:
1. Door schedule indicating door and frame location, type, size, and swing.
 2. Door elevations, dimension and locations of hardware.
 3. Details of frame for each frame type, including dimensions and profile.
 4. Dimensions and locations of blocking for hardware attachment.
 5. Dimensions and locations of mortises and holes for hardware.
 6. Clearances and undercuts.
 7. Doors to be factory primed or finished and application requirements.
- C. Samples for Verification:
1. Transparent and Opaque Finish Doors: Factory finishes applied to actual door face materials, approximately 8 by 10 inches (200 by 250 mm), for each material and finish. For each wood species and transparent finish, provide set of three Samples showing typical range of color and grain to be expected in finished Work.

1.3 INFORMATIONAL SUBMITTALS

1. Warranty:
 - a. Provide manufacturer's written warranty covering materials and installation (labor) stating obligations, remedies, limitations and exclusions.

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1.4 QUALITY ASSURANCE

1.5 PRE-INSTALLATION CONFERENCE

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in opaque plastic bags or cardboard cartons.
- C. Protect doors during transit, storage and handling to prevent damage, soiling and deterioration.
- D. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations:
 - 1. Do not deliver or install doors until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupants for the remainder of construction period.

1.8 COORDINATION

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

1.9 WARRANTY

- A. Manufacturer's Warranty: Furnish manufacturer's written material and labor warranty signed by an authorized representative using manufacturer's standard form agreeing to furnish materials and labor required to repair or replace work which exhibits material defects caused by manufacture or design and installation of product. "Defects" is defined to include but not limited to deterioration or failure to perform as required.
 - 1. Warranty Period for Interior Doors: Manufacturer shall warrant the products to be free from material and labor Defects for a period of 5 years from date of Substantial Completion

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".
- B. Available Manufacturers: Subject to compliance with requirements of Contract Documents as judged by the Architect, manufacturers offering products that may be incorporated into the Work include, but are not limited to, those listed.
- C. Manufacturers:
 - 1. Masonite.
- D. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other available manufacturers offering products

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having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.

1. Basis of Design: Masonite; Interior Residential Hollow Core Doors.

2.2 MATERIALS, GENERAL

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

2.3 WOOD DOORS AND FRAMES, GENERAL

- A. Quality Standard: In addition to requirements specified, comply with ANSI/WDMA I.S. 1A
 1. Performance Grade:
 - a. ANSI/WDMA I.S. 1A Standard Duty: Typical locations.
- B. Low-Emitting Materials: Provide doors made with adhesives and composite wood products that do not contain urea formaldehyde.

2.4 HOLLOW-CORE WOOD VENEER-FACED DOORS FOR TRANSPARENT FINISH

- A. Interior Doors, Hollow-Core Veneer-Faced:
 1. ANSI/WDMA I.S. 1A Grade: Custom.
 2. Species and Cut: As scheduled or indicated in Design Selections.
 3. Vertical Edges: Applied wood-veneer edges of same species as faces and covering edges of faces; sanded eased edges.
 4. Horizontal Edges: Unfaced, sanded smooth, with factory applied seal coat.
 - a. Top Edges Exposed to View: Match exposed vertical edges.
 5. Construction: Standard hollow core.
 6. Blocking: Provide wood blocking with minimum dimensions as follows:
 - a. 5-by-18-inch (125-by-460-mm) lock blocks.

2.5 HOLLOW-CORE WOOD DOORS FOR OPAQUE FINISH

- A. Interior Doors, Hollow Core:
 1. ANSI/WDMA I.S. 1A Grade: Custom.
 2. Faces: Hardboard or MDF.
 - a. Hardboard Faces: ANSI A135.4, Class 1 (tempered) or Class 2 (standard).
 - b. MDF Faces: ANSI A208.2, Grade 150 or Grade 160.
 3. Vertical Edges: Any closed-grain hardwood.
 4. Horizontal Edges: Unfaced, sanded smooth, with factory applied seal coat.
 - a. Top Edges Exposed to View: Match exposed vertical edges.
 5. Construction: Standard hollow core.
 6. Blocking: Provide wood blocking with minimum dimensions as follows:
 - a. 5-by-18-inch (125-by-460-mm) lock blocks.

2.6 WOOD DOOR FRAMES

- A. Interior Frames:
 1. ANSI/WDMA I.S. 1A Grade: Match grade indicated for doors.

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2. Wood Species and Cut: Match species and cut indicated for wood doors unless otherwise indicated.
 3. Wood Moisture Content: Comply with requirements of referenced quality standard.
 4. Profile: Single rabbet unless indicated otherwise on Drawings.
- B. Construction: Solid lumber, particleboard, or medium density fiberboard (MDF) with veneered exposed surfaces.

2.7 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated.
1. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
- B. Factory machine doors for hardware that is not surface applied.
1. Locate hardware to comply with DHI-WDHS-3.
 2. Comply with final hardware schedules, door frame Shop Drawings, ANSI/BHMA-156.115-W, and hardware templates.
 3. Coordinate with hardware mortises in frames, to verify dimensions and alignment before factory machining.
- C. Seal edges of doors, edges of cutouts, and mortises with sealer coat after fitting and machining.

2.8 FACTORY PRIMING

- A. Doors for Opaque Finish: Factory prime faces, all four edges, edges of cutouts, and mortises with one coat of wood primer specified in Division 09 Section Painting.

2.9 FACTORY FINISHING

- A. Comply with referenced quality standard for factory finishing.
1. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
 2. Finish faces, all four edges, edges of cutouts, and mortises.
 3. Stains and fillers may be omitted on edges of cutouts, and mortises.
- B. Factory finish doors, unless indicated otherwise.
- C. Transparent Finish:
1. ANSI/WDMA I.S. 1A Grade: Same grade for finish as specified for doors.
 2. ANSI/WDMA I.S. 1A TR-4 Conversion Varnish.
 3. Staining, Effect and Sheen: Match Architect's sample, as scheduled or indicated in Design Selections.
- D. Opaque Finish:
1. ANSI/WDMA I.S. 1A Grade: Same grade for finish as specified for doors.
 2. ANSI/WDMA I.S. 1A OP-4 Conversion Varnish.
 3. Color and Sheen: Match Architect's sample, as scheduled or indicated in Design Selections.

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PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.
- B. Examine doors and installed door frames, with Installer present, before hanging doors.
 - 1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
 - 2. Reject doors with defects.

3.2 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.

3.3 INSTALLATION

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
 - 1. Respective manufacturer's written installation instructions.
 - 2. Accepted submittals.
 - 3. Contract Documents.
- B. Hardware: For installation, see Division 8 Section Door Hardware.
- C. Install doors and frames to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
- D. Install frames level, plumb, true, and straight.
 - 1. Shim as required with concealed shims. Install level and plumb to a tolerance of **1/8 inch in 96 inches (3.2 mm in 2400 mm)**.
 - 2. Anchor frames to anchors or blocking built in or directly attached to substrates.
 - a. Secure with countersunk, concealed fasteners and blind nailing.
 - b. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.
 - 1) For factory-finished items, use filler matching finish of items being installed.
- E. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
 - 1. Clearances:
 - a. Head, Jambs and Pairs of Doors: Provide **1/8-inch (3.2 mm)** maximum at heads, jambs, and between pairs of doors.
 - b. Between Bottom of Door and Top of Threshold: Where threshold is shown or scheduled, provide **1/4-inch (6.4 mm)** maximum from bottom of door to top of threshold unless otherwise indicated.

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- c. Between Bottom of Door and Top of Finished Floor Material - No Threshold:
Provide 3/4-inch (19 mm) maximum from bottom of door to top of finished floor material unless otherwise indicated on Drawings.
 - F. Factory-Finished Doors: Restore finish before installation when fitting or machining is required at Project site.
- 3.4 ADJUSTING
- A. Operation: Rehang or replace doors that do not swing or operate freely.
 - B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.
- 3.5 FINISH SCHEDULE
- A. Wood Veneer Faced Doors for Transparent Finish:
 - 1. Species and Cut Selection: Match sample accepted by Architect.
 - 2. Species and Cut Selection:
 - 3. Finish:
 - a. Staining, Effect and Sheen: Match sample accepted by Architect.
 - B. Doors for Opaque Finish:
 - 1. Finish: Match sample accepted by Architect.
 - 2. Finish:
 - a. Color and Sheen: Match sample accepted by Architect.

END OF SECTION

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SECTION 083113
ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Access doors and frames and supplementary items necessary for installation.

1.2 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
 - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
- B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components and attachments to other work. Distinguish between shop and field-assembled work.
- C. Ceiling Coordination Drawings for Access Doors at Ceilings: Furnish reflected ceiling plans, drawn to scale, on which ceiling-mounted items including access doors and frames, lighting fixtures, diffusers, grilles, speakers, sprinklers, and special trim are shown and coordinated with each other. Indicate method of attaching door frames to surrounding construction.
- D. Samples for Verification Purposes: For each door face material, at least 3 in by 5 in (75 mm by 125 mm) in size, in specified finish.
- E. Access Door and Frame Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

1.3 CLOSEOUT SUBMITTALS

- A. Maintenance Data: To include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 that are identical to access door and frame assemblies tested for fire-test-response characteristics per the following test method and that are listed and labeled by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - 1. NFPA 252 or UL 10B for vertical access doors and frames.
 - 2. ASTM E 119 or UL 263 for horizontal access doors and frames.
- B. Size Variations: Obtain Architect's acceptance of manufacturer's standard-size units, which may vary slightly from sizes indicated.

1.5 COORDINATION

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.
- B. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed plumbing, mechanical, or other concealed work, and indicate in the schedule specified in "Submittals" Article.

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PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".
- B. Manufacturers:
 - 1. Metal Doors and Frames:
 - a. Acudor Products, Inc.
 - b. Babcock-Davis.
 - c. Dur-Red Products.
 - d. J. L. Industries, Inc.
 - e. Karp Associates, Inc.
 - f. Larsen's Manufacturing Company.
 - g. Maxam Metal Products, Ltd.
 - h. Milcor Inc.
 - i. Nystrom Building Products.
 - j. Williams Brothers Corporation of America.
 - 2. Glass-Fiber-Reinforced Gypsum (GFRG) Doors and Frames:
 - a. Chicago Metallic Corporation.
 - b. Nystrom Building Products.
- C. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other manufacturers offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.

2.2 MATERIALS, GENERAL

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

2.3 STEEL MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36 / A 36M.
 - 1. ASTM A 123 / A 123M, for galvanizing steel and iron products.
 - 2. ASTM A 153 / A 153M, for galvanizing steel and iron hardware.
- B. Steel Sheet: Uncoated cold-rolled steel sheet substrate complying with ASTM A 1008 / A 1008M, Commercial Steel (CS), exposed.
- C. Metallic-Coated (Galvanized) Steel Sheet: ASTM A 653 / A 653M, Commercial Steel (CS) with A60 (ZF180) zinc-iron-alloy (galvannealed) coating or G60 (Z180) mill-phosphatized zinc coating; stretcher-leveled standard of flatness; with minimum thickness indicated representing specified thickness according to ASTM A 924 / A 924M.
- D. Steel Finishes: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Surface Preparation for Steel Sheet: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning", to remove dirt, oil, grease, or other contaminants that could impair

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paint bond. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning", or SSPC-SP 8, "Pickling".

2. Surface Preparation for Metallic-Coated (Galvanized) Steel Sheet: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.

- a. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

3. Factory-Primed Finish: Apply shop primer immediately after cleaning and pretreating.

- E. Drywall Beads: Edge trim formed from 0.0299 in (0.7 mm) zinc-coated steel sheet formed to receive joint compound and in size to suit thickness of gypsum board.

- F. Plaster Beads: Casing bead formed from 0.0299 in (0.7 mm) zinc-coated steel sheet with flange formed out of expanded metal lath and in size to suit thickness of plaster.

2.4 STAINLESS-STEEL MATERIALS

- A. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 316. Remove tool and die marks and stretch lines or blend into finish.

1. Finish: Directional No. 4 Satin Finish.

2.5 ALUMINUM MATERIALS

- A. Aluminum Extrusions: ASTM B 221 / B 221M, Alloy 6063-T6.

1. Mill finish, AA-M10 (Mechanical Finish: as fabricated, unspecified).

- B. Aluminum-Alloy Rolled Tread Plate: ASTM B 632 / B 632M, Alloy 6061-T6.

1. Mill finish, AA-M10 (Mechanical Finish: as fabricated, unspecified).

- C. Aluminum Sheet: ASTM B 209 / B 209M, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than strength and durability properties of Alloy 5005-H15; with minimum sheet thickness indicated representing specified thickness according to ANSI H35.2 / H35.2(M).

1. Mill Finish: AA-M10 (Mechanical Finish: as fabricated, unspecified).

2.6 GLASS-FIBER-REINFORCED GYPSUM MATERIALS

- A. Fabrications: Molded, glass-fiber-reinforced gypsum units complying with ASTM C 1381 / C 1381M.

2.7 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

- A. Non-rated Flush Access Doors and Frames with Exposed Trim:

1. Locations:

- a. Masonry wall surfaces.
- b. Ceramic tile wall surfaces.

2. Fabricated from one of the following as scheduled at the end of this Section.

- a. Steel sheet.
- b. Metallic-coated (galvanized) steel sheet.
- c. Stainless-steel sheet.

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3. Door: Minimum **0.075 in (1.9 mm)** thick sheet metal, set flush with exposed face flange of frame.
 4. Frame: Minimum **0.060 in (1.5 mm)** thick sheet metal with **1-1/4 in (32 mm)** wide, surface-mounted trim.
 5. Hinges: Continuous piano.
 6. Lock: Key-operated cylinder.
 7. Size: **12 in by 12 in (300 mm by 300 mm)**; unless otherwise indicated.
 8. Basis of Design: Nystrom Building Products, Model NT.
- B. Non-rated Flush Access Doors and Trimless Frames:
1. Locations: Wall and ceiling surfaces as scheduled.
 - a. Gypsum board wall and ceiling surfaces.
 - b. Plaster wall and ceiling surfaces.
 2. Fabricated from one of the following as scheduled at the end of this Section.
 - a. Steel sheet.
 - b. Metallic-coated (galvanized) steel sheet.
 - c. Stainless-steel sheet.
 3. Door: Minimum **0.075 in (1.9 mm)** thick sheet metal, set flush with surrounding finish surfaces.
 4. Frame: Minimum **0.060 in (1.5 mm)** thick sheet metal with drywall bead flange.
 5. Hinges: Continuous piano.
 6. Lock: Key-operated cylinder.
 7. Size: **12 in by 12 in (300 mm by 300 mm)**; unless otherwise indicated.
 8. Basis of Design: Nystrom Building Products, Model NW or NP as applicable.
- C. Non-rated Recessed Access Doors and Trimless Frames:
1. Locations:
 - a. Gypsum board wall and ceiling surfaces.
 - b. Plaster wall and ceiling surfaces.
 2. Fabricated from one of the following as scheduled at the end of this Section.
 - a. Steel sheet.
 - b. Metallic-coated (galvanized) steel sheet.
 - c. Stainless-steel sheet.
 3. Door: Minimum **0.060 in (1.5 mm)** thick sheet metal in the form of a pan recessed **5/8 in (15 mm)** for infill.
 4. Frame: Minimum **0.060 in (1.5 mm)** thick sheet metal with finishing bead and only frame edge exposed.
 5. Hinges: Concealed piano hinge or spring-loaded, concealed-pin type pivoting rod hinge.
 6. Lock: Key-operated cylinder with plastic grommet for access through pan recess.
 7. Size: **12 in by 12 in (300 mm by 300 mm)**; unless otherwise indicated.
 8. Basis of Design:
 - a. Gypsum Board Infill: Nystrom Building Products, Model RW.
 - b. Plaster Infill: Nystrom Building Products, Model RP.
- D. Non-rated, Glass-Fiber-Reinforced Gypsum (GFRG) Flush Access Doors and Trimless Frames, Concealed Hinge:
1. Locations:

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- a. Gypsum board wall and ceiling surfaces as scheduled.
 - b. Locations indicated on Drawings.
2. Door: Glass fiber reinforced gypsum door, 5/8-inch (16 mm) deep, rounded corners.
 3. Frame: Glass fiber reinforced gypsum frame
 4. Hinges: Concealed.
 5. Lock: Key-operated cylinder.
 6. Size: 12 in by 12 in (300 mm by 300 mm); unless otherwise indicated.
 7. Basis of Design: Nystrom Building Products; GFRR/GFRS Concealed Hinge Access Doors.
- E. Non-rated, Glass-Fiber-Reinforced Gypsum (GFRG) Flush Access Doors and Trimless Frames:
1. Locations:
 - a. Gypsum board ceiling surfaces as scheduled.
 - b. Locations indicated on Drawings
 2. Door: 1/8 in (3 mm) to 3/16 in (5 mm) thick glass-fiber-reinforced gypsum removable panel with rounded corners.
 3. Frame: 1/8 in (3 mm) to 3/16 in (5 mm) thick glass-fiber-reinforced gypsum with 3 in (75 mm) wide exposed frame.
 4. Hinges: None.
 5. Lock: None.
 6. Size: 12 in by 12 in (300 mm by 300 mm); unless otherwise indicated.
 7. Basis of Design: Chicago Metallic Corporation; GRG Access Doors, Model 8502.00.
- F. Fire-Rated, Insulated, Flush Access Doors and Frames with Exposed Trim:
1. Locations:
 - a. Masonry wall surfaces.
 - b. Ceramic tile wall surfaces.
 2. Fabricated from one of the following as scheduled at the end of this Section.
 - a. Steel sheet.
 - b. Metallic-coated (galvanized) steel sheet.
 - c. Stainless-steel sheet.
 3. Fire-Resistance Rating: Not less than 1-1/2 hours.
 4. Temperature Rise Rating: 250 deg F (139 deg C) at the end of 30 minutes.
 5. Door: Flush panel with a core of mineral-fiber insulation enclosed in sheet metal with a minimum thickness of 0.036 in (0.9 mm).
 6. Frame: Minimum 0.060 in (1.5 mm) thick sheet metal with 1 in (25 mm) wide, surface-mounted trim.
 7. Hinges: Continuous piano.
 8. Automatic Closer: Spring type.
 9. Latch: Self-latching device operated by flush key with interior release.
 10. Size: 12 in by 12 in (300 mm by 300 mm); unless otherwise indicated.
 11. Basis of Design: Nystrom Building Products, Model IT.
- G. Fire-Rated, Insulated, Flush Access Doors and Trimless Frames:
1. Locations:
 - a. Gypsum board wall and ceiling surfaces.
 - b. Plaster wall and ceiling surfaces.
 2. Fabricated from one of the following as scheduled at the end of this Section.

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- a. Steel sheet.
 - b. Metallic-coated (galvanized) steel sheet.
 - c. Stainless-steel sheet.
- 3. Fire-Resistance Rating: Not less than 1-1/2 hours.
 - 4. Temperature Rise Rating: 250 deg F (139 deg C) at the end of 30 minutes.
 - 5. Door: Flush panel with a core of mineral-fiber insulation enclosed in sheet metal with a minimum thickness of 0.036 in (0.9 mm).
 - 6. Frame: Minimum 0.060 in (1.5 mm) thick sheet metal with drywall bead.
 - 7. Hinges: Continuous piano.
 - 8. Automatic Closer: Spring type.
 - 9. Latch: Self-latching device operated by flush key with interior release.
 - 10. Size: 12 in by 12 in (300 mm by 300 mm); unless otherwise indicated.
 - 11. Basis of Design:
 - a. Gypsum Board: Nystrom Building Products, Model IW.
 - b. Plaster: Nystrom Building Products, Model IP.

2.8 FLOOR ACCESS DOORS AND FRAMES

- A. Floor Doors, General: Equip each door with adjustable counterbalancing springs, heavy-duty hold-open arm that automatically locks door open at 90 degrees, release handle with red vinyl grip that allows for one-handed closure, and recessed lift handle.
- B. Watertight Aluminum Floor Door: Single-leaf opening. Extruded-aluminum gutter frame with NPS 1-1/2 (DN 40) drainage coupling and 1/4 in (6 mm) thick, diamond-pattern, aluminum tread plate door; watertight; loading capacity to support 300-lbf/sf (14.4-kN/sm) pedestrian live load. Aluminum mill finish.
 - 1. Hinges: Heavy-duty, aluminum butt hinges with stainless steel pins.
 - 2. Latch: Stainless steel slam latch with removable outside handle.
 - 3. Lock: Keyed deadbolt lock.
 - 4. Hardware Material: Stainless steel, including latch and lifting mechanism assemblies, hold-open arms, and all brackets, hinges, pins, and fasteners.
 - 5. Size: As indicated on drawings.
 - 6. Basis of Design: Nystrom Building Products, Model FDDP.
- C. Fire Rated Aluminum Floor Door: Single-leaf opening. 1/4 in (6 mm) thick aluminum frame with neoprene cushion and continuous anchor flange, and 1/4 in (6 mm) aluminum door with 1 in (25 mm) recess to receive minimum 1/2 in (12 mm) concrete and finish flooring material; loading capacity to support 150-lbf/sf (7.2-kN/sm) pedestrian live load. Aluminum mill finish with bituminous coating on exterior of frame.
 - 1. Hinge: Type 316 stainless steel, continuous.
 - 2. Latch: Type 316 stainless steel slam latch with inside cable release handle and outside removable key handle with gasketed cover plug.
 - 3. Spring: Compression spring operators enclosed in telescopic tubes.
 - 4. Hold-Open Arm: Hydraulic hold-open system to automatically hold door in open position.
 - 5. Self-Closing: Self-contained pneumatic automatic close and latch system when temperature exceeds 165 deg F (73.9 deg C).
 - 6. Fire Proofing: Intumescent coating on inside of door and frame.
 - 7. Fire-Resistance Rating: Not less than 2 hours.
 - 8. Finish painted in yellow with wording "FIRE DOOR - DO NOT STORE MATERIALS ON SURFACE".
 - 9. Size: As indicated on drawings.

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10. Basis of Design: The Bilco Company, Type FR Fire Rated Door.
- D. Aluminum Floor Door: Single-leaf opening. Extruded-aluminum angle frame with 1/4 in (6 mm) thick, diamond-pattern, aluminum tread plate door; nonwatertight; loading capacity to support 300-lbf/sf (14.4-kN/sm) pedestrian live load.
 1. Hinges: Heavy-duty, aluminum butt hinges with stainless steel pins.
 2. Latch: Stainless steel slam latch with removable outside handle.
 3. Lock: Keyed deadbolt lock.
 4. Hardware Material: Stainless steel, including latch and lifting mechanism assemblies, hold-open arms, and all brackets, hinges, pins, and fasteners.
 5. Size: As indicated on drawings.
 6. Basis of Design: Nystrom Building Products, Model FHA.
- E. Steel Angle-Frame Floor Door: Single-leaf opening. Galvanized structural-steel frame with 3/16 in (5 mm) thick, diamond-pattern, galvanized structural-steel tread plate door; nonwatertight; loading capacity to support 300-lbf/sf (14.4-kN/sm) pedestrian live load.
 1. Hinge: Type 316 stainless steel butt hinges bolted to door and frame.
 2. Latch: Type 316 stainless steel slam latch with inside lever handle and outside removable key handle.
 3. Spring: Type 316 stainless steel compression springs enclosed in tubes.
 4. Hold-Open Arm: Type 316 stainless steel handle that automatically locks door at 90 deg. when opened.
 5. Fire-Resistance Rating: Not less than 3 hours.
 6. Finish painted in yellow with wording "FIRE DOOR - DO NOT STORE MATERIALS ON SURFACE".
 7. Size: As indicated on drawings.
 8. Basis of Design: Nystrom Building Products, Model FHR Fire Marshall.

2.9 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.
 1. Gypsum Board Locations: For trimless frames with drywall bead, provide edge trim for gypsum board securely attached to perimeter of frames.
 2. Plaster Locations: For trimless frames with plaster bead for full-bed plaster applications, provide zinc-coated expanded metal lath and exposed casing bead welded to perimeter of frames.
 3. Provide mounting holes in frames for attachment of units to metal framing.
 4. Provide mounting holes in frame for attachment of masonry anchors.
- D. Recessed Access Doors: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling.
 1. Plaster Locations: For recessed doors with plaster infill, provide self-furring expanded metal lath attached to door panel.

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- E. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
 - 1. For cylinder lock, furnish two keys per lock and key all locks alike.
 - 2. For recessed panel doors, provide access sleeves for each locking device. Furnish plastic grommets and install in holes cut through finish.
 - F. Extruded Aluminum at Floor Doors: After fabrication, apply manufacturer's standard protective coating on aluminum that will come in contact with concrete.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

3.2 INSTALLATION, GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
 - 1. Respective manufacturer's written installation instructions.
 - 2. Accepted submittals.
 - 3. Contract Documents.

3.3 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects or errors which would result in poor or potentially defective installation or would cause latent defects in Work.
- B. Advise installers of other work about specific requirements relating to access door and floor door installation, including sizes of openings to receive access door and frame, as well as locations of supports, inserts, and anchoring devices.

3.4 INSTALLATION OF ACCESS DOORS AND FRAMES

- A. Frames with Masonry Anchors: Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.
- B. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.5 ADJUSTING AND CLEANING

- A. Adjust doors and hardware after installation for proper operation.
- B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

3.6 ACCESS DOOR SCHEDULE

- A. Provide access doors where indicated on the drawings and as follows:
 - 1. Steel Access Doors:
 - a. Concealed valves and controls for plumbing and HVAC.
 - b. Fire dampers above non-accessible ceilings.
 - c. Motor operated doors and grilles above non-accessible ceilings.

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- d. Other locations not scheduled below.
- 2. Fire-Rated Steel Access Doors:
 - a. Rated walls and ceilings.
- 3. Metallic-Coated (Galvanized) Steel Access Doors:
 - a. Exterior locations.
- 4. Stainless Steel Access Doors:
 - a. Ceramic tile and other damp locations.
- 5. Glass-Fiber-Reinforced Gypsum (GFRG) Access Doors:
 - a. Gypsum board walls and ceilings.
- 6. Fire-Rated Floor Access Doors:
 - a. Rated floors.

END OF SECTION

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SECTION 084400
GLAZED ALUMINUM FRAMING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Glazed aluminum framing systems and supplementary items necessary for installation.
 - 1. Factory fabricated unitized system, aluminum curtain wall and window wall systems.
 - 2. Factory fabricated unitized system, custom aluminum curtain wall and window wall systems.
 - 3. Aluminum storefront systems.
- B. Related Requirements:
 - 1. Refer to Division 01 Section Field Test for Air and Water Leakage.

1.2 DEFINITIONS

- A. Water Leakage: Uncontrolled water penetrating assemblies or water appearing on assemblies' normally exposed interior surfaces, or water that is not contained and drained to the exterior, or water that may damage adjacent materials or finishes. Water leakage does not include water controlled by flashing and gutters that is drained to exterior.
 - 1. Uncontrolled: Infiltrated water that is not captured, controlled or managed by flashings, gutters, and sills to drain to exterior, or water that wets perimeter containment system, wall insulation or exposed interior surfaces.
 - 2. Controlled: Infiltrated water that is captured, controlled or managed by flashings, gutters, and sills to drain to exterior, or water that does not wet perimeter containment system, wall insulation or exposed interior surfaces.
- B. Sloped Glazing: Glass and framing assembly sloped more than 15 degrees from the vertical plane forming a roof. Sloped glazing serves as the roof for an area of the building.

1.3 DELEGATED ENGINEERING REQUIREMENTS

- A. Delegated Engineering Responsibility: Contractor shall engage a qualified professional engineer to provide engineering for products and systems required to comply with the design intent of Contract Documents.
 - 1. Contract Documents Design Intent: Drawings and Specifications indicate design intent for products and systems and do not necessarily indicate or specify total Work required. Contract Documents shall not be construed as an engineered design; furnish and install Work required for a complete installation.
 - 2. Delegated Engineer Professional Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated with a record of successful in-service performance. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.
 - 3. Submittals: Preparation of structural analysis data including engineering calculations, shop drawings and other submittals signed and sealed by the qualified professional engineer.
 - 4. Coordination of Work:
 - a. Product Variations: In the event of minor differences between products and systems of acceptable or available manufacturers, Contractor shall notify Architect

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of such differences and resolve conflicts in a timely manner. Failure of Contractor to provide notification shall be construed as acceptance of conditions indicated, and changes caused by minor differences between products and Contract Documents shall be included in the Work at no additional cost to Owner.

- b. Allowable Adjustments: Minor dimension and profile adjustments may be made in interest of fabrication or erection methods or techniques or ability to satisfy design intent, provided design intent is maintained as determined by Architect. Proposed deviations shall include a detailed analysis of impact to adjacent substrates or other building systems, including related design or construction cost impacts. If accepted by Architect, deviations causing changes in materials, constructability, substrates, or conditions shall be included in the Work at no additional cost to Owner.

1.4 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
 - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
- B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components and attachments to other work. Distinguish between shop and field-assembled work.
 - 1. Prepared by manufacturer, not installer.
 - a. Shop drawings not prepared by manufacturer shall include manufacturer's written approval on shop drawings.
 - b. Shop drawings shall contain seal of a structural engineer currently registered in licensing jurisdiction of the project and a written statement that the framing system conforms to project requirements, applicable codes, and specified conditions.
 - 2. Include typical unit elevations at 1/2 in (12 mm) scale and details at full scale.
 - 3. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
 - 4. Indicate where and how the system deviates from Contract Documents.
 - 5. Provide material properties and other information needed for structural analysis including computations, prepared, signed and sealed by a structural engineer licensed to practice in the jurisdiction where the project is located.
 - a. Calculations shall include but not limited to the following:
 - 1) Section properties for framing members.
 - 2) Analysis of framing members.
 - 3) Analysis of anchors and embedded anchors in concrete structure.
 - 4) Analysis of stress in structural silicone.
 - 5) Analysis of glass thicknesses and strength.
 - 6. Submittal shall contain statement explaining how proposed system design will accommodate infiltrated and condensate water.
 - 7. Design Modifications: If design modifications are proposed to meet performance requirements and field conditions, submit design calculations and Shop Drawings. Do not adversely affect the appearance, durability, or strength of units when modifying details or materials and maintain the general design concept.
 - 8. Include full-size isometric details of typical and special conditions within the system, showing the following:
 - a. Mullion details, including reinforcement and stiffeners.
 - b. Joinery details, including concealed welds.

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- c. Anchorage.
 - d. Expansion provisions.
 - e. Glazing details.
 - f. Flashing and drainage details.
 - g. Weather-stripping and weather seals within curtain wall framing.
 - h. Thermally improved details.
 - i. Perimeter weather seals and structural seals.
 - j. Interface with other building construction.
 - k. Identification and detail of perimeter fire containment system.
 - l. De-glazing and re-glazing procedures.
 - 1) Unless indicated otherwise, framing and glass shall be designed to be re-glazed from the exterior using original glass size and gaskets without modification to framing. Comply with manufacturer recommended re-glazing procedure.
 - m. Attachment details, including thickness of curtain wall components, designed to receive lightning protection system.
9. Submit insert/embed drawings including layout and enlarged details. Include detail and engineering calculations for field modifications due to location and/or omitted inserts/embeds.
10. Window System Operators for Operable Window Vent Systems: Show locations, mounting, and details for installing operator components and controls.
- C. Samples for Verification: For each type of exposed finish required, prepared on samples of size indicated below.
- 1. Exposed Finishes: 12 in (300 mm) long sections of extrusions or formed shapes, 6 in (150 mm) squares of sheet or plate, each finish type and color.
 - 2. Sealants and Gaskets: 12 in (304 mm) minimum length for sealant or gasket glazed joint, each type and color.
- 1.5 INFORMATIONAL SUBMITTALS
- A. Manufacturer's Project Acceptance Document: Certification by the manufacturer that its products and systems are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required, and that a warranty will be issued.
 - B. Delegated Engineering Submittal: For products and systems indicating compliance with performance requirements. Include structural analysis, calculations and other performance data signed and sealed by the qualified professional engineer responsible for their preparation.
 - C. Energy Performance Certificates: For glazed aluminum framing systems, accessories, and components.
 - 1. Basis for Certification: Certified by manufacturer for energy performance ratings as determined in accordance with NFRC.
 - D. U-Value and Condensation Evaluation: Determine wall system U-Value and provide condensation evaluation using NFRC approved version of Lawrence Berkeley National Laboratory THERM software for simulations. Submit isothermal condensation results, including isothermal graphics, for temperature limits of wall system components.
 - E. Product Test Reports: Written reports based on evaluation of comprehensive tests performed by qualified testing agency indicating that each product complies with requirements.

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1. Anchors and Fasteners: Tested and qualified for use in accordance with ICC-ES or other product approval acceptable to authorities having jurisdiction.
 - F. Field Quality Control Reports: Written report of testing and inspection required by Field Quality Control.
 - G. Warranty:
 1. Provide manufacturer's written warranty covering materials and installation (labor) stating obligations, remedies, limitations and exclusions.
- 1.6 CLOSEOUT SUBMITTALS
- A. Maintenance Data: To include in maintenance manuals.
 1. Structural-Sealant Glazing: For structural-sealant glazing, include ASTM C 1401 recommendations for post-installation-phase, quality-control program.
- 1.7 QUALITY ASSURANCE
- A. Installer Qualifications:
 1. Experience: Installer's personnel with not less than 5 years of experience in the successful performance of Work similar in scope to this Project.
 2. Supervision: Installer shall maintain a competent supervisor at Project while the Work is in progress, and who has not less than 5 years of experience installing products and systems similar in scope to this Project.
 3. Manufacturer Acceptance: Installer shall be certified, approved, licensed, or acceptable to manufacturer to install products.
 - a. Subcontractor Responsibility: Work included in this Technical Section shall be performed by a qualified single subcontractor solely responsible for engineering, fabrication and installation of the Work.
 - B. Welding Qualifications: Qualify procedures and personnel according to AWS qualification requirements and the following:
 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel".
 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum".
 - C. Energy Performance Standards: Comply with NFRC for minimum standards of energy performance, materials, components, accessories, and fabrication. Comply with more stringent requirements when indicated.
 - D. Structural-Sealant Glazing: Comply with ASTM C 1401 "Guide for Structural Sealant Glazing" for design and installation of glazed aluminum wall systems utilizing structural-sealant glazing.
 1. Structural-Sealant Joints: Design reviewed and approved by structural-sealant manufacturer.
 2. Comply with ASTM C 1135 Standard Test Method for Determining Tensile Adhesion Properties of Structural Sealants.
- 1.8 PRECONSTRUCTION TESTING
- A. Preconstruction Sealant Testing: Perform sealant manufacturer's standard tests for compatibility with and adhesion of each material that will be in contact with sealants and for each condition.
 1. Test a minimum five production-run samples each of metal, glazing, and other material.
 - a. Include all adjacent materials with watertight seals to curtain wall systems.

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2. Prepare samples using techniques and primers required for installed assemblies.
3. Perform tests under environmental conditions that duplicate those under which assemblies will be installed.
4. For materials that fail tests, determine corrective measures necessary to prepare each material to ensure compatibility with and adhesion of sealants including, but not limited to, specially formulated primers. After performing these corrective measures on the minimum number of samples required for each material, retest materials.

1.9 MOCKUPS

- A. Mock-ups: Prior to fabrication and installation, build mock-up for each form of construction and finish required to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mock-up using materials indicated for the completed Work.
 1. Build mock-up in the location and of the size indicated or, if not indicated, as directed by Architect. Contractor shall provide structural support framework.
 - a. Show typical components, attachments to building structure, and requirements of installation.
 2. Notify Architect seven days in advance of the dates and times when mock-up will be installed.
 3. Obtain Architect's acceptance of mock-ups before starting fabrication or installation.
 4. Acceptance of mock-ups does not constitute acceptance of deviations from the Contract Documents contained in mock-ups unless such deviations are specifically noted by Contractor and accepted by Architect in writing.
 5. Demolish and remove mock-ups when directed by Architect unless accepted to become part of the completed Work.

1.10 PRE-INSTALLATION CONFERENCE

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.
 1. Participants:
 - a. Architect.
 - b. Contractor, including superintendent.
 - c. Installer, including project manager and supervisor.
 - d. If requested, Manufacturer's qualified technical representative.
 - e. Installers of other construction interfaced with Work.
 2. Minimum Agenda: Installer shall demonstrate understanding of the Work required by describing detailed procedures for preparing, installing, and cleaning the Work. Demonstration shall include, but not be limited to, following topics:
 - a. Tour representative areas of Work, inspect and discuss condition of substrate, and other preparatory work performed by other trades.
 - 1) Review construction tolerances for structural frame and construction surveying requirements.
 - b. Review Contract Document Requirements.
 - c. Review approved submittals.
 - d. Review inspection and testing requirements.
 - e. Review environmental conditions and procedures for coping with unfavorable conditions.
 - f. Resolve deviations or differences between Contract Documents and the manufacturer's specifications.

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3. Record discussions, including decisions and agreements, and prepare report.
- 1.11 DELIVERY, STORAGE, AND HANDLING
- A. Protect materials according to manufacturer's written instructions.
 - B. Prevent damage to framing, glass and glazing materials from abrasion, soiling, contamination, wetting or condensation, temperature changes, direct exposure to sun, or other causes.
 1. Use crating, stacking and storage procedures that prevent damage to finishes and gaskets.
- 1.12 PROJECT CONDITIONS
- A. Field Measurements: Where products and systems are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication.
- 1.13 COORDINATION
- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.
- 1.14 WARRANTY
- A. Manufacturer's Warranty: Furnish manufacturer's written material and labor warranty signed by an authorized representative using manufacturer's standard form agreeing to furnish materials and labor required to repair or replace work which exhibits material defects caused by manufacture or design and installation of product. "Defects" is defined to include but not limited to deterioration or failure to perform as required.
 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Thermal stresses transferring to building structure.
 - c. Glass breakage.
 - d. Noise or vibration created by wind and thermal and structural movements.
 - e. Loosening or weakening of fasteners, attachments, and other components.
 - f. Deterioration of metals and other materials beyond normal weathering.
 - g. Water penetration through fixed glazing and framing areas.
 - h. Air infiltration exceeding performance requirements.
 - i. Adhesive or cohesive sealant failures.
 - j. Failure of operating components.
 2. Warranty Period: Manufacturer shall warrant the products to be free from material and labor Defects for a period of 5 years from date of Substantial Completion
 - B. Installer's Warranty: Furnish installer's written workmanship warranty signed by an authorized representative using installer's standard form agreeing to provide labor required to repair or replace work which exhibits workmanship defects. "Defects" is defined to include but not limited to deterioration or failure to perform as required.
 1. Warranty Period: Installer shall warrant the installation to be free from workmanship Defects for a period of 2 years from date of Substantial Completion.
 - C. Factory Applied Finish Warranty for Anodic Finishes: Furnish manufacturer's written warranty signed by an authorized representative using manufacturer's standard form agreeing to repair finish or replace work which exhibits finish defects. "Defects" is defined to include but not limited to deterioration or failure of finish to perform as required.
 1. Warranty Period: Manufacturer shall warrant the installation to be free from finish defects for a period of 5 years from date of Substantial Completion.

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PART 2 - PRODUCTS

2.1 MANUFACTURERS AND PRODUCTS

- A. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".
- B. Manufacturers:
 - 1. Baker Metal Products Inc.
 - 2. Bruce Wall Systems Corporation.
 - 3. C.R. Laurence - US Aluminum.
 - 4. EFCO Corporation, a Pella Company.
 - 5. Harmon Inc.
 - 6. Insulgard Security Products.
 - 7. Kawneer North America; an Alcoa Company.
 - 8. Oldcastle BuildingEnvelope.
 - 9. YKK AP America Inc.
- C. Available Manufacturers: Subject to compliance with requirements of Contract Documents as judged by the Architect.
- D. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other manufacturers offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.
 - 1. Storefront System: Model TTH600, thermally broken framing system:
 - a. Basis of Design: Insulgard Security Products, Model TTH600
 - 2. Glass Entry Doors; Model TH350 FEMA Doors. Single and double, as indicated on drawings. Wide stile doors.
 - 3. Glass: Model Tor-Gard 40, 1.610 inch glass clad polycarbonate assembly.
 - 4. Hollow Metal Door: Wind and impact resistant with insulated core. Furnish with hollow metal frames and hardware as tested with assembly. Prime finish for field painting.
 - 5. Hollow Metal Door Manufacturers and Products:
 - a. Allegion; Steelcraft "Paladin Series", glass light steel tornado doors (Basis of Design).
 - b. ASSA ABLOY; Ceco Door, "StormPro" tornado resistant assemblies.
 - c. Rocky Mountain Metals, Inc.; Tornado resistant openings.
 - 6. Accessories:
 - a) Anchors: Fully concealed in accordance with requirements of delegated design requirements
 - b) Steel extension anchor plates as required by delegated design.

2.2 MATERIALS, GENERAL

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

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2.3 PERFORMANCE REQUIREMENTS

- A. General Performance: Comply with performance requirements specified, as determined by testing of products and systems representing those indicated for this Project, without failure due to defective manufacture, fabrication, installation, or other defects in construction.
1. Failure includes but is not limited to the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Thermal stresses transferring to building structure.
 - c. Glass breakage.
 - d. Noise or vibration created by wind and thermal and structural movements.
 - e. Loosening or weakening of fasteners, attachments, and other components.
 - f. Deterioration of metals and other materials beyond normal weathering.
 - g. Water penetration through fixed glazing and framing areas.
 - h. Air infiltration exceeding performance requirements.
 - i. Failure of operating units
- B. Structural Loads: Engineer products and systems to withstand loads within limits of allowable working stresses of the materials involved under conditions indicated including, but not limited to gravity, wind, seismic, and erection design loads and thermal movements established by authorities having jurisdiction, applicable building codes, and as indicated.
1. Wind Loads: As indicated on Drawings or Wind Analysis Report.
 2. Other Loads: As indicated on Drawings.
- C. Structural Movement: Engineer system to withstand movements of supporting structure including, but not limited to inter-story drift, twist, column shortening, long-term creep and deflection from uniformly distributed and concentrated live loads:
1. Live Load Deflection: Accommodate differential vertical deflection of floors:
 - a. Deflection: As indicated on Drawings.
 - b. Test Performance: Complying with criteria for passing based on building occupancy type when tested in accordance with AAMA 501.7 at design displacement and 1.5 times the design displacement.
 2. Inter-story Drift: Accommodate inter-story drift between adjacent floors perpendicular and/or parallel to the wall:
 - a. Design Displacement: As indicated on Drawings.
 - b. Test Performance: Complying with criteria for passing based on building occupancy type when tested in accordance with AAMA 501.4 at design displacement and 1.5 times the design displacement.
 - c. Connections shall permit movement in the plane of the panel for inter-story drift and shall be properly designed sliding type connections using slotted or over-sized holes, or connections permitting movement by bending of steel or other connections providing equivalent sliding and ductile capacity.
 - 1) Connector bodies shall have sufficient ductility and rotational capacity to prevent fracture of concrete or brittle failure near welds.
 - 2) Fasteners embedded in concrete shall be attached to reinforcing steel or otherwise terminated to effectively transfer forces to the reinforcing steel in accordance with applicable Building Code requirements.
- D. Deflection of Framing Members: At design wind load in accordance with the Building Code.
1. Deflection Normal to Wall Plane: Edge deflection of individual glazing lites limited to 1/175 for glass edge lengths up to 13 feet 6 inches (4.1 m), and limited to 1/240 plus 1/4 inch (6.35 mm) for glass edge lengths greater than 13 feet 6 inches (4.1 m) and less than

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40 feet (12 m), when designed in accordance with AAMA TIR A11-15 and tested in accordance with ASTM E 330/E330M-14.

a. Exceptions:

- 1) Where a sealant joint occurs between a framing member and a relatively stiff building element, framing member deflection not more than 1/2 of nominal joint width, or less if required by sealant manufacturer.

b. Span is defined as the distance between anchor center line.

2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 in (3 mm).

a. Operable Units (Doors or Windows): Provide a minimum 1/16 in (1.6 mm) clearance between framing members and operable units.

3. Cantilever Deflection: Where framing members overhang an anchor point, as follows:

a. Perpendicular to Plane of Wall: No greater than 2L/175 where L is the cantilever length.

4. Deflection of Framing System Interior Trim: Center deflection of interior trim shall not exceed 1/4 in (6 mm) when subjected to a 250 pound (113 Kg) vertical concentrated load. No permanent deformation allowed when load is removed.

a. Window sill extension trim.

b. Slab edge covers.

E. Structural Test Performance: Test according to ASTM E 330/330M as follows:

1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

F. Water Penetration under Static Pressure for Storefront System: Test in accordance with ASTM E 331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested in accordance with a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 10 lbf/sf (480 Pa).

G. Water Penetration under Static Pressure for Curtain Wall and Window Wall Systems: Test in accordance with ASTM E 331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested in accordance with a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 12 lbf/sf (576 Pa).

H. Water Penetration under Dynamic Pressure for Curtain Wall and Window Wall Systems: Test in accordance with AAMA 501.1 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested in accordance with a dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 12 lbf/sf (576 Pa).

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- I. Maximum Water Leakage: No uncontrolled water penetrating assemblies or water appearing on assemblies' normally exposed interior surfaces. Water leakage does not include water controlled by flashing and gutters that is drained to exterior.
 - 1. Provide drainage to exterior of wall for water entering at joints or glazing reveals, condensation occurring within assemblies, secondary water from adjacent wall systems and similar conditions.
 - a. Provide internal gutters and weep system to collect and drain water leakage and condensation to the exterior.
 - 1) Stick framed curtain wall systems and punched windows shall have an isolated gutter cavity at each glass perimeter such that leakage is confined to and weeped from the opening where leakage originated.
 - 2) Unitized curtain walls shall have continuous spliced gutters at horizontal stack joints with sealed end caps at termination conditions.
 - 3) Window wall shall have a continuous gutter and weep holes at the glass sill and a continuous gutter at the glass head that drains directly to exterior or directs leakage from spandrel above to the window sill.
 - b. Provide continuous subsill below windows with interlocking mullions.
 - c. Coordinate gutter and weep systems with drainage provisions with adjacent construction.
 - d. Coordinate connection of drainage members at columns, spandrel beams and other areas with limited access.
 - e. The use of carbon steel components for gutter and drainage assemblies is prohibited; provide stainless steel or aluminum components.
- J. Energy Performance: Certified or labeled by manufacturer for energy performance ratings in accordance with NFRC.
 - 1. Thermal Transmittance (U-Factor) - Fixed Vision Glazing and Framing Areas: U-factor as determined in accordance with NFRC 100.
 - a. Maximum U-Factor: As indicated on Drawings, comply with building energy performance model for this project.
 - 2. Thermal Transmittance (U-Factor) - Fixed Spandrel Glazing, Metal Panels and Framing Areas: U-factor as determined in accordance with NFRC 100.
 - a. Maximum U-Factor: As indicated on Drawings, comply with building energy performance model for this project.
 - 3. Solar Heat Gain Coefficient (SHGC) - Fixed Glazing and Framing Areas: Solar Heat Gain Coefficient as determined in accordance with NFRC 200.
 - a. Maximum SHGC: As indicated on Drawings, comply with building energy performance model for this project.
 - 4. Air Leakage - Glazed Aluminum Wall and Storefront:
 - a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than **0.06 cfm/sf (0.30 L/s/sm)** at a minimum static-air-pressure differential of **6.24 lbf/sf (300 Pa)** when tested in accordance with ASTM E 283.
 - 5. Condensation Resistance: Condensation resistance as determined in accordance with NFRC 500.
 - a. Fixed Glazing and Framing Areas: No condensation allowed under design conditions indicated.

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- K. Noise Reduction: Test in accordance with ASTM E90, with ratings determined by ASTM E1332, as follows:
 - 1. Outdoor-Indoor Transmission: Minimum Class 34.
- L. Building Maintenance Equipment: Engineer units supporting building maintenance equipment to resist pull-out and horizontal shear forces transmitted from equipment.
- M. Windborne-Debris-Impact-Resistance Performance: Comply with missile impact and cyclic-pressure testing requirements for Wind Zone and facility type.
- N. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:
 - 1. Temperature Change (Range): 120 deg F (49 deg C), ambient; 180 deg F (82 deg C), material surfaces.
 - 2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance.
 - a. Fabrication, assembly and erection procedures shall take into consideration the ambient temperature range at the time of each operation.
- O. Structural-Sealant Joints:
 - 1. Design reviewed and approved by structural-sealant manufacturer.
- P. Structural-Sealant: ASTM C1184. Capable of withstanding tensile and shear stresses imposed by glazed aluminum wall systems without failing adhesively or cohesively. When tested for preconstruction adhesion and compatibility, cohesive failure of sealant shall occur before adhesive failure.
 - 1. Adhesive failure occurs when sealant pulls away from substrate cleanly, leaving no sealant material behind.
 - 2. Cohesive failure occurs when sealant breaks or tears within itself but does not separate from each substrate because sealant-to-substrate bond strength exceeds sealant's internal strength.
- Q. Dimensional Tolerances: Engineer products and systems to accommodate dimensional tolerances of framing members and adjacent construction.

2.4 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - 1. Sheet and Plate: ASTM B 209 / B 209M.
 - 2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 / B 221M.
 - 3. Extruded Structural Pipe and Tubes: ASTM B 429 / B 429M.
 - 4. Structural Profiles: ASTM B 308 / B 308M.
 - 5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.
- B. Steel Internal Reinforcement: Shapes and sizes to suit installation meeting delegated engineered performance requirements, as indicated on Shop Drawings.
 - 1. Structural Shapes, Plates, and Bars: ASTM A 36 / A 36M.
 - 2. Cold-Rolled Sheet and Strip: ASTM A 1008 / A 1008M.
 - 3. Hot-Rolled Sheet and Strip: ASTM A 1011 / A 1011M.
 - 4. Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer, complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

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2.5 GLAZED ALUMINUM FRAMING SYSTEMS

- A. Framing Members: Manufacturer's standard formed- or extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.
 - 1. Structural Thermal Barriers: Provide thermally improved system in compliance with energy model and condensation performance requirements.
 - 2. Field installation of four-sided structural glazing is not allowed.
 - a. Where shop installation of four-sided structural glazing is not feasible, submit proposed field installation locations to Architect for review.
- B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with non-staining, nonferrous shims for aligning system components.
 - 1. Shims:
 - a. Structural Connections: Series 300 Stainless Steel; ASTM A 36 or ASTM A 283 hot-dipped galvanized steel.
 - 1) Dynamic Connections: Molybdenum disulfide filled nylon lubricated pads or washers.
 - b. Non-Structural Connections: U-shaped polystyrene.
 - c. Static Non-Load Transfer Connections: Korolath high-impact polystyrene pads.
 - 2. For connections where shim height is greater than twice the bolt diameter, provide steel or aluminum shims.
 - a. Plastic shims are acceptable only in locations where shim height is less than twice the bolt diameter or fully bearing locations where there is no bending induced into the bolt anchor.
 - 3. Mechanically restrain shims in dynamic connections to remain in place.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding fasteners and accessories compatible with adjacent materials. Domestically manufactured only.
 - 1. Manufacturers and Products - Self Drilling, Self Tapping Screws:
 - a. Elco; Dril-Flex Structural Self-Drilling Screws.
 - b. Hilti; Kwik-Flex Structural Self-Drilling Screws.
 - 2. Manufacturers and Products - Series 300 Stainless Steel Fasteners:
 - a. Elco; Bi-Flex 300 SS with Stalgard.
 - b. Elco; Alumi-Flex 302 SS with Stalgard.
 - c. SFS; Bi-Met 300.
 - 3. Use Series 300 Stainless Steel fasteners for joining framing members and fasteners located in wet areas including fasteners penetrating the waterline and covered with sealant.
 - 4. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 - 5. Reinforce members as required to receive fastener threads.
 - 6. Use concealed fasteners; exposed fasteners are not allowed.
 - a. At locations where exposed fasteners are unavoidable and approved by Architect, use exposed fasteners with countersunk Phillips screw heads finished to match framing system.

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7. Storefront: Furnish heavy duty aluminum sill pan with integral welded or fastened and structurally sealed end dams, typical.
- D. Anchors: Three-way adjustable anchors that accommodate fabrication and installation tolerances in material and finish and are compatible with adjoining materials and recommended by manufacturer. Domestically manufactured only.
 1. Concrete and Masonry Inserts:
 - a. Product Quality Standards: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123 / A 123M or ASTM A 153 / A 153M requirements.
 - b. Manufacturers:
 - 1) Halfen.
 - 2) Hilti.
 - 3) Jordahl.
 - 4) Unitstrut.
 2. Post Installed Expansion Anchors:
 - a. Product Quality Standards: Tested and qualified for use in accordance with ACI 355.2, ACI 318 and ICC-ES AC193 for cracked, uncracked and seismic concrete recognition.
 - 1) Material and Finish: Stainless steel ASTM F 593 Group 1 (Alloy 304/316), mechanically deposited ASTM B 695 or hot-dip zinc coating ASTM A 153 Class C. Thickness not less than 0.0002 inches.
 - b. Acceptable Manufacturers:
 - 1) Dewalt.
 - 2) Hilti.
 - 3) ITW.
 - 4) Simpson.
 - c. Not Acceptable: Chemical type anchors for overhead dead load connectors.
 3. Threaded Concrete Anchors:
 - a. Product Quality Standards: Tested and qualified for use in accordance with ACI 355.2, ACI 318 and ICC-ES AC193 for cracked, uncracked and seismic concrete recognition.
 - 1) Material and Finish: Carbon steel with corrosion resistant coating, not less than 1000 hours of salt spray resistance according to ASTM B 117; 300 Series Stainless Steel, non-magnetic.
 - 2) Anchor Thickness: 3/8 inch minimum.
 - b. Acceptable Manufacturers:
 - 1) Dewalt.
 - 2) Elco.
 - 3) Hilti.
 - c. Condition of Use: Shall not be used in overhead dead load connections supporting sustained load in tension.
- E. Concealed Flashing: Dead-soft, 0.018 in (0.45 mm) thick stainless steel, ASTM A 240 / A 240M of type recommended by manufacturer.
- F. Framing System Gaskets and Sealants: Refer to Division 08 Section "Glazing."

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1. EPDM Gaskets: EPDM shall be isolated from direct contact with silicone; including but not limited to the secondary perimeter silicone seal of insulating glass units.
 - a. Provide silicone gaskets where gaskets are in contact with silicone sealant.
 - G. Pressure Caps: Manufacturer's standard aluminum components that mechanically retain glazing.
 1. Include snap-on aluminum trim that conceals fasteners.
 2. At pressure caps, use ASTM A 193 / A 193M stainless-steel screws.
 - H. Glazed-In Aluminum-Faced Composite Wall Panels: Comply with Division 07 Section "Composite Metal Wall Panels."
 - I. Glazed-In Aluminum-Faced Insulated-Core Metal Panels: Comply with Division 07 Section "Insulated Metal Wall Panels."
 - J. Glazed-in Aluminum Plate Wall Panels: Provide factory-formed, metal plate wall panels fabricated from single sheets of metal formed into profile for installation method indicated. Comply with Performance Requirements indicated in Division 07 Section "Composite Metal Wall Panels."
 1. Material: Tension-leveled, smooth aluminum sheet, **ASTM B 209 (ASTM B 209M)**, **0.125 in (3.18 mm)** thick minimum.
 2. Exterior Finish: Matching framing system.
- 2.6 SUN CONTROL DEVICES
- A. Sunshades: Assemblies consisting of manufacturer's standard outrigger brackets, louvers, and fascia, designed for attachment to curtain wall with mechanical fasteners.
 1. Basis of Design: As scheduled or indicated in Design Selections.
- 2.7 GLAZING
- A. Glazing: Provide glass of types and thicknesses indicated. Fabricate glass to sizes required for openings indicated with edge clearances and tolerances complying with manufacturer's recommendations. Comply with Division 08 Section Glazing.
 1. Glass Types: As scheduled or indicated in Design Selections.
 - B. Glazing Gaskets, Spacers, Setting Blocks, Sealant Backings, and Bond Breakers: Manufacturer's standard permanent, non-migrating types compatible with sealants and suitable for joint movement and assembly performance requirements. Comply with Division 08 Section "Glazing".
 1. Silicone Sealant Compatibility: When in direct contact with silicone sealants, gaskets, spacers and setting blocks shall be heat cured silicone rubber based material which is chemically compatible and with sufficient hardness for the purpose intended and approved in writing by the glazing and curtain wall manufacturers.
 - C. Glazing Sealants: As recommended by manufacturer for joint type.
 1. Structural-Glazing Sealant: ASTM C 1184, chemically curing silicone formulation that is compatible with system components with which it comes in contact, specifically formulated and tested for use as structural-sealant and approved by structural-sealant manufacturer for use in glazed aluminum wall assembly indicated.
 - a. Minimum Tensile Strength: **100 psi (690 kPa)**.
 - b. Modulus of Elasticity: As required by structural-sealant-glazed aluminum wall system design to meet performance requirements.

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- c. Manufacturers and Products: Subject to compliance with requirements, provide one of the following:
 - 1) Dow; DOWSIL 983 Structural Glazing Sealant.
 - 2) GE Silicones; SSG4400 Ultraglaze Sealant.
 - 3) Tremco Incorporated; Proglaze SSG.
 - d. Color: Black, unless otherwise scheduled or indicated in Design Selections Summary.
2. Weatherseal Sealant: ASTM C 920 for Type S, Grade NS, Class 50, neutral-curing silicone formulation compatible with system components with which it comes in contact, and recommended by weatherseal-sealant and curtain-wall manufacturers for this use.
- a. Joint Movement Capability: Accommodates a 50 percent increase or decrease in joint width at time of application when measured according to ASTM C 719.
 - b. Color: Black, unless otherwise scheduled or indicated in Design Selections Summary.
3. Bond-Breaker Tape: Manufacturer's standard tetrafluoroethylene-fluorocarbon or polyethylene material to which sealants will not develop adhesion.

2.8 BACK PAN

- A. Back Pan: Provide factory-formed metal pans fabricated from single sheets of metal formed into profile for installation indicated. Maintain air space between pan and interior surface of glass. Provide continuous seal at pan joints and pan perimeter.
- 1. Material: Galvanized G90 steel, minimum 0.034 in (0.86 mm) thickness.
 - 2. Curtain Wall Insulation: Minimum 2-inch thickness.
 - 3. Accessories: Spacers, cold formed framing, furring, brackets, clips, hangers and components required for complete installation.

2.9 SHADOW BOX BACK PAN

- A. Shadow Box Back Pan: Provide factory-formed metal pans fabricated from single sheets of metal formed into profile for installation indicated. Maintain air space between pan and interior surface of glass; ventilate air space when recommended by manufacturer. Provide continuous seal at pan joints and pan perimeter.
- 1. Material: Smooth aluminum sheet, ASTM B 209 (ASTM B 209M), 0.125 in (3.2 mm) thick.
 - 2. Curtain Wall Insulation: Minimum 2-inch thickness.
 - 3. Accessories: Spacers, cold formed framing, furring, brackets, clips, hangers and components required for complete installation
 - 4. Finish: As scheduled or as indicated in Design Selections.

2.10 ACCESSORY MATERIALS

- A. Joint Sealants: For installation at perimeter of glazed aluminum framing systems, as specified in Division 07 Section "Joint Sealants".
- B. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30 mils (0.762 mm) thickness per coat.
- C. Perimeter Fire-Containment System for Curtain Wall Spandrel Conditions: Safing insulation and curtain wall insulation as specified in Division 07 Section "Fire-Resistive Joint Systems".
- D. Thermal Insulating Materials: As specified in Division 07 Section Thermal Insulation.

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- E. Maintenance Equipment Anchors: As specified in Division 11 Section Building Maintenance Equipment.
- F. Cleaning Agent and Cloth: As recommended by structural-sealant manufacturer.
- G. Linings, Spacers and Sleeves: At dynamic or moving joints, provide type and materials recommended by manufacturer to provide a fully sealed penetration.

2.11 FABRICATION

- A. Do not expose unfinished or cut edges to view.
- B. Shop weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Welds shall be of adequate strength and durability, with jointing tight, flush, smooth and clean. Weld behind finished surfaces so as to cause no distortion and/or discoloration on the finished side. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
 - 1. Field welding aluminum is not allowed.
- C. Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles that is sharp, straight, and free of defects or deformations.
 - 2. Accurately fitted joints with ends coped or mitered.
 - 3. Physical and thermal isolation of glazing from framing members.
 - 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - 5. Provisions for field replacement of glazing. Provide minimum clearances and depth of glazing packets as recommended by glass manufacturer for thickness and type of glass indicated.
 - a. Structural-Sealant-Glazed Framing Members: Include accommodations for using temporary support device to retain glazing in place while structural-sealant cures.
 - 6. Fasteners, anchors, and connection devices that are concealed from view.
 - 7. Internal guttering systems or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum framing systems to exterior.
 - 8. Components curved to indicated radii.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. For Factory-Assembled and Glazed Frame Units:
 - 1. Rigidly secure non-movement joints.
 - 2. Seal joints watertight unless otherwise indicated.
 - 3. Factory-install glazing to comply with requirements in Division 08 Section "Glazing".
 - 4. Structural-Sealant Units: Prepare surfaces that will contact structural-sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.
- F. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.12 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

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- C. Concealed members may be mill finish, providing that they cannot be seen through the glass, do not contact any structural silicone or are not continually exposed to water immersion.
- D. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of accepted Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of accepted Samples and are assembled or installed to minimize contrast.
- E. Selections: As scheduled or as indicated in Design Selections.

2.13 ALUMINUM FINISHES

- A. Finish designations comply with the systems established by the Aluminum Association and AAMA / FGIA for designating aluminum finishes.
- B. Fluoropolymer Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions. Provide dry film thickness, primers, color coats and clear coats required to comply with performance requirements and warranty periods indicated.
 - 1. PVDF Fluoropolymer Finish: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat.
 - 2. FEVE Fluoropolymer Finish: Fluoropolymer finish complying with AAMA 2605 and containing 100 percent fluorinated ethylene vinyl ether (FEVE) resin in color coat.
- C. Baked Enamel Finish or Powder-Coat Finish at Interior Surfaces: At Contractor's option, provide baked enamel or powder coated finish at interior surfaces complying with AAMA 2604 except with a minimum dry film thickness of 1.2 mils (0.03 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 1. Selection: Match exterior mullions unless indicated otherwise.
- D. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
- E. Clear Anodic Finish at Interior Surfaces: AA-M12C22A31, Class II, 0.010 mm or thicker.
- F. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
- G. Color Anodic Finish at Interior Surfaces: AA-M12C22A32/A34, Class II, 0.010 mm or thicker.

2.14 COPPER-ALLOY FINISHES

- A. Finish designations for copper alloys comply with the system established for designating copper-alloy finish systems defined in NAAMM's "Metal Finishes Manual for Architectural and Metal Products".
- B. Buffed Finish, Lacquered: M21-06x (Mechanical Finish: buffed, smooth specular; Coating: clear organic, air drying, as specified below).
- C. Hand-Rubbed Finish, Lacquered: M31-M34-06x (Mechanical Finish: directionally textured, fine satin; Mechanical Finish: directionally textured, hand rubbed; Coating: clear organic, air drying, as specified below).
- D. Medium-Satin Finish, Lacquered: M32-06x (Mechanical Finish: directionally textured, medium satin; Coating: clear organic, air drying, as specified below).
- E. Statuary Conversion Coating over Satin Finish: M31-C55-06x (Mechanical Finish: directionally textured, fine satin; Chemical Finish: conversion coating, sulfide; Coating: clear, organic, air drying, as specified below)[, with color matching Architect's sample].

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- F. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of 1 mil (0.025 mm).

2.15 STAINLESS STEEL FINISHES

- A. General: Remove tool and die marks and stretch lines or blend into finish. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
- B. Directional Satin Finish: No. 4.
- C. Reflective, Directional Polish: No. 7.
- D. Mirrorlike Reflective, Nondirectional Polish: No. 8.
- E. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

2.16 SOURCE QUALITY CONTROL FOR STRUCTURAL-SEALANT-GLAZED SYSTEMS

- A. Structural-Sealant-Glazed Systems: Perform quality-control procedures complying with ASTM C 1401 recommendations including, but not limited to, assembly material qualification procedures, sealant testing, and assembly fabrication reviews and checks.
 - 1. Structural-sealant-glazed system will be considered defective if it does not pass tests and inspections.
 - 2. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

3.2 INSTALLATION, GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
 - 1. Respective manufacturer's written installation instructions.
 - 2. Accepted submittals.
 - 3. Contract Documents.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by isolating metals and other materials from direct contact with incompatible materials.
 - 1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer, applying sealant or tape, or installing nonconductive spacers as recommended by manufacturer for this purpose.
 - 2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

3.3 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors

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which would result in poor or potentially defective installation or would cause latent defects in Work.

1. Furnish inserts for setting in concrete forming, and similar work required to support glazed aluminum wall system.
2. Field measure and verify governing dimensions, including floor elevations, floor-to-floor heights, minimum clearance between wall system and structural frames and other permissible dimensional tolerances in building frame.
 - a. Survey all embeds and floor elevations to confirm correct location above established benchmarks.

3.4 INSTALLATION OF GLAZED ALUMINUM FRAMING SYSTEMS

A. General:

1. Do not install damaged components.
2. Fit joints between aluminum components to produce hairline joints free of burrs and distortion.
3. Rigidly secure non-movement joints.
4. Install anchors with separators and isolators to prevent impediments to movement of joints.
5. Do not cut, trim, weld or braze component parts during erection, in any manner which would damage finish, decrease strength or result in visual imperfection or failure in performance of construction.
6. Weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
7. Seal joints within glazed aluminum framing system according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.

B. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum framing systems to exterior.

C. Set continuous sill members and flashing in full sealant bed and install perimeter joint sealants as specified in Division 07 Section "Joint Sealants" to produce weathertight installation.

D. Install components plumb and true in alignment with established lines and grades, and without warp or rack. Secure to structure with non-staining and non-corrosive shims, anchors, fasteners, spacers and fillers. Maintain minimum clearance of 1 in (25 mm) between inside face of framing system and outside face of building structure.

E. Operable window vent systems: Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.

F. Comply with Division 08 Section Glazing for glass and glazing requirements.

1. Structural-Sealant Glazing:

- a. Prepare surfaces that will contact structural-sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion.
- b. Preparation includes, but is not limited to, cleaning and priming surfaces.

G. Perimeter Fire-Containment System for Curtain Wall Spandrel Conditions: Clean debris from behind framing during erection and provide temporary closures to prevent accumulation of debris. Install spandrel insulation and firestopping securely anchored to prevent dislocation. Comply with requirements of Division 07 Section Fire-Resistive Joint Systems.

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- H. Back Pans: Install with EPDM spacers and maintain air space between pan and interior surface of glass. Seal joints in pan and at perimeter of pan.
1. Ventilate air space between shadow box back pan and interior surface of glass when recommended by manufacturer.

3.5 ERECTION TOLERANCES

- A. Erection Tolerances: Install to comply with the following non-accumulating maximum erection tolerances:
1. Plumb: **1/8 in per 10 ft (3 mm per 3 m); 1/4 in per 40 ft (6 mm per 12 m).**
 2. Level: **1/8 in per 10 ft (3 mm per 3 m); 1/4 in per 40 ft (6 mm per 12 m).**
 3. Alignment:
 - a. Where surfaces abut in line or are separated by reveal or protruding element up to **1/2 in (12 mm)** wide, limit offset from true alignment to **1/16 in (1.5 mm).**
 - b. Where surfaces are separated by reveal or protruding element from **1/2 to 1 in (12 to 25 mm)** wide, limit offset from true alignment to **1/8 in (3 mm).**
 - c. Where surfaces are separated by reveal or protruding element of **1 in (25 mm)** wide or more, limit offset from true alignment to **1/4 in (6 mm).**
 4. Location and Plane: Limit variation from plane to **1/8 in per 12 ft (3 mm per 3.6 m); 1/2 in (12 mm)** over total length.

3.6 FIELD QUALITY CONTROL

- A. Manufacturer Field Service: Manufacturer's qualified technical representative shall periodically inspect Work to ensure installation is proceeding in accordance with manufacturer's designs, recommendations, instructions, and warranty requirements. Representative shall submit written reports of each visit indicating observations, findings, and conclusions of inspection.
1. Manufacturer's Technical Representative Qualifications: Direct employee of technical services department of manufacturer with experience in providing recommendations, observations, evaluations, and problem diagnostics.
- B. Owner Testing Agency: The Owner may employ and pay a qualified independent testing agency to perform field quality control.
1. Refer to Division 01 Section Field Test for Air and Water Leakage.
 2. Refer to Division 01 Building Enclosure Commissioning for Field Observations and Performance Testing.
- C. Special Inspections: Owner will engage a qualified special inspector to perform special inspections and prepare reports:
1. Erection of glazed aluminum framing systems in accordance with the Building Code and current ICC-ESR.
 2. Testing agency will report test results promptly and in writing to Contractor and Architect.
- D. Tests and Inspections, General: Tests and inspections shall take place as installation proceeds to determine compliance with specified performance requirements.
1. Correction of Deficiencies:
 - a. Materials and installation will be considered defective if they do not meet specified requirements.
 - b. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.
 - c. Perform additional tests and inspections, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.

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2. Prepare test and inspection reports.

- E. Contractor Structural-Sealant Compatibility and Adhesion: Testing and inspecting of representative areas of structural-sealant-glazed curtain walls shall take place as installation proceeds to determine compliance of installed assemblies with manufacturer and specified requirements.
1. Structural-Sealant Adhesion: Test structural-sealant according to recommendations in ASTM C 1401, Destructive Test Method A, "Hand Pull Tab (Destructive)," Appendix X2.
 - a. Test a minimum of six (6) areas on each building facade.
 - b. Repair installation areas damaged by testing.

3.7 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as framing systems are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of installation, clean finished surfaces as recommended by manufacturer. Maintain in a clean condition during construction.
- B. After installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace framing systems and panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

3.8 ARCHITECTURAL METAL FINISH SCHEDULE

- A. Color and Gloss:
- B. Color and Gloss: Match sample accepted by Architect.
- C. Color Anodic Finish:
 1. Color: Light bronze.
 2. Color: Medium bronze.
 3. Color: Dark bronze.
 4. Color: Black.
- D. Basis of Design: AMFXX
 1. Manufacturer:
 2. Product Series:
 3. Color Name and Number:

END OF SECTION

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SECTION 087100

DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Items commercially known as finish or door hardware required for operation of doors, and accessories necessary to complete installation.
- B. Products Furnished But Not Installed Under this Section: Coordinating, purchasing, delivering, and scheduling remain requirements of this Section.
 - 1. Cylinders for locks.

1.2 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each item of door hardware indicated, specified, or required.
 - 1. Including material descriptions, dimensions of individual components and profiles, finishes, and installation instructions.
 - 2. Index product data sheets according to hardware schedule by use of numbers or letters, or combination.
- B. Shop Drawings for Electrified Hardware:
 - 1. Wiring Diagrams: Indicate power, signal, and control wiring detailed in following forms distinguishing between manufacturer-installed and field-installed wiring:
 - a. System schematic.
 - b. Point-to-point wiring diagrams.
 - c. Riser diagrams.
 - d. Door elevations.
 - 2. Interface: Details between electrified hardware and fire alarm, access control, security, and building control system.
 - 3. Sequence of Operation: Narrative operation description of doors controlled by electrified hardware.
- C. Hardware Set Schedules: Prepared by suppliers AHC detailing fabrications and assembly of door hardware, as well as procedures and diagrams. Coordinate hardware sets with doors, frames, and related Work to ensure proper size, thickness, hand, function, and finish of item.
 - 1. Format: Use same numbering shown on Drawings and Schedules.
 - a. Content: Organize into hardware sets indicating designations of each item required for each door or opening. Include following information:

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- 1) Type, style, function, size, and finish of each item.
- 2) Manufacturer and product number of each item.
- 3) Fastenings and other pertinent attachment information.
- 4) Location of each set cross referenced to room name and number in which door serves.
- 5) Explanation of abbreviations, symbols, and codes contained in schedule.
- 6) Mounting locations for hardware.
- 7) Door and frame sizes and materials.

- b. Additional Specific Information: Include type of strike plates; length of spindle, hand, backset and bevel of locks; hand and degree opening for closers; length of kickplates; length of rods for flush bolts; type of door stop; and other functions of mechanisms.

2. Keying Schedule: Submit indicating Owner's instructions for keying of locks.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Certification for Electrified Hardware: Written data from product manufacturer certifying electrified hardware is approved for use on types and sizes of labeled fire rated doors comply with listed fire rated door assemblies.
- B. Product Test Reports: Written reports for extended cycle testing based on evaluation of comprehensive tests performed by manufacturer or other qualified testing facility and witnessed by a qualified testing agency, for locksets, exit devices and closers.
- C. Manufacturers Project Acceptance Document: Certification that products are approved, acceptable, or suitable for use in specific locations, for specific details, and for applications indicated, specified, or required, and that warranty will be issued.

1.4 CLOSE-OUT SUBMITTALS

- A. Operation and Maintenance Data: For inclusion in operation and maintenance manual required by Division 01, submit manufacturer's instructions for operation and maintenance of installed Work, including methods and frequency recommended for maintaining optimum condition under anticipated use. Include precautions against cleaning materials and methods which may be detrimental to finishes and performance.
- B. Operational and Maintenance Training: Training materials, including instructor qualifications, required by Close-Out Activities Article.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Maintenance Tools and Instructions: Furnish complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

1.6 QUALITY ASSURANCE

- A. Supplier Qualifications:

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1. Experience: Architectural door hardware supplier that has record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project.
 2. Qualification: Recognized architectural hardware supplier with a minimum of 5 years documented experience supplying both mechanical and electromechanical door hardware similar in quantity, type, and quality to that indicated for this Project. Supplier to be recognized as a factory direct distributor by the manufacturer of the primary materials with a warehousing facility in the Project's vicinity. Supplier to have on staff, a certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
 3. Supplier must be an authorized, factory direct distributor of specified products.
 4. Staff Hardware Expertise: Experienced professional currently certified by DHI as AHC, CDC, and EHC, and experienced in door hardware installations that are comparable in material, design, and extent to this Project that will be responsible for following activities:
 - a. Preparation of submittals, including hardware set schedules.
 - b. Available for consultation to Owner, Architect, and Contractor during course of Work.
 - c. Finalizing keying requirements with Owner.
 5. Electro-Mechanical or Electronic Hardware: When supplied, technician, with minimum of 5 years experience in low voltage installation, shall be available for assistance to Owner, Architect, Contractor, and Installer.
- B. Installer Qualifications:
1. Experience: Company with not less than 10 years experience in performing specified Work similar to scope of this Project; with a record of successful in-service performance; and sufficient capability, facilities and personnel, to produce required Work.
 2. Supervision: Installer shall maintain a competent supervisor who is at Project during times specified Work is in progress, and, who is experienced in installing systems similar to type and scope required for Project.
 3. Manufacturer Training: Technical representatives of manufacturer of locksets, exit devices and closers shall train Installer's installation personnel (supervisor and installers), either at Project or at manufacturers facility, on following:
 - a. Proper installation of products.
 - b. Proper sequence of installation of Work.
 - c. Situations that require special attention or care during installation.
 - d. Situations and conditions that should be avoided.
 - e. Other topics relevant to installation.
- C. Pre-Construction Extended Performance Testing: Manufacturer shall, through its own laboratory testing facilities witnessed and verified by Intertek, Underwriters Laboratories, Inc., or other testing laboratory agency acceptable to Architect, perform pre-construction testing to establish compliance of proposed Work with specified requirements.
1. General Requirements: Test hardware items identified in PART 2 for extended cycle performance.
 2. Test Method: ANSI/BHMA Grade 1.
 3. Reports: Prepare certified reports tabulating test results and indicating if hardware items meet or exceed requirements.

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4. Equivalent Option to Testing: Testing not required if manufacturers has tested hardware items within previous 5 years.
- D. Keying Conference: Before beginning Work of this Section, conduct conference at Project to comply with requirements of applicable Division 01 Sections. Incorporate keying conference decisions into final keying schedule.
1. Required Attendees:
 - a. Owner.
 - b. Architect.
 - c. Contractor, including supervisor.
 - d. Supplier's architectural hardware consultant.
 - e. Hardware installer, including supervisor.
 - f. [Owner's] Security installer, including supervisor.
 - g. Manufacturer's technical representative.
 2. Minimum Agenda:
 - a. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 - b. Preliminary key system schematic diagram.
 - c. Requirements for key control system.
 - d. Address for delivery of keys.
 3. Reports: Record discussions, including decisions and agreements reached, and furnish copy of record to each party attending.
- E. Pre-Installation Conference: Before beginning Work of this Section, conduct conference at Project to comply with requirements of applicable Division 01 Sections.
1. Required Attendees:
 - a. Architect.
 - b. Contractor, including supervisor.
 - c. Supplier's architectural hardware consultant.
 - d. Hardware installer, including supervisor.
 - e. [Owner's] Security installer, including supervisor.
 - f. Manufacturer's technical representative.
 2. Minimum Agenda: Installer shall demonstrate understanding of Work required by reviewing and discussing procedures for, but not limited to, following:
 - a. Tour representative areas of required Work, discuss and evaluate for compliance with Contract Documents, including substrate conditions, surface preparations, sequence of installation and other preparatory Work performed by other installers.
 - b. Review Contract Document requirements.
 - c. Review approved submittals.
 - d. Review installation procedures, including, but not limited to, following:
 - 1) Installation requirements for each hardware item.
 - 2) Sequence of operation for each type of electrified door hardware

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- 3) Relationships between electrified hardware and fire alarm, access control, security, and building control system.
- e. Review required inspection, testing, certifying, and material usage accounting procedures.
- f. Review forecasted weather conditions and procedures for coping with unfavorable conditions.
- 3. Reports: Record discussions, including decisions and agreements reached, and furnish copy of record to each party attending.

1.7 WARRANTY

- A. Manufacturer's Special Warranty: Furnish labor and material warranty for following time periods from date of substantial completion agreeing to repair or replace defects, faulty Work and failures, signed by authorized representative using manufacturer's standard form.
 - A. Mechanical Warranty
 - 1. Locks
 - a. Schlage L Series: 10 years
 - 2. Exit Devices
 - a. Von Duprin: 10 years
 - 3. Closers
 - a. LCN 4000 Series: 30 years
 - 4. Automatic Operators
 - a. LCN: 2 years
 - B. Electrical Warranty
 - 1. Locks
 - a. Schlage: 3 years
 - 2. Exit Devices
 - a. Von Duprin: 3 years
 - 3. Closers
 - a. LCN: 2 years

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Contract Documents are based on products specified in PART 3 "Door Hardware Sets" Article below to establish a standard of quality. Other manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and does not change intent of Contract Documents as judged by Architect.
- B. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents, provide product by one of manufacturers listed alphabetically below. If not listed, submit as substitution according to Conditions of the Contract and Division 01 Sections.
- C. Available Manufacturers and Products: Subject to compliance with requirements of Contract Documents, manufacturers offering products that may be incorporated into the Work include, but are not limited to, those listed alphabetically below.

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2.2 HARDWARE, GENERAL

- A. Single Source Responsibility: Furnish each type of hardware unit from single manufacturer. Electrified door hardware shall be from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that perform electrical modifications and are listed by testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.
- B. Manufacturer's Nameplate: Hardware units shall not have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire rated labels; manufacturer's identification is permitted on rim of lock cylinders only.
- C. Base Metals: Hardware units of base metal, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18. Do not furnish manufacturer's standard materials or forming methods if different from specified standard.
- D. Fasteners: Hardware units manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.
 - 1. Concealed Fasteners: Hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is only means of securely attaching hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
 - 2. Steel Machine or Wood Screws: For following fire rated applications:
 - a. Mortise hinges to doors.
 - b. Strike plates to frames.
 - c. Closers to doors and frames.
 - 3. Steel Through Bolts: For following fire rated applications unless door blocking is provided:
 - a. Surface hinges to doors.
 - b. Closers to doors and frames.
 - c. Surface mounted exit devices.
 - 4. Spacers or Sex Bolts: For through bolting of hollow metal doors.
 - 5. Fasteners for Wood Doors: DHI WDHS.2.
- E. Fire-Test-Response Characteristics:
 - 1. Fire Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.
 - 2. Test Pressure: After 5 minutes into test, neutral pressure level in furnace shall be established at 40 in (1000 mm) or less above sill.

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- F. Accessibility Requirements: Hardware units and installation shall comply with Americans with Disabilities Act (ADA), ANSI A 117.1, and state and local accessibility standards.
- G. Electrical Requirements: Furnish electrical products that are listed and classified by UL as suitable for purpose specified and indicated.
 - 1. Electrified Functions: Concealed PTFE-jacketed wires, secured at each leaf and continuous through hinge knuckle.
 - 2. Concealed Plug Connectors: Termination of multi-wire bundles up to 8 conductors shall be by 8 position concealed plug connector or by 8 position and 4 position connector for 12 wire applications.

2.3 BUTT HINGES

- A. Product Quality Standard: ANSI/BHMA A 156.1, Grade 1, 2 or 3.
- B. Description:
 - 1. Generic Type: Full-mortise, ball bearings.
 - 2. Weight:
 - a. Doors over 36" wide: Heavy weight anti-friction bearing.
 - b. Doors 36" and less in width: Standard weight anti-friction bearing.
 - 3. Hinge Pins: Except as otherwise indicated, hinge pins as follows:
 - a. Out-Swing Exterior Doors: Non-removable pins (NRP) or safety stud.
 - b. Interior Doors: Non-rising pins.
 - c. Top Tips: Flat button and matching plug, finished to match leaves.
 - d. Bottom Tips: Hole in bottom for easy pin removal.
- C. Templates: Except for hinges to be installed entirely (both leaves) into wood doors and wood frames, provide only template-produced units.
- D. Screws: Phillips flat-head screws with heads to match surface of hinges.
 - 1. Metal Doors and Metal Frames: Machine screws installed into drilled and tapped holes.
 - 2. Wood Doors and Wood Frames: Wood screws.
 - 3. Fire Rated Wood Doors: No. 12 by 1-1/4 in (32 mm), threaded-to-head steel wood screws.
- E. Basis of Design, Base Metal and Finish: As scheduled in PART 3 "Door Hardware Sets" Article.
- F. Acceptable Manufacturers:
 - 1. Ives Hardware; an Allegion Company (formerly Ingersoll Rand) (IVE). No Substitute

2.4 CONTINUOUS GEARED HINGES

- A. Product Quality Standard: ANSI/BHMA A 156.26, Grade 1, 2 or 3.

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- B. Description: Extruded-aluminum, pinless, geared hinge leaves; joined by a continuous extruded-aluminum channel cap; with concealed, self-lubricating thrust bearings; type scheduled in PART 3 "Door Hardware Sets" Article. [Steel pins to hold labeled fire rated doors in place if required by tested listing.]
- C. Screws: Phillips flat-head screws with heads to match surface of hinges. Comply with following:
 - 1. Metal Doors and Metal Frames: Machine screws installed into drilled and tapped holes.
 - 2. Wood Doors and Wood Frames: Wood screws.
 - 3. Fire Rated Wood Doors: No. 12 by 1-1/4 in (32 mm), threaded-to-head steel wood screws.
- D. Basis of Design, Base Metal and Finish: As scheduled in PART 3 "Door Hardware Sets" Article.
- E. Acceptable Manufacturers:
 - 1. Ives Hardware; an Allegion Company (formerly Ingersoll Rand) (IVE). No Substitute

2.5 FLUSH BOLTS

- A. Manual Flush Bolts:
 - 1. Product Quality Standards:
 - a. ANSI/BHMA A 156.16.
 - b. Underwriters Laboratories, Inc. listed for fire doors.
 - 2. Description:
 - a. Minimum 1/2 in (12 mm) round rods, forged brass or bronze, furnished in pairs, (top and bottom of door); lengths of rod 12 in (300 mm); where door is higher than 84 in (2.13 m), top bolt shall be of sufficient length to locate flush bolt operator 72 in (1.83 m) above finish floor.
 - b. Standard top strike and dustproof bottom strike.
 - 3. Base Metal and Finish: As scheduled in PART 3 "Door Hardware Sets" Article.
 - 4. Acceptable Manufacturers and Products:
 - a. Ives Hardware; an Allegion Company (formerly Ingersoll Rand) (IVE); FB458, FB358 Series with DP1 or DP2 dustproof strike. No Substitute
- B. Automatic Flush Bolts:
 - 1. Product Quality Standards:
 - a. ANSI/BHMA A 156.16.
 - b. Underwriters Laboratories, Inc. listed for fire doors.
 - 2. Description:

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- a. Minimum 1/2 in (12 mm) round rods, forged brass or bronze, furnished in pairs, (top and bottom of door); lengths of rod 12 in (300 mm); where door is higher than 84 in (2.13 m), top bolt shall be of sufficient length to locate flush bolt operator 72 in (1.83 m) above finish floor.
 - b. Standard top strike and dustproof bottom strike.
 - 3. Base Metal and Finish: As scheduled in PART 3 "Door Hardware Sets" Article.
 - 4. Acceptable Manufacturers and Products:
 - a. Ives Hardware; an Allegion Company (formerly Ingersoll Rand) (IVE); FB30, FB40 Series with DP1 or DP2 dustproof strike. No Substitute
- C. Constant Latching Flush Bolts:
- 1. Product Quality Standards:
 - a. ANSI/BHMA A 156.16.
 - b. Underwriters Laboratories, Inc. listed for fire doors.
 - 2. Description:
 - a. Constant latching flush bolt at top remaining engaged when active door is opened, retracting only when plunger on face of bolt is depressed.
 - b. Automatic flush bolt at bottom.
 - c. Standard top strike and dustproof bottom strike.
 - 3. Base Metal and Finish: As scheduled in PART 3 "Door Hardware Sets" Article.
 - 4. Acceptable Manufacturers and Products:
 - a. Ives Hardware; an Allegion Company (formerly Ingersoll Rand) (IVE); FB50, FB60 Series with DP1 or DP2 dustproof strike. No Substitute

2.6 KEY CONTROL PROTECTION

- A. Level of Key Control Protection: Restricted patented.

2.7 CYLINDERS

- A. Conventional and Restricted Lock Cylinders: ANSI/BHMA A 156.5, Grade 1 unless Grade 2 is indicated.
- B. Description: Tumbler type, not less than 6 pins.
- C. Permanent Cores:
 - 1. Interchangeable Cores: Core insert, removable by use of a special key; usable with other manufacturers' cylinders.
- D. Temporary Cores – Construction Cores: Cores that are replaceable by permanent cores; provide 10 construction master keys. Replace construction cores with permanent cores as directed by directed by Owner.
- E. Basis of Design, Base Metal and Finish: As scheduled in PART 3 "Door Hardware Sets" Article.

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- F. Acceptable Manufacturers
1. Schlage Commercial Lock Division; an Allegion Company (formerly Ingersoll Rand) (SCH); Everest.EV-29 – Basis of Design. No Substitute

2.8 KEYING

- A. Keying System: Factory registered patented system with patent lasting to 2029, incorporating decisions made in keying conference.

1. Product Quality Standard: ANSI/BHMA A 156.28, Appendix A.
2. Great-Grand Master Key System: Cylinders operated by a change key, a master key, a grand master key, and a great-grand master key.

- B. Keys:

1. Metal: Brass.
2. Metal: Bronze.
3. Metal: Stainless steel.
4. Metal: Nickel silver.
5. Stamping: Permanently inscribe each key with a visual key control number and include notation "DO NOT DUPLICATE".
6. Quantity: In addition to one extra key blank for each lock, provide following:
 - a. Cylinder Change Keys: 3.
 - b. Master Keys: 5.
 - c. Grand Master Keys: 5.
 - d. Great-Grand Master Keys: 5.
 - e. Construction Master Keys: 10.
 - f. Construction Core Control Keys: 5.
 - g. Permanent Core Control Keys: 5.

2.9 MORTISE LOCKS AND LATCHES

- A. Product Quality Standards:

1. ANSI/BHMA A 156.13, Grade 1 Operational and Security, except extended cycle performance testing shall be 6 million cycles minimum.

- B. Description:

1. Mortise Box Construction:
 - a. Heavy duty construction with minimum wrought case thickness of not less than **0.093 in (2.3 mm) thickness.**
 - b. **8 in (200 mm)** by **1-1/4 in (32 mm)** front adjustable to **1/8 in (3 mm)** in **2 in (50 mm).**
 - c. **2-3/4 in (69 mm)** backset.
 - d. Minimum **3/4 in (19 mm)** latchbolt throw, or as required for fire rated doors.
 - e. Minimum **1 in (25 mm)** deadbolt throw.
 - f. Split hubs for split spindles.
 - g. Lever handles supported by internal spring.
 - h. Square, split spindles (with all-thread connector), set-screw receiver/retainer notch.

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2. Strikes: Metal strike plate with extended lip to protect frame, and with metal or plastic strike box.
 - a. Single Swing Doors: Minimum lip projection necessary to project from trim.
 - b. Pairs of Doors: With or without astragal, lip projection not beyond face of lock style of inactive leaf.
 - C. Electrified Locks:
 1. Product Quality Standards:
 - a. ANSI/BHMA A 156.25.
 - b. Underwriters Laboratories, Inc. listed for fire rated doors.
 2. Description: Fail safe type (power off unlocks outside lever); provide transformers and wiring necessary to install and connect to building electrical system.
 - D. Basis of Design, Function, Accessories, Lever Base Metal, Face Plate, Rose, and Finish: As scheduled in PART 3 "Door Hardware Sets" Article.
 - E. Acceptable Manufacturers and Products:
 1. (SCH); L9000 Series. No Substitute
- 2.10 EXIT DEVICES
- A. Product Quality Standards:
 - B. Product Quality Standards: ANSI/BHMA A 156.3, Grade 1, except extended cycle performance testing shall be 8 million cycles minimum.
 1. NFPA 101 in means of egress.
 2. Underwriters Laboratories, Inc. listed for fire rated doors.
 3. Listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.
 4. NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252.
 5. Comply with CBC accessibility five pounds of force requirement.
 - C. Description:
 1. Touch bar type, unless scheduled otherwise.
 2. Exit device to operate with a maximum of five pounds of force.
 3. Concealed vertical rods on pairs of doors, unless surface mounted vertical rods required for fire rated doors.
 4. Mortise lock or rim type devices on single doors only.
 5. Outside trim as scheduled in PART 3 "Door Hardware Sets" Article.
 6. Except on fire rated doors where closers are provided on doors equipped with exit devices, equip units with keyed dogging device to keep latch bolt retracted, when engaged.
 7. Except at doors with thresholds, provide vertical rod devices which hold rods in retracted position when door is open.

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- D. Basis of Design, Function, Accessories, Base Metal and Finish: As scheduled in PART 3 "Door Hardware Sets" Article.
- E. Acceptable Manufacturers and Products:
 - 1. Von Duprin; an Allegion Company (formerly Ingersoll Rand) (VON); 98/99 Series; 33A / 35A on Narrow Stile. No Substitute

2.11 ELECTRIC STRIKES

- A. Product Quality Standard: ANSI/BHMA A 156.31, Grade 1.
- B. Operational Type: Fail-secure with fire rated doors.
- C. Basis of Design, Base Metal and Finish: As scheduled in PART 3 "Door Hardware Sets" Article.
- D. Available Manufacturers:
 - 1. HES; an Assa Abloy Company (HES). No Substitute

2.12 ELECTROMECHANICAL LOCKS

- A. Product Quality Standard: ANSI/BHMA A 156.25, Grade 1 for type of lock indicated; motor or solenoid driven.
- B. Basis of Design, Function, Accessories, Base Metal and Finish: As scheduled in PART 3 "Door Hardware Sets" Article.
- C. Acceptable Manufacturers:
 - 1. Schlage Commercial Lock Division; an Allegion Company (formerly Ingersoll Rand) (SCH). No Substitute

2.13 PUSH/PULL TRIM

- A. Product Quality Standard: ANSI/BHMA A 156.6.
- B. Description:
 - 1. Flat Push Plates: 0.050 in (1.3 mm) thick, 4 in wide by 16 in high (100 mm) wide by (400 mm) high); with square corners and beveled edges, secured with exposed screws.
 - 2. Pull-Plate Door Pulls: 0.050 in (1.3 mm) thick plate, 4 in wide by 16 in high (100 mm) wide by (400 mm) high), with square corners and beveled edges; 3/4 in (19 mm) constant-diameter pull, with minimum clearance of 1-1/2 in (38 mm) from face of door; fastened at 8 in (200 mm) o.c., secured with exposed screws.
- C. Basis of Design, Base Metal and Finish: As scheduled in PART 3 "Door Hardware Sets" Article.
- D. Available Manufacturers:
 - 1. Ives Hardware; an Allegion Company (formerly Ingersoll Rand) (IVE). No Substitute

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2.14 CLOSERS

- A. Product Quality Standard: ANSI/BHMA A 156.4, Grade 1, except cycle testing shall be 10 million cycles minimum.
- B. Description: Manual overhead surface and concealed closers.
- C. Size of Units: Except as otherwise specifically indicated, comply with manufacturer's recommendations for size of door control unit depending on size of door, exposure to weather, and anticipated frequency of use.
- D. Access-Free Manual Closers: Where manual closers are indicated for doors required to be accessible, provide adjustable units complying with accessibility requirements for door opening force and delayed action closing.
- E. Basis of Design, Function, Accessories, Base Metal and Finish: As scheduled in PART 3 "Door Hardware Sets" Article.
- F. Surface Closers Acceptable Manufacturer and Model Series:
 - 1. LCN Closers; an Allegion Company (formerly Ingersoll Rand) (LCN); 4000 Series. No Substitute

2.15 LOW-ENERGY DOOR OPERATORS

- A. Product Quality Standard:
 - 1. BHMA A156.19.
 - 2. UL 325.
- B. Description: Operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; for long-term, maintenance-free operation under normal traffic load for type of occupancy indicated. Coordinate operator mechanisms with door operation, hinges, and activation and safety devices.
- C. Electromechanical Operating System: Self-contained unit powered by permanent-magnet dc motor; with closing speed controlled mechanically by gear train and dynamically by braking action of electric motor, connections for power and activation- and safety-device wiring, and manual operation including spring closing when power is off.
- D. Electrohydraulic Operating System: Self-contained low-pressure unit; with separate cylinders for power and checking, connections for power and activation- and safety-device wiring, manual operation including spring closing when power is off.
- E. Basis of Design, Function, Accessories, Base Metal and Finish: As scheduled in PART 3 "Door Hardware Sets" Article.
- F. Available Manufacturers and Model Series:
 - 1. LCN Closers; an Allegion Company (LCN); Senior Swing 9000/9500 Series. No Substitute

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2.16 STOPS AND HOLDERS

- A. Product Quality Standard for Stops and Bumpers: ANSI/BHMA A 156.16, Grade 1.
- B. Product Quality Standard for Overhead Holders and Stays: ANSI/BHMA A 156.16, Grade 1.
- C. Product Quality Standard for Electromagnetic Door Holders: BHMA A 156.15; coordinate with fire detectors and interface with fire alarm system for fire rated doors.
- D. Product Quality Standard for Door Silencers: ANSI/BHMA A 156.16.
- E. Basis of Design, Base Metal and Finish: As scheduled in PART 3 "Door Hardware Sets" Article.
- F. Concealed overhead stops and stays have been specified in the hardware groups. Provide surface mounted units if the fire rating of the door is compromised by using a concealed unit.

2.17 PROTECTIVE TRIM UNITS

- A. Product Quality Standard: ANSI/BHMA A 156.6.
- B. Description: Minimum 0.050 in (1.25 mm) thick metal plates with beveled top and 2 sides fabricated in following configurations:
 - 1. Armor Plates: 34 in (800 mm) high by door width, with allowance for frame stops.
 - 2. Kick Plates: 10 in (250 mm) high by door width, with allowance for frame stops.
- C. Fasteners: Exposed fasteners consisting of either machine screws or self-tapping screws.
- D. Width and Thickness: As scheduled in PART 3 "Door Hardware Sets" Article.
- E. Basis of Design, Base Metal and Finish: As scheduled in PART 3 "Door Hardware Sets" Article.
- F. Available Manufacturers and Products:
 - 1. IVE Hardware; an Allegion Company (formerly Ingersoll Rand) (IVE); 8400 Series. No Substitute

2.18 DOOR GASKETING

- A. Product Quality Standards: ANSI/BHMA A 156.22, and according to following when required:
 - 1. Air Leakage: Not to exceed 0.50 cfm/ft (0.000774 cu m/s/m) of crack length for gasketing other than for smoke control according to ASTM E 283.
 - 2. Smoke Leakage: Comply with NFPA 105 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated according to UL 1784.
 - 3. Fire Rating: Comply with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction according to NFPA 252. After 5 minutes into test, neutral pressure level in furnace shall be established at 40 in (1000 mm) or less above sill.

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4. Sound Rating: Listed and labeled by a testing and inspecting agency according to ASTM E 1408.

B. Basis of Design: As scheduled in PART 3 "Door Hardware Sets" Article.

C. Available Manufacturers:

1. Zero International; an Allegion Company (formerly Ingersoll Rand) (ZER). No Substitute

2.19 THRESHOLDS

A. Product Quality Standard: ANSI/BHMA A 156.21.

B. Basis of Design: As scheduled in PART 3 "Door Hardware Sets" Article.

C. Available Manufacturers:

1. Zero International; an Allegion Company (formerly Ingersoll Rand) (ZER). No Substitute

2.20 KEY CONTROL SYSTEM

A. Key Control Cabinet:

1. Product Quality Standard: BHMA A156.5, Grade 1.
2. Description: Metal cabinet with baked-enamel finish; containing key-holding hooks, labels, 2 sets of key tags with self-locking key holders, key-gathering envelopes, and temporary and permanent markers; with key capacity of 150 percent of number of locks.
3. Multiple-Drawer Cabinet: Cabinet with drawers equipped with key-holding panels and key envelope storage, and progressive-type ball-bearing suspension slides. Include single cylinder lock to lock all drawers.

B. Available Manufacturers:

1. Key Control Systems, Inc. (KCS).
2. Lund Equipment Co., Inc. (LUN).
3. MMF Industries (MMF).

C. Key Control System Software:

1. Product Quality Standard: BHMA A156.5, Grade 1.
2. Description: Multiple-index system for recording and reporting key-holder listings, tracking keys and lock and key history, and printing receipts for transactions. Include instruction manual.

2.21 OWNER'S STOCK

A. Provide the following hardware as owner's stock.

1. 2 each Mortise Locks of every function used on the project.
2. 8 each Door Closers
3. 1 each Exit Device of every function used on the project.
4. 2 each Key Cutters
5. 2 each Keying Kits from Key System manufacturer.

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2.22 MISCELLANEOUS DOOR HARDWARE

A. Boxed Power Supplies:

1. Description: Modular unit in NEMA ICS 6, Type 4 enclosure; filtered and regulated; voltage rating and type matching requirements of door hardware served; and listed and labeled for use with fire alarm systems.
2. Basis of Design, Function, Accessories, Base Metal and Finish: As scheduled in PART 3 "Door Hardware Sets" Article.

B. Auxiliary Hardware:

1. Product Quality Standard: BHMA A156.16, Grade 1.
2. Basis of Design, Function, Accessories, Base Metal and Finish: As scheduled in PART 3 "Door Hardware Sets" Article.
3. Available Manufacturers:
 - a. IVES Hardware; an Allegion Company (formerly Ingersoll Rand) (IVE). No Substitute

C. Silicone Sealant: Exterior non-sag silicone sealant as specified in Division 07 Section "Joint Sealants."

2.23 FINISHES

A. Product Quality Standard: ANSI/BHMA A 156.18, as scheduled in PART 3 "Door Hardware Sets" Article.

B. Protection: Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of range of approved samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within range of approved samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Acceptance of Surfaces and Conditions: Examine doors and frames to receive door hardware and associated Work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting Work within a particular area will be construed as acceptance of surface conditions.

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3.2 INSTALLATION, GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
 - 1. Respective manufacturer written installation instructions.
 - 2. Accepted submittals.
 - 3. Contract Documents.
 - 4. ANSI/DHI A 115.IG.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by isolating metals and other materials from direct contact with incompatible materials.

3.3 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.
- B. Steel Doors and Frames: Comply with DHI A115 Series.
- C. Surface-Applied Door Hardware: Drill and tap doors and frames according to ANSI A 250.6.
- D. Wood Doors: Comply with DHI A115-W Series.
- E. Electrical: Verify raceway system and other provisions for electrical power are adequate for electrified door hardware installation.

3.4 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights indicated as follows unless otherwise indicated or required to comply with governing regulations.
 - 1. Custom Steel Doors and Frames: DHI's "Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames."
 - 2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Hardware Installation:
 - 1. Set hardware items level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
 - 3. Do not install surface-mounted hardware items until finishes have been completed on substrates involved.
- C. Key Control System: Tag keys and place on markers and hooks in cabinet, as determined by final keying schedule.

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- D. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room. Verify location with Architect. [Provide one power supply for each door opening.] [Provide least number of power supplies required to adequately serve doors with electrified door hardware.]
- E. Control Wiring:
 - 1. Raceways: As specified and provided under appropriate Division 26 Section.
 - 2. Connections: Coordinate with appropriate Division 28 Section.
- F. Thresholds: Set thresholds for exterior and acoustical doors in full bed of silicone sealant complying with requirements specified in Division 07 Section "Joint Sealants." Extend full width of opening and notch at door stops.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Manufacturer's qualified technical representative shall periodically inspect Work to ensure installation is proceeding in accordance with manufacturer's designs, recommendations, instructions, and warranty requirements. Representative shall submit written reports of each visit indicating observations, findings, and conclusions of inspection.
 - 1. Manufacturer's Technical Representative Qualifications: Direct employee of technical services department of manufacturer with experience in providing recommendations, observations, evaluations, and problem diagnostics.

3.6 ADJUSTMENTS

- A. Post-Occupancy Adjustment: Approximately 6 months after date of substantial completion, qualified technicians of supplier or installer, accompanied by manufacturers technical representatives of locksets, exit devices, closers, and other hardware manufacturers as required, shall perform following Work:
 - 1. Examine and adjust each item of hardware as necessary to restore proper function of doors and hardware to comply with specified requirements.
 - 2. Replace hardware items that have deteriorated or failed due to faculty design, materials, or installation.
- B. Maintenance Service:
 - 1. First Year Maintenance Service: Beginning at date of substantial completion, supplier or installer shall provide 12 months maintenance service by qualified technicians.
 - a. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper hardware operation.
 - b. Provide parts and supplies same as those used in manufacture and installation of original products.

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2. Proposal for Continuing Maintenance Service: Before expiration of first year maintenance service term, supplier shall furnish Owner with continuing maintenance service agreement, renewable yearly, proposing services, obligations, conditions, and terms for continuing maintenance service.

3.7 CLOSE-OUT ACTIVITIES

- A. Operational and Maintenance Training: Train Owner's personnel on maintenance, operation, and adjustment of door hardware at Project using factory-trained and certified technicians. Provide attendees with bound copies of training materials.

3.8 HARDWARE SCHEDULE

- A. Include the cost of hardware group X for any single door opening or XX for any double door opening without an assigned hardware group.

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HW SET# 001

QTY	DESCRIPTION NOTE	CATALOG NUMBER ALL HARDWARE BY THE DOOR MANUFACTURER	FINISH	MFR

HW SET# 200C

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA HINGE	5BB1 4.5 X 4.5	652	IVE
1	SET AUTO FLUSH BOLT	FB31P/FB41P AS REQ	630	IVE
1	EA DUST PROOF STRIKE	DP2	626	IVE
1	EA STOREROOM W/DEADBOLT	L9480HD 06N L583-363	626	SCH
1	EA SFIC EVEREST CORE	EVEREST SFIC CORE TO MATCH EXISTING KEY SYSTEM	626	SCH
1	EA COORDINATOR	COR X FILLER X MB AS REQ	628	IVE
2	EA SURFACE CLOSER	4040XP SCUSH TBWMS X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
2	EA KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
1	SET MEETING STILE	8193AA (2 PCS - 1 SET) HEIGHT AS REQ (OMIT @ NON-RATED DOORS)	AA	ZER
1	EA GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS) (PERIMETER SEAL BY ALF MFR @ ALF)	BK	ZER

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HW SET# 201

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	STOREROOM W/DEADBOLT	L9480HD 06N L583-363		626	SCH
1	EA	SFIC EVEREST CORE	EVEREST SFIC CORE TO MATCH EXISTING KEY SYSTEM		626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA TBWMS X MTG BRKT, SPCR & PLATE AS REQ		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS) (PERIMETER SEAL BY ALF MFR @ ALF)		BK	ZER

HW SET# 201C

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	STOREROOM W/DEADBOLT	L9480HD 06N L583-363		626	SCH
1	EA	SFIC EVEREST CORE	EVEREST SFIC CORE TO MATCH EXISTING KEY SYSTEM		626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH TBWMS X MTG BRKT, SPCR & PLATE AS REQ		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS) (PERIMETER SEAL BY ALF MFR @ ALF)		BK	ZER

HW SET# 205

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112XY/224XY HEIGHT AS REQ		628	IVE
1	EA	STOREROOM W/DEADBOLT	L9480HD 06N L583-363		626	SCH
1	EA	SFIC EVEREST CORE	EVEREST SFIC CORE TO MATCH EXISTING KEY SYSTEM		626	SCH
1	EA	LOCK GUARD	LG1 OR AS REQ		630	IVE
1	EA	SURFACE CLOSER	4040XP SCUSH TBWMS X MTG BRKT, SPCR & PLATE AS REQ		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	RAIN DRIP	142A DW + 4" (OMIT @ COVERED LOCATIONS)		AA	ZER
1	SET	GASKETING	328AA H & J		AA	ZER
1	EA	DOOR SWEEP	8198AA LENGTH AS REQ		AA	ZER
1	EA	THRESHOLD	65A LENGTH AS REQ		A	ZER

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HW SET# 711CR

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112XY/224XY HEIGHT AS REQ		628	IVE
1	EA	FIRE EXIT HARDWARE	99-L-NL-F-06-SNB LENGTH AS REQ		626	VON
1	EA	RIM CYLINDER	MATCH STANDARD W/KEYED CONST. CORE AS REQ		626	SCH
1	EA	SFIC EVEREST CORE	EVEREST SFIC CORE TO MATCH EXISTING KEY SYSTEM		626	SCH
1	EA	SURFACE CLOSER	4050A SCUSH TBWMS X MTG BRKT, SPCR & PLATE AS REQ		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	GASKETING	488S PSA H & J		BK	ZER

HW SET# C205LW

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112XY/224XY EPT HEIGHT AS REQ		628	IVE
1	EA	POWER TRANSFER	EPT10 CON		✓ 689	VON
1	EA	EU MORTISE LOCK	L9092LEU 06N CON (FAIL SECURE)		✓ 626	SCH
1	EA	DUMMY RIM/MORTISE CYLINDER	TYPE AS REQ		626	
1	EA	SURFACE CLOSER	4040XP SCUSH TBWMS X MTG BRKT, SPCR & PLATE AS REQ		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	RAIN DRIP	142A DW + 4" (OMIT @ COVERED LOCATIONS)		AA	ZER
1	EA	GASKETING	328AA H & J		AA	ZER
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS) (PERIMETER SEAL BY ALF MFR @ ALF)		BK	ZER
1	EA	DOOR SWEEP	8198AA LENGTH AS REQ		AA	ZER
1	EA	THRESHOLD	65A LENGTH AS REQ		A	ZER
1	EA	HARNESS (IN DOOR)	ALLEGION CONNECT TYPE & LENGTH AS REQ		✓	SCH
1	EA	WIRE HARNESS (TO POWER SUPPLY)	WIRE HARNESS (TO POWER SUPPLY) BY SECURITY CONTRACTOR		✓	SCH
1	EA	MULTITECH READER	AS SPECIFIED IN DIVISION 28 (MT/MTK SERIES)		✓ BLK	SCE
1	EA	DOOR CONTACT	DOOR CONTACT(S) BY SECURITY CONTRACTOR		✓ WHT	SCE
1	EA	MOTION SENSOR	SCANII 12/24 VDC		✓ WHT	SCE
1	EA	POWER SUPPLY	POWER SUPPLY BY SECURITY CONTACTOR		✓ LGR	SCE

-INGRESS BY THE CREDENTIAL READER.
-EGRESS BY THE LEVER.

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HW SET# C714M.1

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112XY/224XY EPT HEIGHT AS REQ		628	IVE
1	EA	CONT. HINGE	112XY/224XY HEIGHT AS REQ		628	IVE
1	EA	POWER TRANSFER	EPT10 CON		✓ 689	VON
1	EA	NON-KEYED REMOVABLE MULLION	4954XP STAB HEIGHT AS REQ		689	VON
1	EA	PANIC HARDWARE	LD-XP99-DT-SNB LENGTH AS REQ		626	VON
1	EA	ELEC PANIC HARDWARE	QEL-XP99-DT-CON-SNB LENGTH AS REQ		✓ 626	VON
1	EA	MULLION STORAGE KIT	MT54		689	VON
2	EA	SURFACE CLOSER	4040XP SCUSH TBWMS X MTG BRKT, SPCR & PLATE AS REQ		689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	RAIN DRIP	142A DW + 4"		AA	ZER
			(OMIT @ COVERED LOCATIONS)			
1	SET	GASKETING	328AA H & J		AA	ZER
1	SET	MEETING STILE	328AA (2 PCS - 1 SET)		AA	ZER
1	EA	MULLION SEAL	8780N HEIGHT AS REQ		BK	ZER
2	EA	DOOR SWEEP	8198AA LENGTH AS REQ		AA	ZER
1	EA	THRESHOLD	65A LENGTH AS REQ		A	ZER
2	EA	WIRE HARNESS (ONE IN DOOR & ONE IN FRAME)	ALLEGION CONNECT TYPE & LENGTH AS REQ		✓	SCH
1	EA	WIRE HARNESS (TO POWER SUPPLY)	CON-6W - CONNECTION LEADS		✓	SCH
1	EA	CREDENTIAL READER	BY ANOTHER SECTION			
2	EA	DOOR CONTACT	679-05 TYPE AS REQ		✓ WHT	SCE
			(COORDINATE FINAL LOCATIONS WITH SECURITY PRIOR TO SUBMITTAL)			
1	EA	MOTION SENSOR	SCANII 12/24 VDC		✓ WHT	SCE
1	EA	POWER SUPPLY	PS902 (900-2RS AS REQ) 120/240 VAC		✓	VON
			(COORDINATE POWER SUPPLIES WITH SECURITY PRIOR TO SUBMITTAL. OMIT WHERE PROVIDED BY SECURITY.)			

-INGRESS BY CARD READER OR BY PULL WHEN UNLOCKED BY SECURITY SYSTEM.

-FREE EGRESS AT ALL TIMES BY EXIT DEVICE.

-NO OUTSIDE KEY ENTRY.

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HW SET# C715

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112XY/224XY EPT HEIGHT AS REQ		628	IVE
1	EA	POWER TRANSFER	EPT10 CON		689	VON
1	EA	ELEC PANIC HARDWARE	QEL-XP99-DT-CON-SNB LENGTH AS REQ		626	VON
1	EA	SFIC EVEREST CORE	EVEREST SFIC CORE TO MATCH EXISTING KEY SYSTEM		626	SCH
1	EA	RIM CYLINDER	MATCH STANDARD W/KEYED CONST. CORE AS REQ		626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH TBWMS X MTG BRKT, SPCR & PLATE AS REQ		689	LCN
1	EA	RAIN DRIP	142A DW + 4" (OMIT @ COVERED LOCATIONS)		AA	ZER
1	EA	GASKETING	328AA H & J		AA	ZER
1	EA	DOOR SWEEP	8198AA LENGTH AS REQ		AA	ZER
1	EA	THRESHOLD	65A LENGTH AS REQ		A	ZER
1	EA	HARNESS (IN DOOR)	ALLEGION CONNECT TYPE & LENGTH AS REQ			SCH
1	EA	HARNESS (TO POWER SUPPLY)	CON-6W - CONNECTION LEADS			SCH
1	EA	CREDENTIAL READER	BY ANOTHER SECTION			
1	EA	DOOR CONTACT	679-05 TYPE AS REQ		WHT	SCE
1	EA	POWER SUPPLY	PS902 900-2RS			VON

-INGRESS BY THE CARD READER OR KEY OVERRIDE.

-FREE EGRESS AT ALL TIMES BY EXIT DEVICE.

-COORDINATE POWER SUPPLIES WITH SECURITY PRIOR TO SUBMITTAL. OMIT WHERE PROVIDED BY SECURITY.

-COORDINATE LOCATION OF DOOR CONTACTS WITH SECURITY PRIOR TO SUBMITTAL.

HW SET# E3-40-C

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	PRIVACY W/DB & IND	L9496HD 06N L583-363 L583-375 (INDICATOR)		626	SCH
1	EA	SFIC EVEREST CORE	EVEREST SFIC CORE TO MATCH EXISTING KEY SYSTEM		626	SCH
		NOTE	BALANCE OF EXISTING HARDWARE TO REMAIN			

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HW SET# E3-80I-C

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	STOREROOM W/DEADBOLT W/ OUTSIDE INDICATOR	L9480HD 06N L583-363 OS-OCC (INDICATOR)		626	SCH
1	EA	SFIC EVEREST CORE	EVEREST SFIC CORE TO MATCH EXISTING KEY SYSTEM		626	SCH
		NOTE	BALANCE OF EXISTING HARDWARE TO REMAIN			

HW SET# E3L-80

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	STOREROOM W/DEADBOLT	L9480HD 06N L583-363		626	SCH
1	EA	SFIC EVEREST CORE	EVEREST SFIC CORE TO MATCH EXISTING KEY SYSTEM		626	SCH
		NOTE	BALANCE OF EXISTING HARDWARE TO REMAIN			

HW SET# E3L-80-L

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	STOREROOM W/DEADBOLT	L9480BD 06 L583-363		626	SCH
		NOTE	BALANCE OF EXISTING HARDWARE TO REMAIN			

HW SET# E3L-80CL

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	STOREROOM LOCK	ND80BD RHO		626	SCH
		NOTE	BALANCE OF EXISTING HARDWARE TO REMAIN			

END OF SECTION

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140569 OPT0454717 Version 6

<u>Door#</u>	<u>HwSet#</u>
100	E3L-80-L
101	E3L-80-L
102	E3L-80-L
103	E3L-80-L
104	E3L-80-L
105	E3L-80-L
106	E3L-80-L
107	E3L-80-L
108	E3L-80-L
109	E3L-80-L
110	E3L-80-L
111	E3L-80-L
112	E3L-80-L
113	E3L-80-L
114	E3L-80-L
115	E3L-80-L
116	E3L-80-L
117	E3L-80-L
118	
119	
120	
120A	
120B	
120C	
121	E3L-80-L
121A	E3L-80-L
122	E3L-80-L
122A	
123	
123A	
124	
124A	
129	
130	
131	
132	E3L-80-L
133	E3L-80-L
134	E3L-80-L
135	E3L-80-L
136	E3L-80-L
137	E3L-80-L
138	E3L-80-L
139	E3L-80-L
140	E3L-80-L
141	E3L-80-L

<u>Door#</u>	<u>HwSet#</u>
142	E3L-80-L
143	E3L-80-L
144	E3L-80-L
145	E3L-80-L
146	E3L-80-L
147	E3L-80-L
147A	E3L-80-L
148	E3L-80-L
149	E3L-80-L
150	E3L-80-L
152	
153	
153A	
153B	
154	
154A	
154B	
154C	
157	
157A	
157B	
157C	
165	
200	
200A	
200B	
201	E3L-80-L
201A	E3L-80-L
202	
202A	
203	E3L-80-L
203A	E3L-80-L
204	
204A	
204B	
205	E3L-80-L
206	E3L-80-L
207	E3L-80-L
208	E3L-80-L
209	E3L-80-L
210	E3L-80-L
211	E3L-80-L
212	E3L-80-L
213	E3L-80-L
215	E3L-80-L
216	

<u>Door#</u>	<u>HwSet#</u>
216A	
217	
217A	
E001	C714M.1
E002	C715
E003	C714M.1
E004	C205LW
SS101	200C
SS102	201
SS103	201C
SS104	001
SS107	711CR
SS108	205
SYSGEN	
X100	
X104	
X104A	
X104B	
X105	
X106	
X107	201
X109	
X109A	
X110	
X111	E3L-80-L
X112	E3L-80-L
X113	
X113A	
X113B	
X113C	
X113D	
X113E	
X113F	
X113G	
X114	
X114A	E3-80I-C
X114B	E3-80I-C
X126	
X126A	
X128	
X128A	
X128B	
X128C	
X128D	
X128E	
X132	

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<u>Door#</u>	<u>HwSet#</u>
X133	
X133A	
X134	
X136	
X136A	
X136B	
X137	
X137A	E3L-80-L
X137B	E3-40-C
X138	E3L-80
X139	
X140	E3L-80-L
X141	E3L-80-L
X142	E3L-80-L
X143	
X143A	
X143B	
X143C	
X143D	
X144	
X144A	
X148	
X148A	E3L-80CL
X149	
X206	
X206A	

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SECTION 087101
DOOR HARDWARE SETS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Items commercially known as finish or door hardware required for operation of doors, and accessories necessary to complete installation.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Refer to Division 8 Section Door Hardware for door hardware product requirements.

PART 3 - EXECUTION

3.1 GENERAL

- A. Refer to Division 8 Section Door Hardware for door hardware execution requirements.

3.2 HARDWARE SCHEDULE

- A. Door Hardware Sets Schedule as follows.

END OF SECTION

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GLAZING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Glass, glazing, and supplementary items necessary for installation, including glass specified in other Sections where glazing requirements referenced to this Section.
 - 1. Monolithic glass.
 - 2. Laminated glass.
 - 3. Insulating glass.
 - 4. Decorative glazing.
 - 5. Fire-protection-rated glazing.
 - 6. Monolithic polycarbonate plastic glazing.
 - 7. Bullet-resistive glazing.
 - 8. One-way observation mirrored glazing.
 - 9. Glazing sealants and glazing materials.
- B. Enhanced Source Quality Control Standards: Comply with Manufacturer/Fabricator Enhanced Source Quality Control Standards for glass fabrication.
- C. Related Requirements:
 - 1. Refer to Division 01 Section Field Test for Air and Water Leakage.

1.2 ALTERNATES

- A. Alternate for Heat Soaked Fully Tempered Glass: Where fully tempered glass is required due to structural loads and other performance requirements that cannot be met by increased glass thickness, using laminated glass or other means, provide heat soaked fully tempered glass in lieu of fully tempered glass.

1.3 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. Interspace: Space between lites of an insulating-glass unit.

1.4 DELEGATED ENGINEERING REQUIREMENTS

- A. Delegated Engineering Responsibility: Contractor shall engage a qualified professional engineer to provide engineering for products and systems required to comply with the design intent of Contract Documents.
 - 1. Contract Documents Design Intent: Drawings and Specifications indicate design intent for products and systems and do not necessarily indicate or specify total Work required. Contract Documents shall not be construed as an engineered design; furnish and install Work required for a complete installation.
 - 2. Delegated Engineer Professional Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated with a record of successful in-service performance. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.

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3. Submittals: Preparation of structural analysis data including engineering calculations, shop drawings and other submittals signed and sealed by the qualified professional engineer.
 4. Coordination of Work:
 - a. Product Variations: In the event of minor differences between products and systems of acceptable or available manufacturers, Contractor shall notify Architect of such differences and resolve conflicts in a timely manner. Failure of Contractor to provide notification shall be construed as acceptance of conditions indicated, and changes caused by minor differences between products and Contract Documents shall be included in the Work at no additional cost to Owner.
 - b. Allowable Adjustments: Minor dimension and profile adjustments may be made in interest of fabrication or erection methods or techniques or ability to satisfy design intent, provided design intent is maintained as determined by Architect. Proposed deviations shall include a detailed analysis of impact to adjacent substrates or other building systems, including related design or construction cost impacts. If accepted by Architect, deviations causing changes in materials, constructability, substrates, or conditions shall be included in the Work at no additional cost to Owner.
- B. Project Glazing Analysis: Prepared by manufacturer for primary glass or fabricator for fabricated glass units. Analyze each glass type and glazing condition for thermal, wind, impact and additional design loads indicated in glass performance requirements.
1. Provide glass products in the thickness and strengths required to meet or exceed the criteria based on project loads and in-service conditions.
- C. Delegated Engineering – Structural Glass and Other Applications Exceeding Project Glazing Analysis: Contractor shall employ a qualified structural engineer to provide engineering for products and systems including attachment to building structure required to meet design intent of Contract Documents.
1. Preparation of structural analysis data including engineering calculations, shop drawings and other submittals signed and sealed by the qualified structural engineer
- 1.5 ACTION SUBMITTALS
- A. Product Data: Manufacturer's technical literature for each product and system indicated.
1. Include manufacturer's specifications for materials, installation instructions, and recommendations for maintenance.
- B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components and attachments to other work. Distinguish between shop and field-assembled work.
1. Include details of each type of glazing in conjunction with the appropriate framing system; indicate type of glass, sizes, shapes, glazing material, and quantity.
 2. Include details indicating glazing thickness, bite on glass, glass edge clearance, and depth of rabbet.
- C. Glass Samples: For each type of glass product other than clear monolithic vision glass, 12 inches (300 mm) square.
- D. Glass Range Sample Units: For each type of glass product other than clear monolithic vision glass, provide full size range samples representing anticipated range of appearance on the Project. Retain range samples for reference.

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- E. Glazing Accessory Samples: For gaskets, sealants and colored spacers, each type and color, in 12-inch (300-mm) lengths.
- F. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

1.6 INFORMATIONAL SUBMITTALS

- A. Manufacturer Project Acceptance Documents: Certifications by the manufacturer that its products and systems are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required, and that a warranty will be issued.
 - 1. Certification attesting application and use of glass for effects of thermal loading under expected service temperature ranges has been reviewed, and specified maximum probabilities of breakage will not be exceeded.
 - a. Certification shall include back pan and shadow box back pan conditions.
 - 2. Certifications attesting performance for specified design wind load criteria, has been reviewed; furnish design factor, statistical probability of breakage and center deflection for the largest size of each thickness and type.
 - 3. Certifications attesting face pressure of heat-strengthened glass units falls within limits specified. Glass determined to be outside these limits shall be replaced at no cost to Owner.
 - 4. Insulated Glass Units: Certification from manufacturer of insulating glass edge sealant indicating that glass edge sealants were tested for compatibility with other glazing materials including sealants, glazing tape, gaskets, setting blocks, and edge blocks.
 - 5. Ceramic Frit Coated Glass: Certification from manufacturer acknowledging strength reduction of frit coating used on the Project.
- B. Delegated Engineering Submittal: For products and systems indicating compliance with performance requirements. Include structural analysis, calculations and other performance data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Include strength/deflection calculations and secondary sealant sightline analysis.
 - a. Provide thermal stress analysis and certification that heat strengthening or tempering complies with requirements and conditions indicated for this Project.
 - 2. Where IGU structural performance based on inner/outer lite combination cannot be determined, fabricator shall assume outer lite only to meet structural requirements.
- C. Product Test Reports: Written reports based on evaluation of comprehensive tests performed by qualified testing agency indicating that each product complies with requirements.
 - 1. Product Approvals: Submit Florida Product Approval or Product Control Notice of Acceptance (NOA) issued by Miami-Dade County Building Code Compliance Office (BCCO) or other product approval acceptable to authorities having jurisdiction for systems used at exterior of building.
- D. Source Quality Control Reports for Enhanced Quality Standards: When requested, provide written reports documenting testing procedures and recorded measurements. Include letter(s) certifying compliance for the following.
 - 1. Distortion Tolerance Measurements: For heat-treated glass 6mm or thicker.
 - 2. Insulating Glass Unit Fabrication and Testing Requirements: For insulating glass units.
 - 3. Glass Color Tolerance Measurements: For monolithic coated glass and insulating coated glass units.

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- E. Field Quality Control Reports: Written report of testing and inspection required by Field Quality Control.
- F. Warranty:
 - 1. Provide manufacturer's written warranty covering materials and installation (labor) stating obligations, remedies, limitations and exclusions.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: To include in maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Fabricated-Glass Manufacturer Qualifications: A qualified manufacturer of fabricated glass units who is approved and certified by primary glass manufacturer.
- B. Installer Qualifications:
 - 1. Experience: Installer's personnel with not less than 5 years of experience in the successful performance of Work similar to scope of this Project.
 - 2. Supervision: Installer shall maintain a competent supervisor at Project while the Work is in progress, and who has not less than 5 years of experience installing products and systems similar to scope of this Project.
 - 3. Manufacturer Acceptance: Installer shall be certified, approved, licensed, or acceptable to manufacturer to install products.
 - 4. Certification: Qualified glazing contractor certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AG&M) contractors and who employs glazing technicians certified under the Architectural Glass and Metal Technician (AGMT) certification program.
- C. Reflective- and Low-E-Coated Vision Glass: ASTM C1376, and as follows, whichever is more restrictive.
 - 1. Inspection: At a distance of 10 ft (3 m), in transmission and reflectance at a viewing angle of 90° to the specimen, using a bright uniform background with diffused daylight conditions, without direct sunlight. Vision area shall extend to within 3 in (75 mm) of the perimeter of glass panel.
 - 2. Reflectance and Transmission: Reflectance and transmission may vary slightly and be considered acceptable. Reflectance variations of plus or minus 1.5 percent are permissible.
 - 3. Pinholes: Pinholes greater than 1/16 in (1.5 mm) diameter shall not be allowed within vision area.
 - 4. Scratches: Scratches greater than 1/2 in (12 mm) shall not be allowed within vision area.
 - 5. Verification of Color: Color shall be verified by using a Spectrophotometer placed directly on the specimen.
 - a. Tolerance for Color Variance: ASTM C1376, Total Range (All Units, Each Glass Type) of less than or equal to 4.0 Delta E using CIEDE2000 as defined in ASTM D2244.
- D. Reflective- and Low-E-Coated Spandrel Glass: ASTM C1376, Kind CS, and as follows, whichever is more restrictive.
 - 1. Inspection: At a distance of 15 ft (4.6 m), a viewing angle of 90° to the specimen, using a bright uniform background with diffused daylight conditions, without direct sunlight.
 - 2. Reflectance: Reflectance variations of plus or minus 1.5 percent are permissible.

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3. Verification of Color: Color shall be verified by using a Spectrophotometer placed directly on the specimen.
 - a. Tolerance for Color Variance: ASTM C1376, Total Range (All Units, Each Glass Type) of less than or equal to 4.0 Delta E using CIEDE2000 as defined in ASTM D2244.

E. Anisotropy Measurement: Anisotropy inspection is the measurement of polarized light calculated and presented as Maximum Iridescence or Total Stress in accordance with ASTM C1901-21.

1. Anisotropy shall be monitored using an on-line measurement system to assure that glass produced for this project measures within a consistent and accepted range of results established by baseline measurements on the accepted mockup glass.
 - a. The intent of this requirement is to use measurements taken from mockup glass during the manufacturing process to establish an acceptable range of results as the baseline for the mass production of glass for this project.

1.9 PRECONSTRUCTION TESTING

- A. Preconstruction Adhesion and Compatibility Testing: Test each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
1. Testing will not be required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
 2. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
 3. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
 4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

1.10 MOCKUPS

- A. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.
1. Provide glazing in mockups to match glazing systems required for Project, including glazing methods.

1.11 PRE-INSTALLATION CONFERENCE

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.
1. Participants:
 - a. Architect.
 - b. Contractor, including superintendent.
 - c. Installer, including project manager and supervisor.
 - d. If requested, Manufacturer's qualified technical representative.
 - e. Installers of other construction interfaced with Work.
 2. Minimum Agenda: Installer shall demonstrate understanding of the Work required by describing detailed procedures for preparing, installing, and cleaning the Work. Demonstration shall include, but not be limited to, following topics:

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- a. Tour representative areas of Work, inspect and discuss condition of substrate, and other preparatory work performed by other trades.
 - b. Review Contract Document requirements.
 - c. Review approved submittals.
 - d. Review inspection and testing requirements.
 - e. Review environmental conditions and procedures for coping with unfavorable conditions.
 - f. Resolve deviations or differences between Contract Documents and the manufacturer's specifications.
 3. Record discussions, including decisions and agreements, and prepare report.
- 1.12 DELIVERY, STORAGE, AND HANDLING
 - A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
 - B. Insulating Glass Units: Comply with insulating-glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.
- 1.13 PROJECT CONDITIONS
 - A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F (4.4 deg C), unless approved otherwise by manufacturer in writing.
- 1.14 COORDINATION
 - A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.
 - B. Coordinate glazing channel dimensions.
 1. Provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
 2. Achieve proper safety margins for glazing retention under each design load case, load case combination, and service condition.
- 1.15 WARRANTY
 - A. Manufacturer Warranty: Furnish manufacturer's written material and labor warranty signed by an authorized representative using manufacturer's standard form agreeing to furnish materials and labor required to repair or replace work which exhibits material defects caused by manufacture or design of product. "Defects" are defined to include but not limited to deterioration or failure to perform as required.
 1. Coated Glass: Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
 - a. Warranty Period: Manufacturer's standard but not less than 10 years after date of Substantial Completion.

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2. Laminated Glass: Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
 - a. Warranty Period: Manufacturer's standard but not less than 10 years after date of Substantial Completion.
 3. Insulating Glass Units: Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is obstruction of vision by dust, moisture, or film on interior surfaces of glass.
 - a. Warranty Period: Manufacturer's standard but not less than 10 years after date of Substantial Completion.
 4. Heat-Soaked Tempered Glass: Breakage of heat-soaked tempered glass units that spontaneously break due to nickel sulfide (NiS) inclusions at a rate exceeding 0.3 percent (3/1000) within specified warranty period.
 - a. Warranty Period: Manufacturer's standard but not less than 10 years after date of Substantial Completion.
 5. Polycarbonate Plastic Glazing: Deterioration of polycarbonate glazing is defined products that break or develop defects from normal use that are attributable to manufacturing process and not to practices for maintaining and cleaning plastic glazing contrary to manufacturer's written instructions. Defects include coating delamination, haze, excessive yellowing, and loss of light transmission beyond the limits stated in plastic glazing manufacturer's standard form.
 - a. Warranty Period: Manufacturer's standard but not less than 5 years after date of Substantial Completion.
- B. Installer Warranty: Furnish installer written workmanship warranty signed by an authorized representative using installer standard form agreeing to provide labor required to repair or replace work which exhibits workmanship defects. Defects ☐ is defined to include but not limited to deterioration or failure to perform as required.
1. Warranty Period: Installer shall warrant the installation to be free from workmanship Defects for a period of 2 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section Substitution Procedures.
- B. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other manufacturers/fabricators offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.
 1. Glass Selections: As scheduled or indicated in Design Selections.

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2.2 MATERIALS, GENERAL

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

2.3 PERFORMANCE REQUIREMENTS

- A. General Performance: Comply with performance requirements specified, as determined by testing of products and systems representing those indicated for this Project, without failure due to defective manufacture, fabrication, installation, or other defects in construction.
1. Failure includes but is not limited to the following:
 - a. Structural failures including but not limited to excessive deflection.
 - b. Glass breakage.
 - c. Failure of sealants or gaskets to remain watertight and airtight.
 - d. Deterioration of glazing materials.
- B. Fire-Test-Response Characteristics of Plastic Glazing: As determined by testing plastic glazing by a qualified testing agency acceptable to authorities having jurisdiction.
1. Self-ignition temperature of 650 deg F (343 deg C) or higher when tested according to ASTM D1929 on plastic sheets in thicknesses indicated for the Work.
 2. Smoke density of 75 or less when tested according to ASTM D2843 on plastic sheets in thicknesses indicated for the Work.
 3. Flame-spread index of not less than that indicated when tested according to ASTM E84.
- C. Structural Loads: Engineer products and systems to withstand loads within limits of allowable working stresses of the materials involved under conditions indicated including, but not limited to gravity, wind, seismic, and erection design loads and thermal movements established by authorities having jurisdiction, applicable building codes, and as indicated.
1. Glazing to withstand each applicable design load case and load case combination within limits and under conditions determined in accordance with the IBC and ASTM E1300.
- D. Structural Movement: Engineer system to withstand movements of supporting structure including, but not limited to inter-story drift, twist, column shortening, long-term creep and deflection from uniformly distributed and concentrated live loads.
- E. Exterior Glazing:
1. Design Wind Pressure: As indicated on Drawings or Wind Analysis Report.
 2. Other Loads: As indicated on Drawings.
 3. Design Snow Loads: As indicated on Drawings.
 4. Vertical Glazing: For glass surfaces set vertically 15 degrees or less from vertical, design glass to resist design loads based on glass type factors.
 - a. Probability of Breakage for Vertical Glazing: For glass surfaces set vertically 15 degrees or less from vertical, design glass for a probability of breakage not greater than 0.008.
 5. Sloped Glazing: For glass surfaces sloped more than 15 degrees from vertical, design glass to resist design loads and load combinations based on glass type factors
 - a. Probability of Breakage for Sloped Glazing: For glass surfaces sloped more than 15 degrees from vertical, design glass for a probability of breakage not greater than 0.001.
 6. Maximum Lateral Deflection: At design wind pressure.

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- a. For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/100 times the short-side length or 1 inch (25 mm), whichever is less and keeps glazing retained in place with a suitable margin of safety under design conditions.
 7. Thermal Loads: Design glazing to resist thermal stress breakage induced by conditions including differential shading within individual glass lites, temperatures and limited air circulation.
 - a. Include back pan and shadow box back pan applications.
 8. Windborne-Debris-Impact Resistance: Exterior glazing shall pass ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone protection.
 9. Safety Glazing: Where safety glazing is indicated or required, provide glazing that complies with 16 CFR 1201, Category II.
 - a. Human Impact Loads: Locations indicated, and as defined by building code; glazed with safety glass.
 10. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
 - a. For monolithic glass lites, properties are based on units with lites 1/4 in (6 mm) thick.
 - b. For laminated glass lites, properties are based on products of construction indicated.
 - c. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
 - d. U-Factors: Center-of-glazing values, according to NFRC 100, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
 - e. Solar Heat-Gain Coefficient and Visible Light Transmittance: Center-of-glazing values, according to NFRC 200.
 - f. Visible Reflectance: Center-of-glazing values, according to NFRC 300.
 11. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
 - a. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- F. Interior Glazing:
1. Maximum Lateral Deflection: For glass supported on all four edges or two edges, limit center-of-glass deflection to not more than 1/100 times the short-side length or 1/2 in (12 mm), whichever is less, at 10 lb/sq ft (479 Pa) lateral load.
 2. Differential Deflection: For glass installed to walking surfaces, deflection of adjacent unsupported edges shall not exceed glass thickness when subjected to 50 lbf/ft. (730 N/m) applied horizontally to one panel at any point up to 42 inches (1067 mm) above the adjacent walking surface.
 3. Thermal Loads: Design glazing to resist thermal stress breakage induced by conditions including differential shading within individual glazing lites and temperatures.
 4. Safety Glazing: Where safety glazing is indicated or required, provide glazing that complies with 16 CFR 1201, Category II.
 - a. Human Impact Loads: Locations indicated, and as defined by building code; glazed with safety glass.

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2.4 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
1. NGA/GANA Publications: Glazing Manual and Laminated Glazing Reference Manual.
 2. FGIA/AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR-A7, "Sloped Glazing Guidelines."
 3. FGIA/IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
 4. FGIA/IGMA Publication for Insulating Glass: IGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
 5. FGIA/IGMA Publication Insulating Glazing Tolerances: IGMA TB-1200, "Guidelines for Insulating Glass Dimensional Tolerances."
 6. FGIA/IGMA Publication for Thermal Stress: IGMA TM-1500, "Guidelines to Reduce Instances of Thermal Stress."
 7. NGA/GANA Publications: "Guidelines for the Appearance of Insulating Glass Unit Edges in Commercial Applications at the Time of Installation"
- B. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
1. Acceptable Products: Complying with CSPC 16 CFR 1201, Category II.
 - a. Submit label location and size for Owner approval prior to fabrication. Glass having labels in locations not pre-approved shall be removed and replaced with glass having labels in the correct location at no cost to Owner.
 2. Products Not Permitted: Wired Glass.
- C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
1. Units shall be certified by IGCC to comply with ASTM E 2190 Standard Specification for Insulating Glass Unit Performance and Evaluation.
- D. Insulating Glass Units: Acceptable products shall comply with the following:
1. ASTM E 546 Standard Test Method for Frost Point of Sealed Insulating Glass Units.
 2. ASTM E 576 Standard Test Method for Frost Point of Sealed Insulating Glass Units in the Vertical Position.
- E. Glass Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than thickness indicated.
1. Exterior Glass Schedule: As indicated on Drawings, or as scheduled or as indicated in Design Selections.
 - a. Exterior Lites: Not less than 1/4 in (6 mm) minimum thickness.
 - b. Tinted Glass: Provide same thickness for each tint color indicated throughout Project.
 2. Interior Glass Schedule: As indicated on Drawings, or as scheduled or as indicated in Design Selections.
 - a. Interior Lites: Not less than 1/4 in (6 mm) minimum thickness.

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- F. Glass Strength: Provide Kind HS heat-strengthened float glass or Kind FT fully tempered float glass as required to comply with Performance Requirements, unless otherwise indicated:
1. Provide Kind HS (Heat Strengthened) at exterior conditions and where recommended by manufacturer to comply with performance requirements.
 2. Provide Kind FT (Fully Tempered) as indicated and where recommended by manufacturer to comply with performance requirements or required for safety glazing.
 3. Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with Performance Requirements.
 4. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with Performance Requirements.
 5. Where fully tempered float glass is indicated, provide fully tempered float glass.
 - a. Provide Kind FT fully tempered float glass where recommended by manufacturer to comply with safety glazing requirements.

2.5 GLASS PRODUCTS

- A. Glass Manufacturers and Fabricators:
1. AGC Glass Co. North America, Inc.
 2. Guardian Industries Corporation
 3. Pilkington North America, Inc.
 4. Vitro Architectural Glass (formerly PPG Industries, Inc.)
 5. Saint Gobain.
 6. Viracon.
 7. Interpane.
 8. Tecnoglass.
 9. Oldcastle.
- B. Clear Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.
- C. Low-Iron Float Glass (Ultraclear): ASTM C 1036, Type I, Quality-Q3, Class I, complying with other requirements specified and with visible light transmission not less than 91 percent.
1. Manufacturers and Products:
 - a. AGC Glass Co. North America, Inc.; Krystal Klear.
 - b. Guardian Industries Corp.; Ultrawhite.
 - c. Pilkington North America; Optiwhite.
 - d. Vitro Architectural Glass (PPG Industries, Inc.); Starphire.
- D. Tinted Float Glass: ASTM C1036, Type I, Class 2 (tinted), Quality-Q3.
- E. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion horizontally oriented after completion of field glazing unless Architect's advanced written approval is provided otherwise.
- F. Heat-Strengthened Float Glass: ASTM C1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion horizontally oriented after completion of field glazing unless Architect's advanced written approval is provided otherwise.

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- G. Heat Soaking Tempered Glass: Provide heat soak testing for fully tempered products in accordance with EN 14179-1 or EN 14179-2 and manufacturer's recommended heat soak testing process.
1. Locations Schedule:
 - a. As scheduled or indicated in Design Selections or Drawings.
 - b. As indicated in Alternate for Heat Soaked Fully Tempered Glass.
 - c. Locations recommended by manufacturer.
- H. Reflective- and Low-E-Coated Vision Glass: ASTM C 1376, coated by pyrolytic process or vacuum deposition (sputter-coating) process, standard of manufacturer, and complying with other requirements as specified.
1. Kind: Kind CV (coated vision glass), except that Kind CO (coated overhead glass) may be used where the lower edge of the glass is more than **6 ft (1.8 m)** above the adjacent floor level or cannot be approached closer than **10 ft (3 m)**.
- I. Ceramic-Coated Vision Glass: ASTM C 1048, Condition C, Type 1, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3, heat-treated float glass with ceramic enamel; complying with Specification No. 95-1-31 in NGA/GANA's "Engineering Standards Manual", and with other requirements as specified.
- J. Ceramic-Coated Spandrel Glass: ASTM C 1048, Condition B, Type I, Quality-Q3, and with other requirements as specified.
- K. Reflective- and Low-E-Coated Spandrel Glass: ASTM C 1376, Kind CS; coated by pyrolytic process or vacuum deposition (sputter-coating) process, standard of manufacturer, and complying with other requirements as specified.
- L. Bent Glass: ASTM C1464, kind, glass type, bend, and other properties as indicated.
1. Manufacturers and Fabricators:
 - a. Interpane.
 - b. Cristacurva.
 - c. SBG Standard Bent Glass.
- M. Patterned Glass: ASTM C 1036, Type II (patterned and wired glass, flat), Class 1 (clear), Form 3 (patterned), Quality-Q6, Finish F1 (patterned one side), unless otherwise indicated.
- N. Tempered Patterned Glass: ASTM C 1048, Kind FT (fully tempered), Type II (patterned glass, flat), Class 1 (clear), Form 3 (patterned), Quality-Q6, Finish F1 (patterned one side), unless otherwise indicated.
- O. Decorative Film Overlay: Translucent, dimensionally stable, film, 2-mil- (0.05-mm-) minimum thickness, with pressure-sensitive, clear adhesive back for adhering to glass and releasable protective backing.
1. Selections: As scheduled or indicated in Design Selections.
- 2.6 LAMINATED GLASS
- A. Laminated Glass: ASTM C 1172. Comply with testing requirements in 16 CFR 1201 for Category II materials, and with other requirements specified. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
1. Construction: Laminate glass with polyvinyl butyral (PVB) interlayer or SGP Ionoplast interlayer to comply with interlayer manufacturer's written recommendations.

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2. Interlayer Thickness: Provide thickness not less than indicated and as needed to comply with requirements.
 - a. Minimum Thickness: 0.030 in (0.75 mm) unless otherwise indicated.
 - b. Sloped Glazing: 0.030 in (0.75 mm) to 0.060 in (1.5 mm); as needed to comply with performance requirements.
 - c. Wind Borne Debris Impact Resistance: 0.060 in (1.5 mm) to 0.090 in (2.2 mm); as needed to comply with performance requirements.
 - d. Heat Strengthened and Fully Tempered Glazing: 0.060 in (1.5 mm) minimum.
3. Interlayer Color: Clear unless otherwise indicated.
4. Typical Interlayer - Manufacturers and Products:
 - a. DuPont; Butacite.
 - b. Eastman Chemical Company; Saflex.
 - c. Kuraray; SentryGlas.
5. Glass Railing / Windscreen Interlayer - Manufacturers and Products:
 - a. Basis of Design: Kuraray America Inc.; SentryGlas Ionoplast.
6. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
7. Interlayer Color: Clear unless otherwise indicated.

2.7 INSULATING GLASS

- A. Insulating Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and in compliance with other specified requirements.
 1. Insulating Glass Unit Thickness Tolerance: Minus 1/16 inch, plus 1/32 inch.
 - a. Units Constructed with Patterned or Laminated Glass: Plus or minus 1/16 inch.
 2. Sealing System: Dual seal, with polyisobutylene primary seal and silicone secondary seal in accordance with ASTM C 1249. Provide insulating glass units free of skips or voids in the primary or secondary seals.
 - a. Primary IGU Seal: Primary IGU sealant shall be fully wetted against glass, applied in a continuous, uninterrupted, properly dimensioned bead with no skips or voids around perimeter, each side of IGU.
 - 1) Primary Seal Width: 5/32-inch.
 - 2) Primary Seal Thickness: 1/16-inch minimum thickness after pressing IGU.
 - 3) Air Spacer Visibility: 3/32-inch maximum visible exposure beyond polyisobutylene primary seal.
 - b. Secondary IGU Seal: Secondary IGU sealant shall be fully wetted against glass and spacer, applied in a continuous, uninterrupted, properly dimensioned bead, filling cavity with sealant completely.
 - 1) Secondary Seal Thickness: As determined by glass manufacturer; meeting minimum design width and depth requirements as determined by glass strength and deflections, plus 1/16-inch tolerance.
 - 2) Corners: IGU corners shall be completely filled with secondary sealant.
 - c. Skips and Voids Between Primary and Secondary Sealant: Maximum of 2-inches long by 1/16-inch-wide discontinuity separated by at least 18-inches. Provide

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continuous contact between primary and secondary IGU sealant, cleanly tool secondary sealant prior to packing.

- d. Sealant Color: Black, unless otherwise scheduled or indicated in Design Selections.
- 3. Spacer: Provide a hermetically sealed and dehydrated space; lites shall be separated by a spacer with three bent corners and one keyed-soldered corner or four bent corners and one straight butyl injected zinc plated steel straight key joint.
 - a. Spacer Material and Color:
 - 1) Spacer Material and Color: Aluminum with mill or clear anodic finish, unless otherwise scheduled or indicated in Design Selections.
 - b. Spacer Material and Color:
 - 1) Division 8 Section Glazed Aluminum Framing Systems: Aluminum, black color, unless otherwise scheduled or indicated in Design Selections.
 - 2) Division 8 Section Structural Glass Curtainwall System: Stainless Steel, unless otherwise scheduled or indicated in Design Selections.
- 4. Edge Deletion: Delete coating at perimeter of coated lite prior to fabrication of insulating glass units according to coated glass manufacturer's instructions.
- 5. Desiccant: Molecular sieve or silica gel, or blend of both.

2.8 FIRE-PROTECTION-RATED GLAZING

- A. Fire-Protection-Rated Glazing: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on positive-pressure testing in accordance with NFPA 257 or UL 9, including hose-stream test, and complies with NFPA 80.
- B. Fire-Protection-Rated Glazing Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label indicates manufacturer's name; test standard; whether glazing is permitted to be used in doors or openings; if permitted in openings, whether glazing has passed hose-stream test; whether glazing meets 450 deg F (250 deg C) temperature-rise limitation; and fire-resistance rating in minutes.
- C. Monolithic Fire-Protection-Rated Ceramic Glazing: Clear, ceramic flat glass; 3/16-inch (5-mm) thickness; complying with 16 CFR 1201, Category II.
 - 1. Manufacturers and Products:
 - a. Technical Glass Products; FireLite.
 - b. Safti First; SuperLite.
 - c. Schott North America, Inc.; Pyran Star.
 - d. Vetrotech; Keralite.
 - 2. Basis of Design: Technical Glass Products; FireLite.
 - a. Locations - Safety Glazing not Required: Where indicated or scheduled for 20, 45, 60, and 90-minute ratings.
- D. Fire-Protection-Rated Laminated Ceramic Glazing: Laminated glass made from two plies of clear, ceramic glass; 8-mm total thickness; complying with 16 CFR 1201, Category II.
 - 1. Manufacturers and Products:
 - a. Technical Glass Products; FireLite Plus (Laminated).
 - b. Safti First; SuperLite (Laminated).
 - c. Schott North America, Inc.; Pyran Star (Laminated).

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- d. Vetrotech Saint-Gobain; Keralite (Laminated).
- 2. Basis of Design: Technical Glass Products; FireLite Plus.
 - a. Locations - Safety Glazing Required: Where indicated or scheduled for 20, 45-, 60-, 90-, and 120-minute ratings.

2.9 INTERIOR PLASTIC GLAZING

- A. Glazing Publication: Comply with published instructions of plastic glazing manufacturers and with GANA's "Glazing Manual" unless more stringent requirements are indicated. See this publication for definitions of glazing terms not otherwise defined in this Section or in other referenced standards.
- B. Plastic Glazing Labeling: Identify plastic sheets with appropriate markings of applicable testing and inspecting agency, indicating compliance with required fire-test-response characteristics.
- C. Sizes: Fabricate plastic glazing to sizes required for openings indicated. Allow for thermal expansion and contraction of plastic glazing without restraint and without withdrawal of edges from frames, with edge clearances and tolerances complying with plastic glazing manufacturer's written instructions.
- D. Monolithic Polycarbonate Glazing: Polycarbonate sheet; ASTM C 1349, Appendix X1, Type I (standard, UV stabilized), with a polished finish.
 - 1. Manufacturers and Products:
 - a. Altuglas International, Division of Arkema Inc.; Tuffak XL.
 - b. Amerilux International, LLC; Coverlite Solid Polycarbonate.
 - c. General Electric Company; Lexan XL-1.
 - d. Palram Americas; Palsun.
 - e. Sheffield Plastics Inc., a Bayer Material Science Company; Makrolon SL.
 - 2. Nominal Thickness: 0.236 in (6 mm) unless indicated otherwise.
 - 3. Color: Transparent colorless
 - 4. Flame-Spread Index: 25 or less.

2.10 GLAZING GASKETS

- A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:
 - 1. EPDM (peroxide cured) complying with ASTM C 864.
 - 2. Silicone complying with ASTM C 1115.
- B. Soft Compression Gaskets: Extruded or molded closed-cell, integral-skinned gaskets of EPDM, silicone, or thermoplastic polyolefin rubber, complying with ASTM C 509, Type II, black, and of profile and hardness required to maintain watertight seal and compatible with sealants.
 - 1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.
 - a. Gasket Color: Black, unless otherwise scheduled or indicated in Design Selections. Gaskets concealed from view may be black.
- C. Provide factory pre-molded, vulcanized or heat welded corners, for continuous, joint-free glazing material around sides of the glazing rabbet. Field-cut corners not allowed.
- D. Provide gasket slightly longer than opening to be filled, as recommended by gasket manufacturer.

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2.11 GLAZING SEALANTS

A. General:

1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Additional Movement Capability: Provide products with the capability, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C 719, to withstand the specified percentage change in the joint width existing at time of installation and remain in compliance with other requirements in ASTM C 920 for uses indicated.

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT.

1. Manufacturers and Products:

- a. Dow; DOWSIL 795 Silicone Building Sealant.
- b. GE Construction Sealants; Momentive Performance Materials Inc. GE Advanced Materials - Silicones; Silglaze II.
- c. Pecora Corporation; 895.
- d. Sika Corp.; Sikasil WS-295.

2. Color: As selected by Architect from manufacturer's full range of colors.

C. Structural-Glazing Sealant: ASTM C 1184, chemically curing silicone formulation that is compatible with system components with which it comes in contact, specifically formulated, and tested for use as structural-sealant and approved by structural-sealant manufacturer for use in glazed aluminum wall assembly indicated.

1. Minimum Tensile Strength: 100 psi (690 kPa).
2. Modulus of Elasticity: As required by structural-sealant-glazed aluminum wall system design to meet performance requirements.
3. Manufacturers and Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow; DOWSIL 983 Structural Glazing Sealant.
 - b. GE Construction Sealants; Momentive Performance Materials Inc. GE Silicones; SSG4400 Ultraglaze Sealant.
 - c. Tremco Incorporated; Proglaze SSG.

4. Color: Black, unless otherwise scheduled or indicated in Design Selections Summary.

D. Glazing Sealants for Fire-Rated Glazing Products: Neutral-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 50, Use NT. Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated.

2.12 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

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1. AAMA 806.3 tape is for high-performance commercial glazing applications involving continuous pressure from gaskets or pressure-generating stop designs. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.

2.13 ENGINEERED TRANSITION ASSEMBLIES

- A. Engineered Transition Assembly: Provide engineered transition assembly to seal air barrier perimeter to windows, doors and glazed aluminum framing systems.
 1. Basis of Design: Tremco, Inc; Proglaze Engineered Transition Assembly (ETA).
- B. Pre-Engineered Aluminum and Silicone Materials: Mechanically attach system assembly to glazed aluminum framing systems and provide durable seal. Engineered transitions assembly includes the following components:
 1. Silicone Rubber Sheet (SRS): Extruded, 40 durometer, translucent silicone, with lock-in rubber dart.
 2. Silicone Rubber Corners (SRC): Pre-molded, 40 durometer, translucent silicone, with lock in rubber dart
 3. Silicone Sealants: Comply with ASTM C 920, single-component, neutral-curing silicone; Class 100/50, Grade NS, Use O.
 - a. Basis of Design: Tremco Inc.; Spectrem 1, or another approved sealant as recommended by manufacturer.
 4. Extruded Aluminum Attachment (EAA): Alodine finished, pre-engineered profile designed to receive silicone lock-in rubber dart. Pre-drilled extrusion with butyl tape, 100% solid polyisobutylene-cross linked butyl preformed sealant.

2.14 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks:
 1. Silicone material with a Shore, Type A durometer hardness of 85, plus or minus 5.
 2. Type recommended in writing by sealant or glass manufacturer.
- D. Spacers:
 1. Silicone blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
 2. Type recommended in writing by sealant or glass manufacturer.
- E. Edge Blocks:
 1. Silicone material of hardness needed to limit glass lateral movement (side walking).
 2. Type recommended in writing by sealant or glass manufacturer.
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
- G. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

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2.15 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
 - 1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
- B. Butt Glazing: Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
- C. Grind smooth and polish exposed glass edges and corners.

2.16 SOURCE QUALITY CONTROL

- A. Inspections and Testing: Manufacturer/fabricator shall perform pre-construction source quality-control inspections and testing, including but not limited to the following.
 - 1. Basis of Design for Enhanced Quality Control Standard: Guardian Elite Optical Quality Standards or equivalent enhanced fabrication standard as recommended by glass manufacturer/fabricator and accepted by the Architect to meet the design intent for the Project.
 - 2. Certification: Certifications by the manufacturer/fabricator that its products and systems comply with requirements and that products failing to meet requirements are not incorporated into the Work.
 - 3. Documentation: Inspection and testing records shall be maintained for a period of 10 years from the date of Substantial Completion. Provide inspection and testing records upon request and at no cost to Owner or Architect.
 - 4. Visual Mockup Glass:
 - a. Measurements reviewed and approved for glass panels used in mockups shall establish fabrication tolerances for the Project.
 - b. Glass panels used in visual mockups shall be fabricated to the same fabrication tolerances as glass panels to be used on the Project.
- B. Distortion Tolerance Measurement for Processing Heat-Treated Glass.
 - 1. On-Line Distortion Measurement System: Measure each piece of monolithic, uncoated or coated, heat-treated glass 6 mm or thicker.
 - 2. Roll Wave and Optical Distortion Limits (mD): On-Line Measurement.
 - a. Roll Wave Distortion Limits: Maximum peak-to-valley roll wave of 0.003 inch (0.08 mm) in the central area of the glass lite, and 0.008 inch (0.20 mm) within 12 inches (305 mm) of the leading and trailing edge of the lite, measured in accordance with ASTM C 1651 – Standard Test Method for Measurement of Roll Wave Optical Distortion in Heat-Treated Float Glass.
 - b. Center Kink Distortion Limits: Maximum center-kink of 0.001 inch (0.025 mm) roll wave measured over the surface of the glass perpendicular to the direction of travel through the heat treatment furnace.
 - c. Optical Distortion Limits - Millidiopter (mD) Measurements for Clear or Low-Iron Glass 1/4-Inch (6 mm) to 3/8-Inch (10 mm) Thickness, No Ceramic Frit or Ink: Maximum distortion of plus or minus 100 mD over 95% of the glass surface area, measured in accordance with ASTM C 1652 - Standard Test Method for Measuring Optical Distortion in Flat Glass Products Using Digital Photography Grids.

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- d. Measurement Equipment: On-Line measurement system utilizing high resolution optics measured in diopters.
 - 1) Basis of Design: LiteSentry; Osprey (Version 7 or Higher) Online Distortion Measurement System.
- e. Exclusions: Silk screen, full coverage ceramic frit glass and glass panels 10 mm and thicker are excluded from this requirement.

C. Enhanced Insulating Glass Unit Fabrication and Testing Requirements.

- 1. Sealant Uniformity: Perform IGMA Sealant Uniformity of Mix Test not less than once per shift. Submit test reports upon Architect's request.
- 2. Primary Seal - Sealant Adhesion Testing: Manufacturer recommended IGU adhesion pull testing process on units fabricated at the same time of production and on the same production line using the same processing equipment to produce this Project. Conduct testing each shift or carton change on units not less than 24 in (600 mm) x 24 in (600 mm).
 - a. Adhesion Criteria: Comply with pass/fail requirements of manufacturer published guidelines and/or manufacturer certification requirements.
- 3. Residual Moisture Content: Perform IGMA Residual Moisture Content by Head of Absorption Test. Perform test in accordance with desiccant manufacturer's written recommendations. Submit test reports upon Architect's request.
- 4. Bow/Warp Unit Distortion Tolerance (Concave/Convex): Off-Line Straight Edge Measurement.
 - a. Localized and Overall Bow (Warp) Distortion: Localized and overall bow (warp) per lite shall not exceed one-half of the maximum allowed by ASTM C 1048. Localized warp shall not exceed 1/32 in (0.8 mm) over any 12" span (30mm).
 - b. Air Space Gap Measurement: Visually inspect all units and measure center air space gap on all finished units over 35 square feet.
 - 1) Air Space Gap Tolerance: Maximum plus or minus 1/16 in (1.5 mm) at time of fabrication.
- 5. Sealant Application: No skips/voids in primary or secondary seal. Secondary seal cleaned/tooled prior to packing; no sealant smears on glass surfaces.
- 6. Coating Edge Deletion: Clean, straight and precise.
 - a. Coating Edge Deletion Tolerance: Uniformly remove coating to the greater of 3/8 in (10 mm) from the edge of glass to the edge of the coating, or at least 50% through the primary seal width to the edge of glass.
- 7. Spacers: Metal, bent.
 - a. Spacer connections shall be sealed to ensure IGU is hermetically sealed.

D. Glass Color:

- 1. General: Based on the established color target for each type of glass product, perform quality color control checks using on-line and off-line measurement spectrophotometer instrumentation to ensure compliance with ASTM C1376. Measure each piece of the following glass types:
 - a. Monolithic coated glass.
 - b. Insulating glass units.

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2. Anisotropy (Iridescence): Perform anisotropy (iridescence) scan utilizing detection system approved by glass manufacturer. Perform test in accordance with detection system manufacturer's written instructions. Continuously monitor production and record results. Maintain results for a period of not less than 10 years.
3. Color Variation of Glass Coatings: Provide vacuum deposition coatings on glass complying with color variation limits specified in ASTM C 1376. Perform color monitoring utilizing spectrophotometer equipment approved by glass manufacturer. Perform test in accordance with manufacturer's approved procedure. Test finished insulated glass units in accordance with reflected color specifications and in comparison, to approved mockup control sample. Statistically monitor production and record results. Maintain results for a period of not less than 10 years.
 - a. Tolerance for Color Variance: ASTM C1376, Total Range (All Units, Each Glass Type) of less than or equal to 4.0 Delta E using CIEDE2000 as defined in ASTM D2244.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.
- B. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 2. Presence and functioning of weep systems.
 3. Minimum required face and edge clearances.
 4. Effective sealing between joints of glass-framing members.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
 1. Respective manufacturer's written installation instructions.
 2. Accepted submittals.
 3. Contract Documents.

3.3 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.
- B. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

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- C. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

3.4 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where length plus width is larger than 50 in (1270 mm).
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - 2. Provide 1/8 in (3 mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- K. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

3.5 TAPE GLAZING FOR INTERIOR INSTALLATIONS

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

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- C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until right before each glazing unit is installed.
- F. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

3.6 GASKET GLAZING (DRY)

- A. Fabricate compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

3.7 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.8 FIELD QUALITY CONTROL

- A. Owner Testing Agency: The Owner may employ and pay a qualified independent testing agency to perform field quality control.
 - 1. Refer to Division 01 Section Field Test for Air and Water Leakage.
 - 2. Refer to Division 01 Building Enclosure Commissioning for Field Observations and Performance Testing.
 - 3. Glass Color Tolerances: Owner testing agency may perform onsite color measurements using spectrophotometer instrumentation to ensure compliance with Tolerances for Color Variation.

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- a. Onsite Developed Reference Target: Onsite developed reference target shall be the average measurement of not less than 75% of glass units of the same glass type per façade.
 - 1) Tolerance for Color Variance: ASTM C1376, Total Range (All Units, Each Glass Type) of less than or equal to 4.0 Delta E using CIEDE2000 as defined in ASTM D2244.
 - b. Testing agency will prepare survey report indicating locations not complying with specified tolerances.
- B. Tests and Inspections, General: Tests and inspections shall take place as installation proceeds to determine compliance with specified performance requirements.
- 1. Correction of Deficiencies:
 - a. Materials and installation will be considered defective if they do not meet specified requirements.
 - b. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.
 - c. Perform additional tests and inspections, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.
 - 2. Prepare test and inspection reports.

3.9 CLEANING AND PROTECTION

- A. Immediately after installation, remove non-permanent labels and clean surfaces.
- B. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.
- C. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
 - 1. If, despite such protection, contaminating substances do contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.
- E. Wash glass on both exposed surfaces in each area of Project before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.
 - 1. Coordinate glass cleaning schedule with Owner's requirements.

3.10 GLASS TYPE SCHEDULE

- A. Exterior Glass Schedule: (Note: Provide FT glass where required for safety glazing.)
 - 1. GL01: Insulating Coated Glass - Vision
 - a. Overall Thickness: 1 in (25 mm) nominal.
 - b. Outboard Lite: Clear HS; 1/4 in (6 mm) thick glass with coating on No. 2 surface.
 - c. Air Space: 1/2 in (12 mm); Black spacer; Black sealant.

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- d. Air Space: 1/2 in (12 mm); [Aluminum][Stainless Steel], [Mill Finish][Black], [Air][Argon].
 - e. Inboard Lite: Clear HS; 1/4 in (6 mm) thick glass.
 - f. Basis of Design Manufacturer and Product:
 - g. Remarks: Sealants and Gaskets to be Black color unless indicated otherwise.
 - h. Performance Requirements:
 - 1) Visible Light Transmittance:
 - 2) Exterior (Vis-Out) Reflectance:
 - 3) Winter U-Value:
 - 4) Summer U-Value:
 - 5) Shading Coefficient:
 - 6) Solar Heat Gain Coefficient:
 - 7) Light to Solar Gain Ratio:
2. GL02: Insulating Coated Glass, Ceramic-Coated - Vision
- a. Overall Thickness: 1 in (25 mm) nominal.
 - b. Outboard Lite: Clear HS; 1/4 in (6 mm) thick glass with coating on No. 2 surface.
 - 1) Silk-Screened Ceramic Frit: [Color][Pattern; eg: Pattern of alternating 10 mm horizontal color bands and 10 mm open bands starting at the top with a line on No. 2 surface].
 - 2) Digital Image Ceramic Ink: Custom digital image applied to glass and heat-fused to glass.
 - c. Outboard Lite: Clear HS; 1/4 in (6 mm) thick glass with coating on No. 2 surface.
 - d. Air Space: 1/2 in (12 mm); Black spacer; Black sealant.
 - e. Inboard Lite: Clear HS; 1/4 in (6 mm) thick glass.
 - f. Basis of Design Manufacturer and Product:
3. GL03: Insulating Coated Glass - Vision with Shadow Box Back Panel
- a. Overall Thickness: 1 in (25 mm) nominal.
 - b. Outboard Lite: Clear HS; 1/4 in (6 mm) thick glass with coating on No. 2 surface.
 - c. Air Space: 1/2 in (12 mm); Black spacer; Black sealant.
 - d. Inboard Lite: Clear HS; 1/4 in (6 mm) thick glass.
 - e. Shadow Box Back Panel: Aluminum, 2 mm thick with pre-finished color: [List Color]
 - f. Basis of Design Manufacturer and Product:
4. GL04: Insulating Glass - Vision at Lobby (Low Iron)
- a. Overall Thickness: 1 in (25 mm) nominal.
 - b. Outboard Lite: Clear, Low Iron FT; 1/4 in (6 mm) thick glass with coating on No. 2 surface.
 - c. Air Space: 1/2 in (12 mm); Grey spacer; Grey sealant.
 - d. Inboard Lite: Clear, Low Iron FT; 1/4 in (6 mm) thick glass.
 - e. Basis of Design Manufacturer and Product:
 - f. Remarks: Sealants and Gaskets to be Grey color unless indicated otherwise.
5. GL05: Insulating Laminated Coated Glass - Vision [Wind Borne Debris Impact Resistant, Large Missile Impact][Wind Borne Debris Impact Resistant, Small Missile Impact][Blast-Resistant][Skylight]
- a. Overall Thickness: As required by design.
 - b. Outboard Lite: Clear HS; 1/4 in (6 mm) thick glass with coating on No. 2 surface.

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- c. Air Space: 1/2 in (12 mm); Black spacer; Black sealant.
 - d. Inboard Lite: Two plies Clear HS; 1/4 in (6 mm) thick glass; laminated.
 - e. Interlayer: [PVB][SentryGlas Ionoplast], [Clear][Color], [thickness as required for intended use][0.030 in (0.75 mm)][0.060 in (1.5 mm)][0.090 in (2.25 mm)][.100 in. (2.50 mm)].
 - f. Basis of Design Manufacturer and Product:
6. GL06: Laminated Insulating Coated Glass - Vision [Wind Borne Debris Impact Resistant][Blast-Resistant][Skylight]
- a. Overall Thickness: As required by design.
 - b. Outboard Lite: Two plies Clear HS; 1/4 in (6 mm) thick glass; laminated.
 - c. Interlayer: [PVB][SentryGlas Ionoplast], [Clear][Color], [thickness as required for intended use][0.030 in (0.75 mm)][0.060 in (1.5 mm)][0.090 in (2.25 mm)][.100 in. (2.50 mm)].
 - d. Air Space: 1/2 in (12 mm); Black spacer; Black sealant.
 - e. Inboard Lite: Clear HS; 1/4 in (6 mm) thick glass with coating on No. 4 surface.
 - f. Basis of Design Manufacturer and Product:
7. GL07: Insulating Laminated Coated Glass - Acoustical Vision
- a. Overall Thickness: 1.5 in. (38mm), STC 45.
 - b. Outboard Lite: Two plies Clear HS; 1/4 in (6 mm) thick glass; laminated with coating on No. 2 surface. Interlayer: 0.60 in PVB.
 - c. Air Space: 3/4 in (19 mm); Black spacer; Black sealant.
 - d. Inboard Lite: Two plies Clear HS; 1/8 in (3 mm) thick glass; laminated.
 - e. Interlayer: [PVB][SentryGlas Ionoplast], [Clear][Color], [thickness as required for intended use][0.030 in (0.75 mm)][0.060 in (1.5 mm)][0.090 in (2.25 mm)][.100 in. (2.50 mm)].
 - f. Basis of Design Manufacturer and Product:
8. GL08: Laminated Coated Glass - Vision
- a. Overall Thickness: As required by design.
 - b. Outboard Lite: Clear HS; 1/4 in (6 mm) minimum thick glass with coating on No. 2 surface.
 - c. Inboard Lite: Clear HS; 1/4 in (6 mm) minimum thick glass.
 - d. Interlayer: [PVB][SentryGlas Ionoplast], [Clear][Color], [thickness as required for intended use][0.030 in (0.75 mm)][0.060 in (1.5 mm)][0.090 in (2.25 mm)][.100 in. (2.50 mm)].
 - e. Basis of Design Manufacturer and Product:
9. GL09: Laminated Glass - Vision
- a. Overall Thickness: As required by design.
 - b. Outboard Lite: Clear HS; 1/4 in (6 mm) minimum thick glass.
 - c. Inboard Lite: Clear HS; 1/4 in (6 mm) minimum thick glass.
 - d. Interlayer: [PVB][Dupont SentryGlas Ionoplast], [Clear][Color], [thickness as required for intended use][0.030 in (0.75 mm)][0.060 in (1.5 mm)][0.090 in (2.25 mm)][.100 in. (2.50 mm)].
 - e. Basis of Design Manufacturer and Product:
10. GL10: Laminated Glass, Ceramic-Coated - Canopy
- a. Overall Thickness: As required by design.
 - b. Upper Lite: Clear HS; 3/8 in (10 mm) minimum thick glass with ceramic frit on the No. 2 surface.

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- 1) Silk-Screened Ceramic Frit: [Color][Pattern; eg: Pattern of alternating 10 mm horizontal color bands and 10 mm open bands starting at the top with a line on No. 2 surface].
 - 2) Digital Image Ceramic Ink: Custom digital image applied to glass and heat-fused to glass.
 - c. Lower Lite: Clear HS; **3/8 in (10 mm)** minimum thick glass.
 - d. Interlayer: [PVB][Dupont SentryGlas Ionoplast], [Clear][Color], [thickness as required for intended use][0.030 in (0.75 mm)][0.060 in (1.5 mm)][0.090 in (2.25 mm)][.100 in. (2.50 mm)].
 - e. Basis of Design Manufacturer and Product:
11. GL11: Laminated Glass, Ceramic-Coated - Guardrail
- a. Overall Thickness: As required by design.
 - b. Outboard Lite: Clear HS; **1/4 in (6 mm)** minimum thick glass with ceramic frit.
 - 1) Silk-Screened Ceramic Frit: [Color][Pattern; eg: Pattern of alternating 10 mm horizontal color bands and 10 mm open bands starting at the top with a line on No. 2 surface].
 - 2) Digital Image Ceramic Ink: Custom digital image applied to glass and heat-fused to glass.
 - c. Inboard Lite: Clear HS; **1/4 in (6 mm)** minimum thick glass.
 - d. Interlayer - Basis of Design: SentryGlas Ionoplast; Clear, thickness as required for intended use.
 - e. Basis of Design Manufacturer and Product:
12. GL12: Laminated Glass - Guardrail
- a. Overall Thickness: As required by design.
 - b. Outboard Lite: Clear HS; **1/4 in (6 mm)** minimum thick glass.
 - c. Inboard Lite: Clear HS; **1/4 in (6 mm)** minimum thick glass.
 - d. Interlayer - Basis of Design: SentryGlas Ionoplast; Clear, thickness as required for intended use.
 - e. Basis of Design Manufacturer and Product:
13. GL13: Monolithic Coated Glass
- a. Overall Thickness: **1/4 in (6 mm)** nominal.
 - b. Monolithic Lite: Clear; **1/4 in (6 mm)** thick glass with coating on No. 2 surface.
 - c. Basis of Design Manufacturer and Product:
14. GL14: Monolithic Glass - All Glass Doors and Vestibules
- a. Lite: Clear FT; **3/4 in (19 mm)** minimum thick glass.
15. GL15: Insulating Coated Glass, Ceramic-Coated - Spandrel
- a. Overall Thickness: **1 in (25 mm)** nominal.
 - b. Outboard Lite: Clear HS; **1/4 in (6 mm)** thick glass with coating on No. 2 surface.
 - c. Air Space: **1/2 in (12 mm)**; Black sealant.
 - d. Inboard Lite: Clear HS; **1/4 in (6 mm)** thick glass with ceramic frit on No. 4 surface.
 - 1) Silk-Screened Ceramic Frit: [Color].
 - 2) Digital Image Ceramic Ink: Custom digital image applied to glass and heat-fused to glass.
 - e. Basis of Design Manufacturer and Product:

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16. GL16: Insulating Laminated Coated Glass - Spandrel [Wind Borne Debris Impact-Resistant][Blast-Resistant][Skylight]
 - a. Overall Thickness: As required by design.
 - b. Outboard Lite: Clear HS; 1/4 in (6 mm) thick glass with coating on No. 2 surface.
 - c. Air Space: 1/2 in (12 mm); Black spacer; Black sealant.
 - d. Inboard Lite: Two plies Clear HS; 1/4 in (6 mm) thick glass; laminated.
 - e. Interlayer: [PVB][Dupont SentryGlas Ionoplast], [Clear][Color], [thickness as required for intended use][0.030 in (0.75 mm).][0.060 in (1.5 mm).][0.090 in (2.25 mm).][.100 in. (2.50 mm)].
 - f. Basis of Design Manufacturer and Product:
 17. GL17: Monolithic Glass - Spandrel
 - a. Overall Thickness: 1/4 in (6 mm) nominal.
 - b. Monolithic Lite: Clear HS; 1/4 in (6 mm) thick glass with [Color] ceramic frit on No. 2 surface.
 - c. Basis of Design Manufacturer and Product:
- B. Interior Glass Schedule: (Note: Provide FT glass where required for safety glazing.)
1. GL101: 1/4 in (6 mm) thick clear float glass.
 2. GL102: 1/4 in (6 mm) thick fully tempered clear glass.
 3. GL103: 1/4 in (6 mm) thick wire glass.
 4. GL104: Laminated glass - Vision.
 - a. Overall Thickness: As required by design.
 - b. Outboard Lite: Clear float, 1/4 in (6 mm) minimum thick glass.
 - c. Inboard Lite: Clear float; 1/4 in (6 mm) minimum thick glass.
 - d. Interlayer: [PVB][SentryGlas Ionoplast], [Clear][Color], [thickness as required for intended use][0.030 in (0.75 mm).][0.060 in (1.5 mm).][0.090 in (2.25 mm).][.100 in. (2.50 mm)].
 5. GL105: Patterned Glass
 - a. Thickness: 1/4 in (6 mm)
 - b. Description:
 - c. Basis of Design Manufacturer and Product:
 6. GL106: Bullet-Resistive Glass
 - a. Thickness:
 - b. Description:
 - c. Basis of Design Manufacturer and Product:
 7. GL107: Fire Rated Glass
 - a. Thickness:
 - b. Description:
 - c. Basis of Design Manufacturer and Product:
 8. GL108: Transparent Mirror
 - a. Thickness: 1/4 in (6 mm)
 - b. Color: [Clear][Grey]
 - c. Basis of Design Manufacturer and Product: Interpane; MirroVue.
 9. GL109: Decorative Glass
 - a. Basis of Design Manufacturer and Product:

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b. Pattern:

3.11 GLAZING SCHEDULE

A. Tape Glazing:

1. Interior door glass lites.
2. Interior borrowed lights less than 75 united inches.

B. Sealant and Tape Glazing:

1. Exterior door glass lites.
2. Interior borrowed lights greater than 75 united inches.

C. Compression Gasket Glazing:

1. Curtain and window walls
2. Interior store fronts
3. Skylights
4. Sloped glazing
5. Fixed aluminum windows

D. Structural Silicone Glazing: Where indicated on drawings.

END OF SECTION

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SECTION 092900
GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Gypsum board assemblies and supplementary items necessary for installation.
 - 1. Grid suspension systems for ceilings.
 - 2. Channel framed suspension systems for ceilings.
 - 3. Metal framing systems for interior partitions.
 - 4. Interior gypsum board and tile backing panels.
 - 5. Gypsum board accessories and finishing systems.

1.2 DEFINITIONS

- A. Gypsum Board Construction Terminology: Refer to ASTM C 11 Standard Terminology Related to Gypsum and Related Building Materials and Systems for definitions of terms not defined in this Section or in other referenced quality standards.
- B. Damage: Stored or installed gypsum board materials shall be classified as defective and nonconforming Work if they have been exposed to wetness or dampness at any time prior to Substantial Completion or if they exhibit evidence of active or dormant mold or mildew.
- C. Concentrated Loads: Wall or partition mounted equipment, wall finishes, stone facings, lead lined doors and frames, or ornamentation exceeding 15 lbs/sf uniform load, 75 lb. point load, or 50 lb/ lf lineal load.

1.3 DELEGATED ENGINEERING REQUIREMENTS

- A. Delegated Engineering Responsibility: Contractor shall engage a qualified professional engineer to provide engineering for products and systems required to comply with the design intent of Contract Documents.
 - 1. Contract Documents Design Intent: Drawings and Specifications indicate design intent for products and systems and do not necessarily indicate or specify total Work required. Contract Documents shall not be construed as an engineered design; furnish and install Work required for a complete installation.
 - 2. Delegated Engineer Professional Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated with a record of successful in-service performance. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.
 - 3. Submittals: Preparation of structural analysis data including engineering calculations, shop drawings and other submittals signed and sealed by the qualified professional engineer.
 - 4. Coordination of Work:
 - a. Product Variations: In the event of minor differences between products and systems of acceptable or available manufacturers, Contractor shall notify Architect of such differences and resolve conflicts in a timely manner. Failure of Contractor to provide notification shall be construed as acceptance of conditions indicated, and changes caused by minor differences between products and Contract Documents shall be included in the Work at no additional cost to Owner.

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- b. Allowable Adjustments: Minor dimension and profile adjustments may be made in interest of fabrication or erection methods or techniques or ability to satisfy design intent, provided design intent is maintained as determined by Architect. Proposed deviations shall include a detailed analysis of impact to adjacent substrates or other building systems, including related design or construction cost impacts. If accepted by Architect, deviations causing changes in materials, constructability, substrates, or conditions shall be included in the Work at no additional cost to Owner.
 - B. Project Framing Analysis: Analyze each framing condition for design loads indicated in performance requirements.
 - 1. Provide framing products in sizes and thicknesses required to meet or exceed the criteria based on project loads, spans and in-service conditions.
 - 2. Material Quality Standard for Metal Framing Components: Provide components of sizes indicated but not less than that required to comply with ASTM C 754 for conditions indicated.
 - C. Gypsum Board Assemblies Supporting Concentrated Loads - Delegated Engineering Responsibility: Contractor shall employ a qualified professional engineer to provide engineering for products and systems required to support concentrated loads including attachment to building structure required to meet design intent of Contract Documents including, but not limited to, the following.
 - 1. Preparation of structural analysis data including engineering calculations, shop drawings and other submittals signed and sealed by the qualified professional engineer responsible for their preparation.
 - 2. Preparation of structural analysis data including engineering calculations, shop drawings and other submittals signed and sealed by the qualified professional engineer responsible for their preparation.
- 1.4 ACTION SUBMITTALS
- A. Product Data: Manufacturer's technical literature for each product and system indicated.
 - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
 - B. Shop Drawings:
 - 1. Include scaled and dimensioned drawings showing locations of control joints.
 - 2. Gypsum Board Location Schedule: Provide detailed schedule in format similar to "Gypsum Board Schedule" at end of this Section indicating gypsum board products to be installed and their respective locations.
 - C. Shop Drawings for Engineered Gypsum Board Assemblies - Concentrated Loads: Scaled and dimensioned drawings showing locations, fabrication, and installation of gypsum board assemblies required to support concentrated loads, including plans, elevations, sections, details of components, and attachments to building structure; include seal and signature of delegated engineering professional responsible for their preparation.
- 1.5 INFORMATIONAL SUBMITTALS
- A. Delegated Engineering Submittal: For products and systems indicating compliance with performance requirements. Include structural analysis, calculations and other performance data signed and sealed by the qualified professional engineer responsible for their preparation.

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- B. Preconstruction Test Reports for Acoustical Sealant: Compatibility test reports from sealant manufacturer indicating that materials forming joint substrates and joint-sealant backings have been tested for compatibility with sealants; include sealant manufacturer's certification of test results for sealant compatibility and recommendations for primers and substrate preparation needed to obtain adhesion and prevent corrosion of substrate.

1.6 QUALITY ASSURANCE

- A. Code-Compliance Certification of Studs and Tracks: Certification of framing members in accordance with the product-certification program of the Steel Framing Industry Association (SFIA) or a similar organization that provides a verifiable code-compliance program.
- B. Mock-ups: Prior to fabrication and installation, build mock-up for each form of construction and finish required to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mock-up to comply with the following requirements, using materials indicated for the completed Work:
 - 1. Build mock-up in the location and of the size indicated or, if not indicated, as directed by Architect. Contractor shall provide structural support framework.
 - a. Show typical components, attachments to building structure, and requirements of installation.
 - b. Field Samples for Gypsum Board Finishing: Build 10 ft (3 m) square gypsum board (attached to metal studs) area for each finish level specified. Include not less than one tapered-to-tapered edge gypsum board joint and cut edge-to-cut edge gypsum board joint.
 - 2. Clean exposed faces of mock-up.
 - 3. Notify Architect seven days in advance of the dates and times when mock-up will be installed.
 - 4. Demonstrate the proposed range of aesthetic effects and workmanship.
 - 5. Protect accepted mock-up from the elements with weather-resistant membrane.
 - 6. Obtain Architect's acceptance of mockups before starting fabrication.
 - 7. Maintain mock-ups during construction in an undisturbed condition as a standard for review of the completed Work.
 - 8. Acceptance of mock-ups does not constitute approval of deviations from the Contract Documents contained in mock-ups unless such deviations are specifically noted by Contractor, submitted to Architect in writing, and accepted by Architect in writing.
 - 9. Demolish and remove mock-ups when directed by Architect unless accepted to become part of the completed Work.

1.7 PRE-INSTALLATION CONFERENCE

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.
- B. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Protect metal framing from corrosion, deformation, and other damage during delivery, storage, and handling as required by AISI S202, "Code of Standard Practice for Cold-Formed Steel Structural Framing."

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1.9 PROJECT CONDITIONS

- A. Environmental Conditions: Comply with ASTM C 840 requirements or respective gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Field Measurements: Where products and systems are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication.

1.10 COORDINATION

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND PRODUCTS

- A. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".
- B. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other manufacturers offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.

2.2 MATERIALS, GENERAL

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

2.3 PERFORMANCE REQUIREMENTS

- A. General Performance: Comply with performance requirements specified, as determined by testing of products and systems representing those indicated for this Project, without failure due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Structural Movement: Withstand movements of supporting structure including, but not limited to inter-story drift, twist, column shortening, long-term creep and deflection from uniformly distributed and concentrated live loads established by authorities having jurisdiction.
 - 1. Live Load Deflection: Accommodate differential vertical deflection of floors:
 - a. Deflection: As indicated on Drawings.
- C. Seismic Performance: Withstand the effects of earthquake motions determined in accordance with local building code and authorities having jurisdiction.
- D. Horizontal Deflection: For composite and non-composite wall assemblies, limited to deflections and horizontal loading indicated in Metal Framing Schedule.
- E. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated, in accordance with ASTM E119 / NFPA 251 / UL 263, and displaying a classification label from an independent testing agency acceptable to authorities having jurisdiction.
 - 1. Construct fire-resistance-rated partitions in compliance with tested assembly requirements indicated on Drawings.

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2. Rated assemblies to be substantiated from applicable testing using proposed products, by Contractor.
 3. Independent Testing Agencies as evidenced by design designation included in approval manual.
 - a. UL - "Fire Resistance Directory", Category BXUV.
 - b. GA 600 - "Fire Resistance Design Manual".
 - c. Other agencies acceptable to authorities having jurisdiction.
 - F. Smoke-Resistance-Rated Assemblies: For smoke-resistance-rated assemblies, provide materials and construction identical to those tested in accordance with fire-resistance-rated assemblies by an independent testing agency acceptable to authorities having jurisdiction.
 - G. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, in accordance with ASTM E90 and classified in accordance with ASTM E413 by an independent testing agency.
 - H. Dimensional Tolerances: Provide products and systems to accommodate dimensional tolerances of framing members and adjacent construction.
- 2.4 SUSPENDED GRID SYSTEM FOR INTERIOR CEILINGS
- A. Suspension System:
1. Material Quality Standard: ASTM C 645, heavy-duty rating.
 2. Description: Manufacturer's standard direct-hung suspended grid system composed of main beams and cross furring members that interlock to form a modular supporting network for application of gypsum board.
 3. Protective Coating - Standard Applications: ASTM A 653/A 653M, not less than G40 (Z120), hot-dip galvanized coating, unless otherwise indicated.
 4. Protective Coating - High Moisture / Humidity Applications: ASTM A 653 / A 653M, G90 (Z275) hot-dip galvanized coating at high moisture areas such as Kitchens, Saunas, Steam Rooms, and Pool Enclosures.
 5. Main Beams: Inverted T-shaped profile of single or double mounting flange; minimum 1-1/2 in (38 mm) profile height with top bulb and minimum 1-3/8 in (35 mm) wide knurled mounting flange; factory punched for hanger wire, and to receive cross furring members.
 6. Cross Furring Members:
 - a. Tees: Inverted T-shaped profile of single or double mounting flange; 1-1/2 in (38 mm) profile height with top bulb and minimum 1-3/8 in (35 mm) wide knurled mounting flange; with ends formed for positive interlocking with main beam.
 - b. Channels: Inverted hat shaped profile; minimum 7/8 in (21 mm) profile height and minimum 1-3/8 in (35 mm) wide knurled mounting flange; with ends formed for positive interlocking with main beam.
 7. Wall Angle: Angle shaped profile with each leg not less than 1-1/4 in (32 mm).
 8. Curved Members: Where curved ceilings are indicated, members shall be rolled by manufacturer; field fabricated curved members not permitted.
 9. Accessories: Specifically designed as an integral part of suspended grid system.
 10. Manufacturers and Products:
 - a. Armstrong World Industries Inc.; Drywall Grid System.
 - b. Chicago Metallic Corporation; 650-C/670-C Fire-Rated Drywall Grid System.
 - c. United States Gypsum Company (USG Interiors, Inc.); Drywall Suspension System.

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B. Hanger Attachments to Concrete:

1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching hanger wires and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by a qualified independent testing agency.
 - a. Cast-in-place anchor, designed for attachment to concrete.
 - b. Post-installed chemical anchor.
 - c. Post-installed expansion anchor.
2. Powder-Actuated Fasteners: Suitable for application indicated, ANSI A 10.3; low velocity, powder-actuated fasteners; drive pins and clip angles fabricated from corrosion-resistant materials, with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, an ultimate load capacity not less than 10 times that imposed by construction as determined by testing according to ASTM E 1190 by a qualified independent testing agency.
3. Manufacturers:
 - a. Construction Materials, Inc.
 - b. Heckman Building Products, Inc.
 - c. Hilti Corp.
 - d. ITW Ramset/Red Head.
 - e. Powers Fasteners.
 - f. Simpson Strong Tie Anchor Systems.
4. For post-tensioned concrete, anchors shall not exceed **1 in (25 mm)** embedment. Obtain Structural Engineer's written approval for all proposed anchors in post-tensioned concrete prior to installation.

C. Wire:

1. Material Quality Standard: ASTM A 641 / A 641M, Class 1, zinc-coated, soft annealed, mild steel wire.
2. Tie Wire Minimum Size: Single **0.0625 in** (16 gage) (**1.6 mm**) diameter strand, or double **0.0475 in** (18 gage) (**1.2 mm**) diameter strands. Preformed furring channel clips are acceptable.
3. Hanger Wire Minimum Size: **0.1620 in** (8 gage) (**4.12 mm**) diameter.

D. Rod Hangers: ASTM A 1008 / A 1008M, **7/32 in (0.56 mm)** diameter mild carbon steel rod, with primer painted finish.

E. Flat Hangers: ASTM A 1008 / A 1008M, **1 in by 3/16 in (25 mm by 5 mm)** by length indicated or required, with primer painted finish.

F. Angle Hangers: ASTM A 36 / A 36M, rolled steel angle, **2 in by 2 in (50 mm by 50 mm)**, with primer painted finish.

2.5 SUSPENDED CHANNEL FRAMED SYSTEM FOR INTERIOR CEILINGS

- A. Material Quality Standard: Provide components of sizes indicated but not less than that required to comply with ASTM C 754 for conditions indicated.
- B. Protective Coating - Standard Applications: ASTM A 653/A 653M, not less than G40 (Z120), hot-dip galvanized coating, unless otherwise indicated.
- C. Hanger Attachments to Concrete:

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1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching hanger wires and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by a qualified independent testing agency.
 - a. Cast-in-place anchor, designed for attachment to concrete.
 - b. Post-installed chemical anchor.
 - c. Post-installed expansion anchor.
2. Powder-Actuated Fasteners: Suitable for application indicated, ANSI A10.3; low velocity, powder-actuated fasteners; drive pins and clip angles fabricated from corrosion-resistant materials, with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, an ultimate load capacity not less than 10 times that imposed by construction as determined by testing according to ASTM E 1190 by a qualified independent testing agency.
3. Manufacturers:
 - a. Construction Materials, Inc.
 - b. Heckman Building Products, Inc.
 - c. Hilti Corp.
 - d. ITW Ramset/Red Head.
 - e. Powers Fasteners.
 - f. Simpson Strong Tie Anchor Systems.
4. For post-tensioned concrete, anchors shall not exceed 1 in (25 mm) embedment. Obtain Structural Engineer's written approval for all proposed anchors in post-tensioned concrete prior to installation.

D. Wire:

1. Material Quality Standard: ASTM A 641 / A 641M, Class 1, zinc-coated, soft annealed, mild steel wire.
 2. Tie Wire Minimum Size: Single 0.0625 in (16 gage) (1.6 mm) diameter strand, or double 0.0475 in (18 gage) (1.2 mm) diameter strands.
 3. Hanger Wire Minimum Size: 0.1620 in (8 gage) (4.12 mm) diameter.
- E. Compression Struts: Metal framing section with L/R ratio of 200 maximum and formed from galvanized sheet steel; with bolted connections with 5/16 in (8 mm) diameter bolts.
- F. Carrying Channels: Cold-rolled, commercial grade galvanized sheet steel, 0.0538 in (16 gage) (1.3 mm) minimum uncoated base metal thickness; 1/2 in (12 mm) wide flanges by 1-1/2 in (38 mm) deep.
- G. Furring Channels: Cold-rolled, commercial grade galvanized sheet steel, 0.0283 in (22 gage) (0.72 mm) minimum uncoated base metal thickness; inverted hat shaped profile; minimum 7/8 in (21 mm) profile height and minimum 1-3/8 in (35 mm) wide knurled mounting flange.

2.6 FRAMING SYSTEMS

- A. Project Framing Analysis: Analyze each framing condition for design loads indicated in performance requirements.
1. Provide framing products in sizes and thicknesses required to meet or exceed the criteria based on project loads, spans and in-service conditions.
- B. Framing Members, General: Comply with ASTM C645 and AISI S220 for conditions indicated.
1. Steel Sheet Components: Comply with ASTM C645 and AISI S220 requirements for metal unless otherwise indicated.

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2. Protective Coating - Standard Applications: ASTM A 653/A 653M, not less than G40 (Z120), hot-dip galvanized coating or coating with equivalent corrosion resistance, unless otherwise indicated.
 - a. Equivalent Protective Coatings: Coating demonstrates equivalent corrosion resistance with an evaluation report acceptable to authorities having jurisdiction.
- C. Metal Studs and Floor Track (Runners):
 1. Metal Framing Components for Typical Partitions:
 - a. Stud Description: C-shaped members formed from galvanized sheet steel with 1 1/4 in (32 mm) flange edges bent back 90 degrees and doubled over to form 13/64 in (5 mm) wide minimum return lip; of web depth indicated on Drawings and uncoated base metal thickness indicated in "Metal Framing Schedule" at end of this Section; with web punchouts.
 - 1) Alternative Jamb Stud Members - Contractor's Option: "Heavy Duty" or "King" studs; C-shaped members formed from galvanized sheet steel with 3 in (75 mm) flange width; of web depth indicated on Drawings and uncoated base metal thickness indicated in "Metal Framing Schedule" at end of this Section.
 - b. Track (Runner) Description: U-shaped members formed from galvanized sheet steel with depth compatible with studs and flange dimension indicated to hold studs by friction; of same web size and uncoated base metal thickness as studs.
 - 1) Floor Track (Runner): 1-1/4 in (32 mm).
 - 2) Top of Wall Track (Runner): 3 in (75 mm).
 2. Metal Framing for Shaftwall Partitions:
 - a. Stud Description: C-H, double E, C-T, or I-shaped members formed from galvanized sheet steel; of web depth indicated on Drawings and uncoated base metal thickness indicated in "Metal Framing Schedule" at end of this Section; with web punchouts.
 - b. Track (Runner) and Jamb Description: J-shaped track or jamb members formed from galvanized sheet steel with depth compatible with studs and flange dimension indicated to hold studs by friction; of same web size and uncoated base metal thickness as studs.
 3. Equivalent Products - Deformed Metal Studs and Tracks (Runners):
 - a. Equivalent Gauge Thickness (EQ) Steel Studs and Runners Evaluation Criteria: Certified third-party testing with gypsum board in accordance with ICC-ES AC86 indicating compliance with requirements.
 - b. Material Quality Standard: ASTM A 1003 / A 1003M sheet steel with galvanized coating.
 - c. Stud Description: C-shaped members formed from deformed surface galvanized sheet steel with 1-1/4 in (32 mm) flange edges bent back 90 degrees and bent again to form 3/16 in (5 mm) wide minimum return lip; of web depth indicated on Drawings and uncoated base metal thickness indicated in "Metal Framing Schedule" at end of this Section; with web punchouts.
 - d. Track (Runner) Description: U-shaped members formed from deformed surface galvanized sheet steel with depth compatible with studs and flange dimension indicated to hold studs by friction; of same web size and uncoated base metal thickness as studs.
 - e. Manufacturer and Product: ClarkDietrich Building Systems; ProSTUD.

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- D. Flat Straps and Back-Up Plates: Galvanized sheet steel for blocking and bracing in length and width indicated, of same uncoated base metal thickness as adjacent metal studs.
- E. Bridging:
 - 1. Channel: U-shaped members formed from galvanized sheet steel not less than 0.0566 in (16 gage) (1.44 mm) minimum uncoated base metal thickness, with 1/2 in (12 mm) flanges and depth fitting stud punchouts.
 - 2. Clip Angle: 1-1/2 in by 1-1/2 in (38 mm by 38 mm) L-shaped members formed from galvanized sheet steel not less than 0.0713 in (14 gage) (1.81 mm) uncoated base metal thickness.
- F. Rigid Furring Channels: Hat-shaped members formed from galvanized sheet steel not less than 0.0312 in (20 gage) (0.78 mm) minimum uncoated base metal thickness; 7/8 in (21 mm) depth and minimum 1-3/8 in (35 mm) wide knurled mounting flange.
- G. Resilient Furring Channels: 1/2 in (12 mm) deep members formed from galvanized sheet steel not less than 0.0283 in (22 gage) (0.72 mm) minimum bare-metal thickness, designed to reduce sound transmission.
 - 1. Configuration: Asymmetrical or hat shaped.
- H. Sound Isolation Clips: Uni-body molded rubber and galvanized steel mount designed to receive standard galvanized steel furring channels.
 - 1. Basis of Design: Pliteq; GenieClip RST.
- I. Sound Isolation Ceiling Hangers:
 - 1. Resilient Sound Isolation Bracket: Molded rubber isolator and steel hanger bracket designed to receive ceiling suspension system wire ties.
 - a. Basis of Design: Pliteq; GenieClip LB Resilient Sound Isolation Bracket.
 - 2. Spring Isolation Hanger: Spring hanger with channel clip designed to receive gypsum board furring/framing assembly.
 - a. Basis of Design: Kinetics Noise Control; ICC Deck Suspended Ceiling Hanger.
- J. Framing Accessories for Spanning Multiple Floors: Framing manufacturers standard connectors, bracings, brackets, clips, gussets, and other framing devices as required by conditions, formed from galvanized sheet steel complying with requirements of main support system.
- K. Z-Shaped Furring: Members formed from galvanized sheet steel not less than 0.0283 in (22 gage) (0.72 mm) minimum bare-metal thickness, with slotted or non-slotted web, face flange of 1-1/4 in (32 mm), wall attachment flange of 7/8 in (21 mm); depth required to fit insulation thickness indicated.
- L. Pony Wall Framing Connection: ASTM A36 hot rolled steel base plate, Structural Grade 50 Type H Stud connector designed to support cantilevered partial wall systems.
 - 1. Basis of Design: ClarkDietrich; Pony Wall.
- M. Manufacturers:
 - 1. Building Products Division of Consolidated Fabricators Corp.
 - 2. California Expanded Metal Products Co. (CEMCO).
 - 3. ClarkDietrich Building Systems
 - 4. Marino Ware; Division of Ware Industries.
 - 5. MBA Metal Framing.

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6. Scafco Corp.
7. Slip-Type Head Joints: Clips designed for use in head-of-wall deflection conditions that provide a positive attachment of studs to runners while allowing for vertical movement.
 - a. Basis of Design: ClarkDietrich Building Systems; Fast Top Clip FTC3 or FTC5.
8. Anchor Clips: Pre-punched, galvanized anchor clips designed for use in floor n conditions that provide a positive attachment of studs to runners while allowing for horizontal, torsional and vertical (uplift) loads.
 - a. Basis of Design: ClarkDietrich Building Systems; EasyClip T-Series, T685 or T683.

2.7 PRE-ENGINEERED METAL FRAMING COMPONENTS

A. Deflection and Firestop Track (Runner):

1. Description: Proprietary track (runner) formed from galvanized sheet steel manufactured to accommodate movement of building structure without transferring stress to partition (to prevent cracking of gypsum board resulting from deflection of building structure above) while maintaining continuity of fire resistance rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
2. Manufacturers:
 - a. Metal Stud Framing Manufacturer.
 - b. Fire Trak Corp.
 - c. The Steel Network.

B. Flexible Track (Runner):

1. Description: Proprietary track (runner) formed from galvanized sheet steel manufactured to be flexible and adjustable to fit design requirements; in thickness not less than indicated for studs and in width to accommodate depth of studs.
2. Manufacturers:
 - a. Metal Stud Framing Manufacturer.
 - b. Accu-Arc Curved Wall Products.
 - c. Flex-Ability Concepts.
 - d. Radius Track Corp.

C. Headers:

1. Description: Proprietary header assembly formed from galvanized sheet steel manufactured to bear partition load above openings without transferring stress to partition (to prevent cracking of gypsum board); in thickness not less than indicated for studs and in width to accommodate depth of studs.
2. Manufacturers:
 - a. Metal Stud Framing Manufacturer.
 - b. Brady Construction Innovations, Inc.

2.8 GYPSUM BOARD PRODUCTS

- A. Sizes: Maximum lengths and widths available that will minimize short edge-to-short edge butt joints and to correspond to support system indicated.
- B. Typical Paper-Faced Gypsum Board Products:
 1. Paper-Faced Type X Gypsum Board:
 - a. Material Quality Standard: ASTM C 1396 / C 1396M, Type X.

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- b. Description: Noncombustible fire resistant gypsum core with paper surfacing on face, back, and long edges; tapered long edges; 5/8 in (15 mm) thick.
 - c. Manufacturers and Products:
 - 1) American Gypsum Company; FireBloc Type X Gypsum Board.
 - 2) CertainTeed Corporation; Type X Gypsum Board.
 - 3) Georgia-Pacific Gypsum LLC; ToughRock Fireguard Gypsum Board.
 - 4) National Gypsum Company; Gold Bond Fire-Shield Gypsum board.
 - 5) United States Gypsum Company (USG); Sheetrock Firecode Core.
2. Sustainable Paper-Faced Type X Gypsum Board: At Contractors option, provide sustainable paper-faced Type X gypsum board or typical paper-faced Type X gypsum board.
- a. Material Quality Standard: ASTM C 1396 / C 1396M, Type X.
 - b. Description: Noncombustible fire resistant gypsum core with paper surfacing on face, back, and long edges; tapered long edges; 5/8 in (15 mm) thick. UL Type Designation ULIX.
 - 1) ISO 14040 Environmental Management, Life Cycle Assessment, Principles and Framework:
 - a) Carbon emissions per Gypsum Association; Industry Standard Type III EPD for North American Type X wallboard with a manufacturing Global Warming Potential of 317.4 kg CO₂-eq./1000MSF.
 - b) Water reduction per Gypsum Association; Industry Standard Type III EPD for North American Type X wallboard having net use of fresh water value of 1.329 m³/1000 ft².
 - c) Primary Energy from non-renewable resources per Gypsum Association; Industry Standard Type III EPD for North American Type X wallboard have a value of 5,291 MJ/1000 ft².
 - c. Basis of Design:
 - 1) United States Gypsum Company, LLC, USG Sheetrock Brand EcoSmart Panels Firecode X.
3. Paper-Faced Type C Gypsum Board:
- a. Material Quality Standard: ASTM C 1396 / C 1396M, Type X.
 - b. Description: Noncombustible fire resistant gypsum core, with additives to enhance fire resistance, with paper surfacing on face, back, and long edges; tapered long edges; 5/8 in (15 mm) thick.
 - c. Manufacturers and Products:
 - 1) American Gypsum Company; FireBloc Type C Gypsum Board.
 - 2) CertainTeed Corporation; Type C Gypsum Board.
 - 3) Georgia-Pacific Gypsum LLC; ToughRock Fireguard C Gypsum Board.
 - 4) National Gypsum Company; Gold Bond Fire-Shield C Gypsum board.
 - 5) United States Gypsum Company (USG); Sheetrock Firecode C Core Gypsum Panels.
4. Paper-Faced Acoustically Enhanced Gypsum Board:
- a. Description: Noncombustible gypsum core, with polymer sound dampening sheet in center, with paper surfacing on face, back and long edges; tapered long edges; 5/8 in (15 mm) thick.
 - b. Manufacturers and Products:

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- 1) CertainTeed Corporation; SilentFX Acoustical Gypsum Board.
 - 2) National Gypsum Company; Gold Bond SoundBreak Gypsum Board.
 - 3) PABCO Gypsum; QuietRock ES.
5. Paper-Faced Flexible Gypsum Board at Curved Surfaces:
- a. Material Quality Standard: ASTM C 1396 / C 1396M.
 - b. Description: Gypsum core with paper surfacing on face, back and long edges; manufactured to bend to fit tight radii and be more flexible than typical panels without wetting; tapered long edges; 1/4 in (6 mm) thick.
 - c. Manufacturers and Products:
 - 1) American Gypsum Company; 1/4" ClasicRoc Gypsum Board.
 - 2) CertainTeed Corporation; 1/4" Flex Gypsum Board.
 - 3) Georgia-Pacific Gypsum LLC; ToughRock FlexRoc Gypsum Board.
 - 4) National Gypsum Company; Gold Bond High Flex Brand Gypsum board.
 - 5) United States Gypsum Company (USG); Sheetrock 1/4" Flexible Gypsum Panels.
- C. Moisture-Resistant Gypsum Board Products:
1. Moisture-Resistant Paper-Faced Gypsum Board:
 - a. Material Quality Standard: ASTM C 1396 / C 1396M, Type X.
 - b. Description: Enhanced moisture-resistant, noncombustible gypsum core, with moisture-resistant paper surfacing on face, back and long edges; tapered long edges; score of 10 according to ASTM D 3273; 5/8 in (15 mm) thick.
 - c. Manufacturers and Products:
 - 1) American Gypsum Company; M-Bloc Mold and Moisture Resistant Type X Gypsum Board.
 - 2) CertainTeed Corporation; M2Tech Moisture and Mold Resistant Type X Gypsum Board.
 - 3) National Gypsum Company; Gold Bond XP Gypsum Board.
 - 4) United States Gypsum Company (USG); Sheetrock Mold Tough Firecode Gypsum Board.
 2. Moisture-Resistant Paperless Glass-Mat Gypsum Board:
 - a. Material Quality Standard: ASTM C 1658 / C 1658M.
 - b. Description: Enhanced moisture-resistant, noncombustible gypsum core with inorganic, embedded fiberglass mat on both faces; square edges; score or 10 according to ASTM D 3273; 5/8 in (15 mm) thick.
 - c. Manufacturers and Products:
 - 1) Georgia-Pacific Gypsum LLC; DensArmor Plus Fireguard Interior Guard.
 - 2) National Gypsum Company; eXP Interior Extreme Gypsum Panels.
 3. Moisture-Resistant Paper-Faced Shaft-Liner Gypsum Board:
 - a. Material Quality Standard: ASTM C 1396/C 1396M, Type X.
 - b. Description: Enhanced moisture-resistant, noncombustible gypsum core with moisture-resistant paper surfacing on face, back and long edges; tapered long edges; score of 10 according to ASTM D 3273; 1 in (25 mm) thick.
 - c. Manufacturers and Products:
 - 1) American Gypsum Company; M-Bloc Shaft Liner Panels.
 - 2) CertainTeed Corporation; M2Tech Moisture & Mold Resistant Shaftliner.
 - 3) National Gypsum Company; Gold Bond 1 Fire-Shield Shaftliner XP.

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- 4) USG Corp.; SHEETROCK Mold Tough Gypsum Liner Panels.
4. Moisture-Resistant Paperless Glass-Mat Shaft-Liner Gypsum Board:
 - a. Material Quality Standard: ASTM C 1658 / C 1658M.
 - b. Description: Enhanced moisture-resistant, noncombustible gypsum core with inorganic, embedded fiberglass mat on both faces, double bevel long edges; score of 10 according to ASTM D 3273; **1 in (25 mm)** thick.
 - c. Manufacturers and Products:
 - 1) American Gypsum Company; M-Glass Shaft Liner Panels.
 - 2) CertainTeed Corporaton; GlasRoc Shaftliner Type X.
 - 3) Georgia-Pacific Gypsum LLC; DensGlass Shaftliner.
 - 4) National Gypsum Company; eXP Extended Exposure Shaftliner.
 - 5) USG Corp.; SHEETROCK Glass-Mat Liner Panels
5. Moisture-Resistant Coated Glass-Mat Gypsum Board Products (Tile Backing Panel):
 - a. Material Quality Standard: ASTM C 1178 / C 1178M.
 - b. Description: Enhanced moisture-resistant, noncombustible, gypsum core with inorganic, embedded fiberglass mat on both sides; outside face coated with heat-cured copolymer water-resistant coating; square edges; score or 10 according to ASTM D 3273; **5/8 in (15 mm)** thick.
 - c. Manufacturers and Products:
 - 1) CertainTeed Corporation; Diamondback Tile Backer.
 - 2) Georgia-Pacific Gypsum LLC; DensShield Tile Backer.
 - 3) National Gypsum Company; eXP Tile Backer.
 - 4) USG; Durock Brand Glass-Mat Tile Backerboard.
6. Moisture-Resistant, Abuse-Resistant Gypsum Board Products:
 - a. Material Quality Standard: ASTM **C 1629 (C 1629M)**, Type X, and as follows:
 - 1) Soft Body Impact Test: ASTM E 695, Classification Level 2.
 - 2) Hard Body Impact Test: Annex A1, Classification Level 1.
 - 3) Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
 - b. Paper-Faced Products: Specially formulated, noncombustible, gypsum core with heavy liner paper on back and smooth, heavy abrasive-resistant face paper on face and long edges; manufactured to produce greater resistance to surface indentation and through-penetration than typical gypsum panels; tapered long edges; **5/8 in (15 mm)** thick.
 - 1) Manufacturers and Products:
 - a) CertainTeed Corporation; Air Renew Extreme Abuse.
 - b) National Gypsum Company; Gold Bond Hi-Abuse XP Gypsum Board.
 - c. Paperless Products: Specially formulated, noncombustible, gypsum core with coated, fiberglass mat on both faces; manufactured to produce greater resistance to surface indentation and through-penetration than typical gypsum panels; tapered long edges; **5/8 in (15 mm)** thick.
 - 1) Manufacturers and Products:
 - a) National Gypsum Company; Gold Bond eXP Interior Extreme AR Gypsum Panel.
 - b) USG Corporation; Fiberock Interior Panel, Abuse Resistant.

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7. Moisture-Resistant, Impact-Resistant Gypsum Board Products for Elevator Hoistway Enclosures and Stairwells:
 - a. Material Quality Standard: ASTM C 1629 (C 1629M), Type X, and as follows:
 - 1) Soft Body Impact Test: ASTM E 695, Classification Level 2.
 - 2) Hard Body Impact Test: Annex A1, Classification Level 3.
 - 3) Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
 - b. Paper-Faced Products: Specially formulated, noncombustible, gypsum core with heavy liner paper on back and smooth, heavy abrasive-resistant face paper on face and long edges; manufactured to produce greater resistance to surface indentation and through-penetration than typical gypsum panels; tapered long edges; 5/8 in (15 mm) thick.
 - 1) Manufacturers and Products:
 - a) CertainTeed Corporation; Air Renew Extreme Impact.
 - b) National Gypsum Company; Gold Bond Hi-Impact XP Gypsum Board.
 - c. Paperless Products: Specially formulated, noncombustible, gypsum core with coated, fiberglass mat on both faces; manufactured to produce greater resistance to surface indentation and through-penetration than typical gypsum panels; tapered long edges; 5/8 in (15 mm) thick.
 - 1) Manufacturers and Products:
 - a) USG Corporation; Fiberock Panels, VHI Abuse-Resistant.
 - d. Locations: As indicated on the Drawings and as follows.
 - 1) Elevator Hoistway Enclosures and Stairwells.
 - 2) Fire Service Access Elevator Hoistways Enclosures.
8. Moisture-Resistant, Impact-Resistant Gypsum Board Products:
 - a. Material Quality Standard: ASTM C 1629 (C 1629M), Type X, and as follows:
 - 1) Soft Body Impact Test: ASTM E 695, Classification Level 3.
 - 2) Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
 - b. Paper-Faced Products: Specially formulated, noncombustible, gypsum core with heavy liner paper on back and smooth, heavy abrasive-resistant face paper on face and long edges; manufactured to produce greater resistance to surface indentation and through-penetration than typical gypsum panels; tapered long edges; 5/8 in (15 mm) thick.
 - 1) Manufacturers and Products:
 - a) CertainTeed Corporation; Air Renew Extreme Impact.
 - b) National Gypsum Company; Gold Bond Hi-Impact XP Gypsum Board.
 - c. Paperless Products: Specially formulated, noncombustible, gypsum core with coated, fiberglass mat on both faces; manufactured to produce greater resistance to surface indentation and through-penetration than typical gypsum panels; tapered long edges; 5/8 in (15 mm) thick.
 - 1) Manufacturers and Products:

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- a) Georgia-Pacific Gypsum LLC; Dens Armor Plus Impact-Resistant Interior Panels.
- b) National Gypsum Company; Gold Bond eXP Interior Extreme IR Gypsum Panel.
- c) USG Corporation; Fiberock Panels, VHI Abuse-Resistant.

2.9 CEMENTITIOUS BOARDS

A. Cementitious Backer Units:

- 1. Material Quality Standard: ANSI A118.9 or ASTM C 1325.
- 2. Description: Cementitious panels composed of Portland cement, aggregates, glass mesh on both faces, and manufacturer's proprietary ingredients; capable of remaining unaffected by prolonged exposure to water; 1/2 in (12 mm) thick.
- 3. Manufacturers and Products:
 - a. Custom Building Products; WonderBoard.
 - b. FinPan, Inc.; Util-A-Crete Concrete Backer Board.
 - c. National Gypsum Company.
 - 1) Straight: PermaBase Cement Board.
 - 2) Curved: PermaBase Flex Cement Board.
 - d. United States Gypsum Company (USG); DUROCK Interior Cement Board.

2.10 TRIM ACCESSORIES

A. Typical Drywall Trim Accessories:

- 1. Material Quality Standard: ASTM C 1047.
- 2. Description: Trim profile fabricated of galvanized steel sheet; of size suitable for gypsum board thickness; with recessed, perforated flange formed to receive joint compound.
- 3. Trim Products:
 - a. Cornerbead:
 - 1) Purpose: For protecting outside (external) corners.
 - 2) Basis of Design: United States Gypsum Company (USG); Dur-A-Bead Corner Bead, 103.
 - b. Optional Equivalent Products – Structural Laminate Cornerbead System: At Contractor's option, provide high strength tapered co-polymer core cornerbead with tight fibered paperboard facing and joint tape paper backing.
 - 1) Purpose: For protecting outside (external) corners.
 - 2) Basis of Design: Structus Building Technologies; No-Coat Structural Laminate Drywall Corner System.
 - c. LC-Bead (J-Bead):
 - 1) Purpose: For protecting exposed edges of gypsum board where back flange can be used.
 - 2) Basis of Design: United States Gypsum Company (USG); J-Trim, 200-A.
 - d. L-Bead:
 - 1) Purpose: For protecting exposed edges of gypsum board where back flange cannot be used.
 - 2) Basis of Design: United States Gypsum Company (USG); L-Trim, 200-B.
 - e. J-Stop:

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- 1) Purpose: For protecting edges of gypsum board that does not require finishing.
- 2) Basis of Design: United States Gypsum Company (USG); J-Stop, 402.
- f. Control Joint:
 - 1) Description: One-piece trim formed with V-shaped slot, with removable strip covering slot opening.
 - 2) Purpose: For conditions requiring expansion and contraction stresses of large areas of gypsum board to be relieved.
 - 3) Basis of Design: United States Gypsum Company (USG); Control Joint, 093.
- g. Control Joint - Fire Rated:
 - 1) Description: One-piece trim formed with V-shaped slot and intumescent tape factory applied to one side of back of control joint, with removable strip covering slot opening.
 - 2) Purpose: For conditions requiring expansion and contraction stresses of large areas of gypsum board to be relieved at fire rated partitions.
 - 3) Basis of Design: Clark Dietrich; Fire Rated Control Joint.
- h. Other Trim or Special Shapes: Products as required by condition.
4. Manufacturers:
 - a. Dietrich Industries, Inc.; Unimast.
 - b. Fry Reglet Architectural Metals.
 - c. Marino Ware; Division of Ware Industries.
 - d. Niles Building Products Co.
 - e. Superior Metal Trim; Division of Delta Star, Inc.
 - f. United States Gypsum Company (USG).
- B. Plastic Drywall Trim Accessories:
 1. Description: Trim profile fabricated of high-impact PVC, of size suitable for gypsum board thickness; with recessed, perforated flange formed to receive joint compound.
 2. Trim Products Profiles: As listed above in "Typical Drywall Trim Accessories".
 3. Manufacturers:
 - a. Alabama Metal Industries Corporation; a Gibraltar Industries Company.
 - b. Phillips Manufacturing Co.
 - c. Plastic Components, Inc.
 - d. Trim Tex Drywall Products.
 - e. Vinyl Corp., a division of ClarkDietrich Building Systems.
- C. Accent Trim Accessories:
 1. Description: Extruded aluminum accessories of profiles and dimensions indicated of alloy and temper with not less than strength and durability properties of ASTM B 221, alloy 6063-T5.
 2. Basis of Design:
 - a. Aluminum Trim Accessory Type 1:
 - 1) Manufacturer:
 - 2) Product:
 - 3) Reveal Dimension:
 - 4) Finish:

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- b. Aluminum Trim Accessory Type 2:
 - 1) Manufacturer:
 - 2) Product:
 - 3) Reveal Dimension:
 - 4) Finish:
 - 3. Manufacturers:
 - a. Fry Reglet Architectural Metals.
 - b. Gordon, Inc.
 - c. Pittcon Industries.
 - D. Partitions to Glazed Aluminum Framing Trim Accessories:
 - 1. Partition and Mullion Gap Closure:
 - a. Description: Pre-assembled, spring loaded, partition gap closure fabricated from extruded aluminum with sound attenuating mineral wool insulation, compressible foam between extrusion and interior face of glass and acoustical sealant.
 - b. Manufacturers and Products:
 - 1) Basis of Design: Gordon; Mullion Mate Series 30, Series 40 or Series 60.
 - 2) STC Rating: Not less than Partition STC Rating; refer to Partition Types.
 - 3) Finish: As selected by Architect to match mullion finish, unless indicated otherwise.
 - 2. Sound Barrier Mullion Trim Cap (Demising Partitions between Units):
 - a. Description: Custom sound barrier mullion trim cap fabricated from window mullion jamb extensions filled with sound attenuating mineral wool insulation, compressible foam between extrusion and interior face of glass, fire containment sealant and acoustical sealant. Mullion trim cap shall engage end of partition and cover mullion with profiles indicated on Drawings, width as required for each condition.
 - 1) Basis of Design: Custom configuration as indicated on Drawings.
 - 2) Finish: As selected by Architect to match mullion finish, unless indicated otherwise.
 - 3. Proprietary Sound Barrier Mullion Trim Cap (Demising Partitions between Units):
 - a. Description: Sound barrier mullion trim cap fabricated from extruded aluminum with sound attenuating foam, compressible foam between extrusion and interior face of glass and acoustical sealant.
 - b. Manufacturers and Products:
 - 1) Basis of Design: Mull-it-Over Products; 55 Classic Mullion Trim Cap.
 - 2) STC Rating: 55.
 - 3) Finish: As selected by Architect to match mullion finish, unless indicated otherwise.
- 2.11 FASTENERS
- A. Limitations: Nails and staples are not permitted.
 - B. Fasteners for Attaching Metal Framing to Concrete Structure:
 - 1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching hanger wires and capable of sustaining, without failure, a load equal to 5 times that

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imposed by construction as determined by testing according to ASTM E 488 by a qualified independent testing agency.

- a. Cast-in-place anchor, designed for attachment to concrete.
 - b. Post-installed chemical anchor.
 - c. Post-installed expansion anchor.
2. Powder-Actuated Fasteners: Suitable for application indicated, ANSI A 10.3; low velocity, powder-actuated fasteners; drive pins and clip angles fabricated from corrosion-resistant materials, with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, an ultimate load capacity not less than 10 times that imposed by construction as determined by testing according to ASTM E 1190 by a qualified independent testing agency.
3. Manufacturers:
- a. Construction Materials, Inc.
 - b. Heckman Building Products, Inc.
 - c. Hilti Corp.
 - d. ITW Ramset/Red Head.
 - e. Powers Fasteners.
 - f. Simpson Strong Tie Anchor Systems.
4. For post-tensioned concrete, anchors shall not exceed **1 in (25 mm)** embedment. Obtain Structural Engineer's written approval for all proposed anchors in post-tensioned concrete prior to installation.
- C. Metal Framing Screws: Screw fasteners of type, material, size, corrosion resistance, holding power, and other properties required to fasten metal framing and furring members securely to substrates involved; complying with recommendations of gypsum board manufacturers for applications indicated.
- D. Gypsum Board Screws: Steel Drill Screws, ASTM C1002 unless otherwise indicated.
1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
 2. Cementitious Backer Units: Use screws of type and size recommended by panel manufacturer.
 3. Product Description - Standard Applications: Bugle head, self-drilling, self-tapping, corrosion resistant steel screws with Phillips-head recess of type, size and other properties recommended by gypsum panel manufacturer.
 4. Product Description - High Moisture / Humidity Applications: Bugle head, self-drilling, self-tapping, stainless steel screws with Phillips-head recess of type, size and other properties recommended by gypsum panel manufacturer; for use at high moisture areas such as Kitchens, Showers and Tub Enclosures, Saunas, Steam Rooms, and Pool Enclosures.
- E. Miscellaneous Fasteners: For conditions not indicated, fasteners shall be type, finish, size, and holding power recommended by respective gypsum board manufacturer and conditions.
- 2.12 JOINT TREATMENT MATERIALS
- A. Material Quality Standard: ASTM C 475 / C 475M.
- B. Joint Tape:
1. Paper Tape: Nominal **2 in (50 mm)** wide cross-fibered paper tape with finish suitable for bonding, creased in center for easy folding, and compatible with joint compound.
 2. Mesh Tape: Nominal **2 in (50 mm)** wide self-adhering 10-by-10 fiberglass mesh tape.

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C. Joint Compound:

1. Setting-Type: Job-mixed powder for mixing with water, chemical-hardening compound; includes taping types.
2. Drying-Type: Ready-mixed or job-mixed powder for mixing with water, air-drying, vinyl based compounds; includes taping, topping, and all-purpose types.

2.13 INTERIOR SURFACING COMPOUNDS

A. Level 5 Primer and Surfer: Latex based compound containing polyvinyl acetate (PVA) polymer that can be spray or roller applied to change a Level 4 finish to a Level 5 finish.

1. Manufacturers and Products:

- a. CertainTeed Corporation; ProRoc Level V Wall and Ceiling Primer/Surfer.
- b. United States Gypsum Company (USG); Sheetrock Brand Tuff-Hide Primer-Surfer.

B. Concrete Surfacing Compound: Vinyl-based, factory-formulated product applied in two or more coats as necessary for filling and smoothing to provide monolithic concrete surfaces to match Gypsum Board Level 4 finish.

1. Basis of Design: United States Gypsum Company (USG); Cover Coat Brand Compound.

2.14 RELATED MATERIALS

A. General: Provide auxiliary materials for gypsum board construction that comply with referenced quality standards and recommendations of gypsum board manufacturer.

B. Firestopping Products at Penetrations: As specified in Division 07 Section "Penetration Firestopping".

C. Fiberglass Sound Attenuation Blankets:

1. Material Quality Standard: ASTM C 665, Type I.
2. Description: Unfaced blankets produced by bonding inorganic glass fibers with a thermosetting binder; free of formaldehyde.
3. Surface Burning Characteristics: According to ASTM E 84/NFPA 255/UL 723:
 - a. Flame Spread: Class A - no greater than 25.
 - b. Smoke Developed: No greater than 50.
4. Thickness: Not less than 2-1/2 in (62 mm), unless otherwise indicated.
5. Manufacturers and Products:
 - a. CertainTeed Corporation; CertaPro AcoustaTherm Batts.
 - b. Johns Manville Building Insulation Div.; Sound Control Batts, Formaldehyde Free.
 - c. Knauf Fiber Glass; QuietTherm.
 - d. Owens Corning; Sound Attenuation Batts.

D. Mineral Wool Sound Attenuation Blankets:

1. Material Quality Standard: ASTM C 665, Type I.
2. Description: Unfaced mineral-fiber blanket insulation produced by combining mineral fibers of rock or slag with thermosetting resins; free of formaldehyde.
3. Surface Burning Characteristics: According to ASTM E 84/NFPA 255/UL 723:
 - a. Flame Spread: Class A - no greater than 25.
 - b. Smoke Developed: No greater than 50.

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4. Thickness: Not less than 3 in (75 mm), unless otherwise indicated.
 5. Density: Not less than nominal 2.5 pounds per cubic foot.
 6. Manufacturers:
 - a. Fibrex Insulations, Inc.
 - b. Rock Wool Manufacturing Co.
 - c. Roxul.
 - d. Thermafiber LLC.
- E. Acoustical Sealant:
1. Description: Manufacturer's standard nonsag, paintable, nonstaining sealant complying with ASTM C 834 or ASTM C 920. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies per ASTM E 90 or other acceptable test method.
 - a. Preconstruction Compatibility Testing: Test sealant for compatibility with copper substrates. Testing will not be required if data submitted on previous testing of current sealant products matches those submitted.
 - b. Do not use acrylic, neoprene, and nitrile based sealants that are not recommended for use with copper substrates.
- F. Fire-Resistance Rated and Acoustical Putty Pads:
1. Product Quality Standard: UL 263 (ASTM E 119).
 2. Description: Fire-rated, non-hardening, moldable, intumescent compound formed into sheets designed to seal penetrations, construction gaps, and around electrical boxes against spread of fire, smoke, and toxic gases.
 3. Manufacturers and Products:
 - a. Grace Construction Products; Flamesafe FSP 1077 Putty Pads.
 - b. Hilti; CP 617 Intumescent Acoustic Putty Pads.
 - c. Hilti; CFS-P PA.
 - d. Specified Technologies, Inc; Series SSP Putty Pads.
 - e. Tremco; TREMstop Electrical Box Insert.
 - f. 3M; Fire Barrier Moldable Putty+Pads.
- G. One-Piece Barrier Box:
1. Description: Rigid reinforced polyethylene box designed to fit around electrical boxes to prevent leaks of air and vapor.
 2. Basis of Design: Lessco Air-Vapor Barrier Box.
- H. Fire Resistive Sealants: Intumescent elastomeric sealant as specified in Division 07 Section "Fire-Resistive Joint Firestopping".
- I. Sealants: Sealant as specified in Division 07 Section "Joint Sealants".
- J. Isolation Strips: Adhesive-backed, closed cell neoprene or vinyl foam strips that allow fastener penetration with foam displacement, size as indicated, compressed 50 percent.
- K. Drywall Penetration Barrier Mesh: Barrier mesh, 0.048-inch (16 gauge) steel, 3/4-inch flattened diamond expanded-metal panels as a penetration barrier behind gypsum wallboard walls and/or ceilings, where indicated on Drawings.
1. Barrier-Mesh Clips: Barrier mesh shall be attached to framing members using barrier-mesh clips and appropriate threaded fasteners.

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PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

3.2 INSTALLATION, GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
 - 1. Respective Manufacturer's written installation instructions.
 - 2. Accepted submittals.
 - 3. Contract Documents.
 - 4. ASTM C754 Standard Specification for installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
 - 5. ASTM C840 Standard Specification for Application and Finishing of Gypsum Board.
 - 6. Gypsum Association GA 216.
 - 7. United States Gypsum Company (USG); Gypsum Construction Handbook when no other installation quality standard applies to condition.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by isolating metals and other materials from direct contact with incompatible materials.

3.3 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.
- B. Suspended Gypsum Ceilings: Coordinate installation of ceiling suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hanger wires at spacing required to support ceilings and that hangers will develop their full strength.
- C. Coordination with Sprayed Fire-Resistance Materials:
 - 1. Pre-Application Coordination: Before sprayed fire-resistance materials are applied, attach Z shaped clips and offset mounting plates to structural steel members with powder actuated fasteners, leaving portion of flange exposed outside of sprayed fire-resistive materials to attach head of wall track for gypsum board assembly.
 - 2. Post-Application Coordination: After sprayed fire-resistive materials are applied, remove materials only to extent necessary for installation of gypsum board assemblies, attach Z shaped clips and offset mounting plates to structural steel members with powder actuated fasteners, leaving portion of flange exposed outside of sprayed fire-resistive materials to attach head of wall track for gypsum board assembly, and patch with fire-resistive material specified in Division 07 Section "Cementitious Fireproofing" that is required to obtain fire-resistance rating indicated.

3.4 INSTALLATION OF GYPSUM BOARD ASSEMBLIES

- A. Resistance Rated Partitions: Construct fire resistance rated, smoke resistance rated, and sound resistance rated partitions according to respective assembly test reports. Ensure every

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material used within an assembly shall comply with manufacturers listed and product qualities indicated in respective assembly test report.

- B. Penetrations and Openings: Construct within gypsum board assemblies work as required to properly form penetration or opening to receive firestopping materials specified in following Sections:
 - 1. Division 07 Section "Penetration Firestopping".
 - 2. Division 07 Section "Fire-Resistive Joint Firestopping".
 - C. Control Joints: Install control joints at locations indicated on Drawings, in specific locations approved by Architect for visual effect and according to the following:
 - 1. Spaced not more than 24 to 30 feet in either direction for uninterrupted straight planes of ceilings and walls.
 - 2. Where different substrates occur at ceilings and walls.
 - 3. Where control joints occur in substrates at ceilings and walls.
 - 4. Where L, U, or T shaped ceiling configurations are joined.
 - 5. At less-than-ceiling-height cased opening frames and gypsum board openings over 60 inches in width; extend control joints from both corners at top of frame or opening up to ceiling.
 - 6. Where less-than-ceiling-height door frames occur on walls more than 30 feet in length; extend control joints from top of frame up to ceiling at corner of hinge side of door
 - 7. Where less-than-ceiling-height borrowed lites occur on walls more than 30 feet in length; extend control joints from top of frame up to ceiling and from bottom of frame to floor at both corners.
 - D. Isolation from Building Structure: Isolate gypsum board assemblies from building structure to prevent transfer of loading imposed by structural movement.
 - 1. Provide isolation joints as indicated or required by installation quality standards.
 - 2. Isolate ceiling assemblies abutting or penetrated by building structure.
 - 3. Isolate partition framing and wall furring abutting or penetrated by building structure, except at floor.
 - E. Building Expansion Joints: Avoid bridging building expansion joints with metal framing or furring members; frame both sides of joints independently with framing or furring members, coordinating with building expansion joint products specified in Division 07 Section "Expansion Control".
 - F. Fire-Resistance Rated and Acoustical Putty Pads: Hand apply pads to surfaces indicated, packing tightly into gaps and openings, in such a manner that pad will remain secured to surface; pinch pleat excess material together to close gaps.
 - G. One-Piece Barrier Box: Install in accordance with manufacturer's recommendations as indicated on the Drawings.
 - H. Supplemental Accessories: Install supplementary framing, blocking, reinforcing, and bracing in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, hand rails, furnishings, or similar construction. Comply with details indicated and recommendations of installation quality standards or manufacturer.
- 3.5 INSTALLING SUSPENDED GRID SYSTEM FOR INTERIOR CEILINGS
- A. Installation Quality Standard: In addition to standards listed elsewhere, perform suspended ceiling work according to following, unless otherwise specified in this Section:

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1. ASTM C 636 / C 636M Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.
 2. ASCE/SEI 7, Minimum Design Loads and Associated Criteria for Buildings and Other Structures.
 3. ASTM E 580 / E 580M, Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions.
- B. Pattern: Lay out spaces and arrange suspension system in a regular pattern, parallel or perpendicular to surrounding walls.
- C. Hangers for Ceiling System: Suspend hangers from building structural members and as follows:
1. Install hangers plumb and free from contact with mechanical and electrical equipment, insulation or other objects within ceiling plenum that are not part of supporting structural frame or ceiling suspension system. Within limitations allowed by installation quality standards, splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers required to support suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by installation quality standards.
 3. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail.
 4. Secure the appropriate hangers to structure, including intermediate framing members, by attaching to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 5. Install metal framing components for suspended ceilings so that members are level to within **1/8 in in 12 ft (3 mm in 3.6 m)** as measured both lengthwise on each member and transversely between parallel members.
 6. Attach hangers to structural members.
 7. Do not connect or suspend any ceiling components from ducts, pipes or conduit.
- D. Perimeters: Using gypsum board screws through gypsum board into metal studs, attach perimeter wall angle where suspended grid system meets vertical surfaces unless otherwise indicated; cut main beams and cross furring members to fit into wall angle.
- E. Main Beams:
1. Suspend main beams spaced **48 in (1200 mm)** on center from structure with wire hangers spaced not greater than **48 in (1200 mm)** on center.
 2. Install main beams level within **1/8 in in 12 ft (3 mm in 3.6 m)** with hanger wire taut and tightly wrapped to prevent vertical movement or rotation.
 3. Do not make local kinks or bends in hanger wires as a means of leveling.
- F. Cross Furring Members:
1. Install cross furring members at right angles to main beams, spaced as required and join to main beams with positive interlock.
 2. Install cross furring members to within **1/32 in (0.8 mm)** of their required location and within **0.015 in (0.38 mm)** of same horizontal plane as main beam, and never below continuous member.

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3. Install additional cross furring members at right angles to beams and cross furring members to support ends of recessed light fixtures, diffusers or grilles.

G. Seismic Conditions: Install bracing wires, compression struts, and other components as required by installation quality standard.

3.6 INSTALLING SUSPENDED CHANNEL FRAMED SYSTEM FOR INTERIOR CEILINGS

A. Installation Spacings: Install framing components at spacings indicated but not less than that required by referenced metal framing installation quality standard.

1. Wire Hangers: 4 ft (1200 mm) on centers.
2. Carrying Channels (Main Runners): 1-1/2 in (38 mm), 4 ft (1200 mm) on centers.
3. Metal Furring Channels (Furring Members): 16 in (400 mm) on centers.

B. Seismic Conditions: Install bracing wires, compression struts, and other components as required by installation quality standard.

3.7 INSTALLING METAL FRAMING COMPONENTS

A. Priority: Assemble various assemblies giving priority to partitions with higher rating; extend partition with higher rating intact through partition with lower rating.

B. Joinery and Connections: Install various metal framing components according to details indicated; for situations and conditions not indicated, comply with installation quality standards and with respective manufacturer's recommendations.

C. General Requirements: Construct partition framing of studs, tracks, and headers using screws of number and spacing required.

1. Install studs of uncoated base metal thickness as determined by Metal Framing Schedule at end of this Section.
2. Extend partition framing full height to underside of structure above, except where partitions are indicated to terminate at, or immediately above, suspended ceilings.
3. Continue framing over door frames and openings to provide support for gypsum board.
4. Space studs as indicated on Metal Framing Schedule at end of this section.
5. Cut studs 1 in (25 mm) short of full height to provide deflection relief at head of wall conditions.
6. Install studs so that flanges point in same direction.
7. Attach with screws through each stud flange and track (runner) flange, except top deflection track assemblies.
8. For fire resistance rated, smoke resistance rated, and sound resistance rated assemblies that are required to extend to underside of structure above to obtain ratings, install framing around structural and other members extending below floor slabs or roof decks, as needed to support gypsum board closures and make partitions continuous from floor to underside of structure above.
9. Do not lap studs.
10. At intersections and corners, locate studs no more than 2 in (50 mm) from partition intersections and corners and secure with screws through both flanges of studs and tracks.

D. Metal Track (Runner) Requirements:

1. Floors: Install tracks (runners) using appropriate fasteners spaced not more than 16 in (400 mm) on centers.
2. Head of Wall: Install deep leg deflection tracks using appropriate fasteners to laterally support assembly, and to avoid axial loading of assembly by deflection from building structure above.

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3. Head of Wall: Where indicated, install proprietary deflection and firestop track (runner) using appropriate fasteners for the substrate and installation conditions.
- E. Support for Wall Mounted Accessories or Equipment: Install back-up plate or track (runner) turned on its side, using screws as indicated or as required, to studs to properly transfer accessory or equipment load to metal framing.
- F. Openings: Frame single door, double door, above ceiling openings, and below ceiling openings using studs, tracks (runners), clip angles, and headers.
 1. Install 2 studs on each side of each opening in configuration indicated, including strap plates; extend from floor to underside of structure above; do not cut these studs under any circumstances. Include sound attenuation blankets within cavity when partition is scheduled to have a sound resistance rating.
 2. Construct header of appropriate configuration for type of opening to be spanned and secure with clip angles; include sound attenuation blankets within cavity when partition is scheduled to have a sound resistance rating.
 3. Install short intermediate studs **16 in (400 mm)** on center between top track and header.
 4. At partitions indicated to terminate immediately above ceiling, install diagonal bracing at not less than spacing as indicated.
- G. Supplementary Framing: Install around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, and similar items that cannot be supported directly by metal framing.
- H. Penetrations: Maintain fire-resistance rating of assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons, elevator floor indicators, and similar items.
- I. Chase Partitions:
 1. Position double row of studs vertically in tracks (runners), opposite each other in pairs with flanges pointing in same direction.
 2. Attach with screws through each stud flange and track (runner) flange.
 3. Cross brace between rows of studs with one of following at **48 in (1200 mm)** on center maximum vertically, attached to stud webs with screws:
 - a. Coated glass-mat gypsum board, **12 in (300 mm)** high by chase width.
 - b. Metal studs turned on side, webs back-to-back.
- J. Furred Walls:
 1. Erect furring channels vertically, spaced **16 in (400 mm)** on centers maximum, unless otherwise indicated.
 2. Attach with appropriate fasteners, staggered on flanges.
 3. Splice ends by nesting channels **8 in (200 mm)** and securely anchoring to surface.
 4. Miter **24 in (600 mm)** long horizontal furring channels at corners and space **24 in (600 mm)** on centers vertically.
 5. Locate furring channels around perimeter of openings and secure to surfaces.
- K. Control Joints:
 1. Construct metal framing as indicated by installation quality standard to allow gypsum board control joints to function as intended.
 2. For control joints located in fire resistance rated walls and partitions, construct of metal studs and mineral wool, full height of partition, according to assembly fire test reports.

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- L. Metal Framing Spanning Multiple Floors: Construct metal framing as required using longest length metal studs possible and attach to building structure with floor bypass clips.
- M. Curved Partitions:
1. Metal Track (Runner) shall comply with one of following:
 - a. Field Fabricated From Straight Components:
 - 1) Cut top and bottom runners (tracks) through leg and web at 2 in (50 mm) intervals for arc length. In cutting lengths of runners allow for uncut straight lengths of not less than 12 in (300 mm) at ends of arcs.
 - 2) Bend runners to uniform curve of radius indicated and locate straight lengths so they are tangent to arcs.
 - 3) Support outside (cut) leg of runners by clinching a 1 in (25 mm) high by runner thickness sheet metal strip to inside of cut legs using metal lock fasteners.
 - b. Field crimped using a crimping tool.
 - c. Manufactured flexible products.
 2. For full height partitions, attach runners to structural elements at floor and ceiling with appropriate fasteners located 2 in (50 mm) from ends and spaced 12 in (300 mm) on centers.
 3. For ceiling height partitions, attach runners to suspended ceilings with toggle bolts or hollow wall anchors located 2 in (50 mm) from ends and spaced 8 in (200 mm) on centers in between where attached to suspended ceilings.
 4. Position studs vertically with open sides facing in same direction and engaging floor and ceiling runners.
 5. Begin and end each arc with a stud and space intermediate studs equally along arcs at stud spacing recommended by gypsum board manufacturer for radii indicated.
 6. Attach studs to runners with 3/8 in (10 mm) long pan head framing screws. On straight lengths at ends of arcs, place studs 6 in (150 mm) on centers with last stud left free standing.
- N. Security Mesh: Where indicated, attach to metal studs before installation of gypsum board.
- O. Installation Tolerances: Install each metal stud metal framing and furring member so that fastening surfaces do not vary more than 1/8 in (3 mm) from plane formed by faces of framing members.

3.8 INSTALLING GYPSUM BOARD PRODUCTS

- A. General Requirements:
1. Install type of gypsum board at location indicated by gypsum board schedule at end of this Section.
 2. Do not install damaged gypsum boards.
 3. Install gypsum boards with finishable face side out.
 4. Butt gypsum boards together for a light contact at edges and ends with not more than 1/16 in (1.5 mm) of open space between panels.
 5. Do not force gypsum boards into place.
 6. Do not place tapered edges against cut edges or ends.
 7. Locate panel joints so that no joint will align with the edge of an opening unless control joints are installed at these locations.
- B. Isolation from Building Structure:

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1. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments or surfaces where movement is anticipated. Provide 1/4 in to 1/2 in (6 mm in 12 mm) wide spaces at these locations or as indicated below:
 - a. At top of wall or where partitions intersect open building structure members projecting below underside of floor slabs and roof decks, cut to fit profile formed by coffer, joists, beams, and other structural members; form proper annular joint to receive firestopping at rated partitions and form 3/4 in (20 mm) joint at top of wall at non-rated partitions.
 2. Trim edges with edge trim where edges of gypsum boards are exposed.
 3. Seal joints between edges and abutting structural surfaces with firestopping at rated locations and acoustical sealant at non-rated locations.
- C. Single-Layer Board Assemblies:
1. At typical conditions, install gypsum board vertically (long dimension parallel to metal framing), to minimize short end-to-short end joints unless otherwise indicated or required by assembly fire test reports.
 2. At interior of stairwells and other high walls, install gypsum boards horizontally, unless otherwise indicated or required by assembly fire test reports. Stagger abutting end joints not less than one framing member in alternate courses of gypsum boards.
- D. Multi-Layer Board Assemblies: Apply base layers and face layers vertically (long dimension parallel to metal framing) with joints of base layers located over stud or furring member and face layer joints offset at least one stud space from base layer joints, unless otherwise indicated or required by assembly fire test reports. Stagger joints on opposite sides of partitions.
- E. Ceiling Applications:
1. Apply gypsum board at right angles to main beams of suspension framing to minimize number of abutting end joints and avoid abutting end joints in central area of each ceiling.
 2. Stagger abutting end joints of adjacent panels not less than one framing member.
 3. Locate both edge or end joints of gypsum boards over intermediate supports or gypsum board back-blocking where metal framing is not present.
- F. Typical Wall Applications:
1. Attach gypsum boards to metal studs so that leading edge or end of each board is attached to open (unsupported) edges of stud flanges first.
 2. Stagger vertical joints on opposite sides of partitions.
 3. Do not make joints other than control joints at corners of framed openings.
 4. Attach gypsum boards to framing provided at doors, openings and cutouts. Install gypsum boards over door heads and extend to not less than one stud space - 16 in (400 mm) at each side of door or opening.
 5. Cover both faces of metal framing with gypsum boards as indicated, except in chase walls that are braced internally.
 6. Cut and fit gypsum boards around ducts, pipes, conduits, and other penetrations to form proper annular joint to receive firestopping at rated partitions.
 - a. At non-rated partitions, annual space around ducts, pipes, conduit or other penetrations to be properly sized to receive sealant; 3/4 in (20 mm) maximum.
 - b. "Blow-out" patches are not allowed.
 7. Support both edge and end joints of gypsum boards over metal framing.
- G. Curved Wall Assemblies:

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1. Install 2 layers of flexible gypsum board horizontally and unbroken, to extent possible, across curved surface plus 12 in (300 mm) long straight sections at ends of curves and tangent to them.
 2. On convex sides of partitions, begin installation at one end of curved surface and fasten gypsum boards to studs as they are wrapped around curve. On concave side, start fastening gypsum boards to stud at center of curve and work outward to panel ends.
 3. Fasten base layer to studs with screws spaced 16 in (400 mm) on centers maximum. Center second layer over joints in base layer, and fasten to studs with screws spaced 12 in (300 mm) on centers maximum.
- H. Screw Attachments:
1. Attach gypsum board to metal framing with screw fasteners of type appropriate for gypsum board materials and installation conditions:
 - a. Length shall be as required by condition and penetrating metal framing not less than 3/8 in (10 mm).
 - b. Spacing shall be as recommended by installation quality standard, gypsum board manufacturer, or respective assembly test report.
 - c. Use properly adjusted, positive-clutch electric power tool equipped with adjustable screw-depth head and a Phillips bit. Nails and staples are not permitted.
 2. Drive screws to slightly dimple surface without breaking face paper, fracturing core, or stripping metal framing member around screw shank.
 3. Space screws for non-fire resistance rated partitions and ceilings as recommended by installation quality standards.
 4. Space screws for fire resistance rated partitions as required by assembly fire test reports.
 5. Start field screwing near center and work towards edges.
 6. Space screws not less than 3/8 in (10 mm) from gypsum boards edges.
 7. Do not attach gypsum boards to top runner where wall or partition extends to building structure unless required by fire test reports.
- I. Control Joints: Form control joints and expansion joints at locations indicated with required space between edges of adjoining gypsum boards.
- J. Sound Attenuation Blankets: Install blankets within stud cavities set so that they are held in place by friction with metal studs; ensure blankets are secure within cavity and will not become displaced when second gypsum board side is closed.
- K. Elevator Shaft Cants: Where gypsum board shaftwall assemblies cannot be positioned within 4 in (100 mm) of shaft face of structural beams, floor edges, and similar projections into shaft, install 5/8 in (15 mm) thick gypsum board cants covering tops of projections.
1. Slope cant panels at least 75 degrees from horizontal. Set base edge of panels in adhesive and secure top edges to shaft walls at 24 in (600 mm) on centers with screws fastened to shaftwall framing.
 2. Where steel framing is required to support gypsum board cants, install framing at 24 in (600 mm) on centers and extend studs from projection to shaftwall framing.
- L. Sealant:
1. Comply with ASTM C 919 and manufacturers written recommendations for closing off sound-flanking paths around or through gypsum board assemblies, including sealing partitions above acoustical ceilings.
 2. Seal wall assemblies at perimeters, behind control joints, and at openings and penetrations with a continuous bead of sealant material according to following:
 - a. Fire Resistance Sealant: Joints within fire resistance rated assemblies.

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- b. Water Resistance Sealant: Joints within non-fire resistance rated assemblies exposed to possible water infiltration.
- c. Acoustical Sealant: All other joints.

3.9 INSTALLING TRIM ACCESSORIES

- A. General: Fasten trim accessories continuously according to accessory manufacturer's instructions using gypsum board screws; installation by clinch-on tool and staples not permitted.
- B. Interior Trim Accessories: Install in the following locations:
 - 1. Corner Beads: Install trim at external corners; use screws at each flange at 9 in (225 mm) on centers, opposite each other.
 - 2. Edge Trim: Install trim where gypsum boards abut dissimilar material, and where edge of gypsum boards would otherwise be exposed; use screws at flange at 9 in (225 mm) on centers.
 - a. LC-Bead (J-Bead): Install trim at exposed conditions where back flange can be attached to framing or supporting substrate before gypsum board installation.
 - b. L-Bead: Install trim at exposed conditions where trim can only be installed after gypsum board installation.
 - c. J-Stop: Install trim at concealed conditions where trim can only be installed after gypsum board installation.
 - 3. Control Joints: Install trim at appropriate locations, ensuring gypsum board is not continuous over joint; use screws at each flange at 6 in (150 mm) on centers.
 - a. Control joints to extend 4 in (100 mm) above finished ceiling at non-rated conditions and extend to structure at rated wall conditions.
- C. Accent Trim Accessories: Install at locations indicated, mitering corners and intersections to form tight, flush and uniform joints; use screws at each flange at 9 in (225 mm) on centers.
- D. Trim Accessories at Exterior Windows: Install at locations indicated, mitering corners and intersections to form tight, flush and uniform joints; use screws at each flange at 9 in (225 mm) on centers or as recommended by manufacturer for manufactured products.

3.10 FINISHING GYPSUM BOARD PRODUCTS

- A. General: Treat board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare surfaces for decoration.
- B. Joint Tape: Finish joints according to the following and as recommended by manufacturer:
 - 1. Typical Paper-Faced Gypsum Board Products: Paper tape.
 - 2. Moisture-Resistant Gypsum Board Products:
 - a. Moisture-Resistant Paper-Faced Gypsum Board: Paper tape.
 - b. Moisture-Resistant Paperless Glass-Mat Gypsum Board: Paper or mesh tape.
 - c. Moisture-Resistant Coated Glass-Mat Gypsum Board - Tile Backer: Mesh tape.
 - 3. Cementitious Backer Units: Mesh tape.
- C. Finishing: Finish boards and units to achieve specified level of finish as indicated in schedule at end of Section:
 - 1. Typical Paper-Faced Gypsum Board: Either or combination of the following as recommended by manufacturer:
 - a. Setting-type joint compounds.
 - b. Drying-type joint compounds.

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2. Moisture-Resistant Paper-Faced Gypsum Board: Setting-type joint compounds.
3. Cementitious Backer Unit: Setting-type joint compounds.

3.11 INTERIOR SURFACING COMPOUNDS

- A. Skim Coat Finishing with Joint Compound - Gypsum Board:
 1. Apply setting-type joint compound or Level 5 Primer and Surfer over entire surface in thickness recommended by manufacturer.
- B. Skim Coat Finishing with Concrete Surfacing Compound - Concrete:
 1. Prepare concrete surfaces for applied finishes.
 - a. Grind ridges, fins, and high areas.
 - b. Remove form oil, efflorescence and greasy deposits.
 - c. Fill offsets, voids, bugholes, rock pockets level with surrounding surfaces with concrete surfacing compound.
 - d. Apply as many coats of concrete surfacing compound as necessary to eliminate cracks.
 - e. Verify that resulting concrete surface is uniformly smooth and free of irregularities.
 2. Apply Concrete Surfacing Compound over entire surface in thickness recommended by manufacturer.

3.12 ADJUSTMENTS

- A. Damaged Materials: Stored or installed gypsum board materials shall be classified as damaged, defective, and nonconforming Work if they have been exposed to wetness or dampness at any time prior to Substantial Completion or if they exhibit evidence of active or dormant mold or mildew. Damaged materials and assemblies shall be replaced with new and dry materials and assemblies.

3.13 PROTECTION

- A. Procedures: Protect products and systems from damage during installation and remainder of construction period according to manufacturer's instructions.

3.14 METAL FRAMING SCHEDULE

- A. Metal Stud Framing Schedule:
 1. Stud Depth: As indicated on Drawings.
 2. Spacing: Maximum 16 in (400 mm) on centers, unless otherwise indicated, or as required to comply with respective assembly test report.
 3. Minimum Performance Requirements: Lateral pressure loads (lb/sq ft) are allowable design values and shall not be reduced further by load combinations. Minimum performance requirements unless otherwise indicated:
 - a. Typical Partitions: L/240 at 5 lb/sq ft (239 Pa) lateral load.
 - b. Elevator Shaft Partitions: L/240 at 7.5 lb/sq ft (359 Pa) lateral load.
 - c. Partitions with Tile Facing: L/360 at 7.5 lb/sq ft (359 Pa) lateral load.
 - d. Partitions with Interior Stone Facing Concentrated Loads: Provide delegated engineering to comply with L/720 at 10 lb/sq ft (479 Pa) lateral load.
 - e. Partitions supporting Lead Lined Doors and Frames: Provide delegated engineering to comply with L/480 at 10 lb/sq ft (479 Pa) lateral load.
 - f. Partitions supporting all other Concentrated Loads: Provide delegated engineering to comply with L/360 at 10 lb/sq ft (479 Pa) lateral load

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4. Minimum Uncoated Base Steel Thickness:
- a. Typical Gypsum Board Assemblies: As determined by manufacturer's limiting height engineering data unless otherwise indicated.
 - 1) 20 Gauge Drywall Studs: 0.0296 inch (0.75 mm) minimum base steel thickness.
 - a) Typical partitions unless otherwise indicated.
 - 2) 20 Gauge Equivalent Studs: Allowed only when included as part of an approved tested assembly.
 - 3) 20 Gauge Structural Studs: 0.0329 inch (0.84 mm) minimum base steel thickness.
 - a) Partitions supporting ceramic or stone tile.
 - b. 16 Gauge Studs:
 - a) Typical at partitions supporting stone facing unless otherwise indicated.
 - c. Gypsum Board Assemblies required to Support Concentrated Loads: As required by delegated engineering professional but not less than minimum uncoated base metal thickness indicated above.
 - d. Gypsum Board Assemblies required to Withstand Seismic Loads: As required by delegated engineering professional but not less than minimum uncoated base metal thickness indicated above.

3.15 GYPSUM BOARD SCHEDULE

- A. Gypsum Board Schedule, General: Install the designated gypsum board product based on exposure classification to water and / or moisture and applied finish system as follows, unless otherwise indicated or scheduled on the Drawings.
- B. No Exposure: Surfaces not normally exposed to water and / or moisture sources, including but not limited to the following locations:
 - 1. Typical walls and ceilings.
 - a. Paint and Wall Coverings Only: Typical paper-faced gypsum board.
 - b. Tile: Moisture-resistant coated-glass-mat gypsum board.
 - 2. Horizontal fire-rated assemblies and ceilings:
 - a. Paint Only: Paper-faced Type C gypsum board.
 - 3. Walls in acoustical barriers as indicated in the Drawings.
 - a. Paint and Wall Coverings Only: Paper-faced acoustically enhanced gypsum board.
 - 4. Curved walls:
 - a. Paint and Wall Coverings Only: Paper-faced flexible gypsum board; installed in two layers.
 - 5. Shaft-Side Face of Shaft-Liner Assemblies:
 - a. No Finish Required: Moisture-resistant paperless glass mat shaft-liner gypsum board.
 - b. No Finish Required: Moisture-resistant paper-faced shaft-liner gypsum board.

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- C. Incidental Exposure: Surfaces immediately adjacent to water and / or moisture sources, including but not limited to the following locations:
 - 1. Walls and ceilings in mechanical equipment rooms and janitor closets.
 - 2. Walls within 24 inches of centerline of drinking fountains, isolated wall-hung lavatories, and countertop sinks and other similar water sources.
 - 3. Interior face of exterior walls.
 - 4. Acceptable gypsum board products for the above listed conditions:
 - a. Paint and Wall Coverings: Moisture-resistant paper-faced or moisture-resistant paperless glass-mat gypsum board.
 - b. Tile: Moisture-resistant coated-glass-mat gypsum board.
 - 5. Top of walls above ceilings adjacent to mechanical equipment in corridors.
 - a. Moisture-resistant paperless glass-mat gypsum board.
- D. Direct Exposure: Surfaces normally soaked, saturated, or regularly and frequently exposed to water and / or moisture, including but not limited to the following locations:
 - 1. Walls and ceilings in commercial kitchens, toilet rooms and bathrooms including bathtubs and showers:
 - a. Paint and Wall Coverings: Moisture-resistant paper-faced or moisture-resistant paperless glass-mat gypsum board.
 - b. Tile: Moisture-resistant coated-glass-mat gypsum board.
 - 2. Walls and ceilings in saunas, steam rooms, gang showers, and pool enclosures:
 - a. Tile Only: Cementitious backer units.
- E. Any Exposure:
 - 1. Moisture-Resistant, Abuse-Resistant Gypsum Board Products: Where indicated on drawings.
 - a. Paint and Wall Coverings: Paper-faced or paperless products.
 - b. Tile: Paperless products.
 - 2. Moisture-Resistant, Impact-Resistant Gypsum Board Products for Enclosing High-Rise Elevator Shafts and Stairwells: Where indicated on drawings.
 - a. Paint and Wall Coverings: Paper-faced or paperless products.
 - b. Tile: Paperless products.
 - 3. Moisture-Resistant, Impact-Resistant Gypsum Board Products: Where indicated on drawings.
 - a. Paint and Wall Coverings: Paper-faced or paperless products.
 - b. Tile: Paperless products.

3.16 GYPSUM BOARD FINISHING SCHEDULE

- A. Gypsum Board Finishing Schedule, General: Finish panels to Levels of Finish indicated below. Apply joint tape over panel joints, except those with trim having flanges not intended for tape. Sand between coats and after last coat to produce a surface free of defects and ready for applied finish system.
 - 1. Levels of Finish: According to ASTM C 840.
- B. Preparation: Apply joint compound at open joints, panel edges, and damaged surface areas.

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- C. Level 1: At following locations, embed tape at joints in joint compound unless a higher level of finish is required for fire resistance rated assemblies. Trim accessories to be installed but not embedded in joint compound unless required for fire rating:
1. Ceiling plenum areas above ceilings.
 2. Concealed areas.
 3. Substrate for interior stone facing.
 4. Substrate for interior woodwork.
 5. Unfinished areas designated for future expansion.
 6. Not used.
- D. Level 2: At following locations, embed tape and apply separate first coat of joint compound to tape, fasteners, and trim flanges:
1. Substrate for tiling.
 2. Not used.
- E. Level 3: At following locations, embed tape and apply separate first and second coats of joint compound to tape, fasteners, and trim flanges:
1. Mechanical, electrical, data and elevator equipment rooms.
 2. Stair towers.
 3. Not used.
- F. Level 4: At following locations, embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges:
1. Areas to receive paint.
 2. Areas to receive wall coverings.
 3. Areas to receive veneer plastering.
 4. Not used.
- G. Level 5: At following locations, embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges, and apply skim coat of joint compound or Level 5 Primer and Surfacers over entire surface:
1. Areas to receive whiteboard paint or dry erase board coatings.
 2. Curved ceilings and partitions.
 3. Front of House areas.
 - a. Areas to receive paint.
 - b. Areas to receive wall coverings.
 - c. Areas to receive veneer plastering.
 4. Other areas as indicated on the Drawings.
 5. Not used.

3.17 FIELD QUALITY CONTROL

- A. Owner Acoustical Testing Agency: The Owner may employ and pay a qualified independent testing agency to perform field quality control. Testing and inspections may include the following.
1. Airborne-Sound Testing, Horizontal and Vertical: Perform testing of installed assemblies for noise isolation in accordance with ASTM E 336 Standard Test Method from Measurement of Airborne Sound Attenuation between Rooms in Buildings, ASTC (Apparent Sound Transmission Class) determined by ASTM E413 Classification for Rating Sound Insulation.

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- a. Extent of Testing: Testing agency shall randomly select assemblies for testing.
- 2. Structure-Borne Sound Testing, Vertical: Perform testing of installed assemblies for noise isolation in accordance with ASTM E 1007 Standard Test Method for Field Measurement of Tapping Machine Impact Sound Transmission through Floor-Ceiling Assemblies and Associated Support Structures, AIIIC (Apparent Impact Isolation Class) determined by ASTM E989 Standard Classification for Determination of Single-Number Metrics for Impact Noise.
 - a. Extent of Testing: Testing agency shall randomly select assemblies for testing.
- B. Tests and Inspections, General: Tests and inspections shall take place as installation proceeds to determine compliance with specified performance requirements.
 - 1. Correction of Deficiencies:
 - a. Materials and installation will be considered defective if they do not meet specified requirements.
 - b. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.
 - c. Perform additional tests and inspections, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.
 - 2. Prepare test and inspection reports.

END OF SECTION

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SECTION 09 3000

TILING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Modular tiles, membrane underlayments, setting materials, grouting materials, accessories, and supplementary items necessary for installation.

1.2 DEFINITIONS

- A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
- B. Module Size: Actual tile size plus joint width indicated.
- C. Face Size: Actual tile size, excluding spacer lugs.
- D. Ceramic (Mosaic) Tile: Tile formed by either the dust-pressed or plastic method, usually **1/4 in** to **3/8 in** (**6 mm** to **10 mm**) thick, and having a facial area of less than **6 sq in** (**3900 mm²**). Ceramic mosaic tile may be of either porcelain or natural clay composition and they may be either plain or with an abrasive mixture throughout.
- E. LHT: Large and Heavy Tile. Tiles are typically larger than **8 in by 8 in** (**200 mm by 200 mm**) or with at least one side greater than **15 in** (**375 mm**) or weigh **5 psf** (**239 Pa**) or heavier and have an ungauged thickness.
- F. Paver Tile: Glazed or unglazed porcelain or natural clay tile formed by dust-pressed method having a facial area of **6 sq in** (**3900 mm²**) or more.
- G. Porcelain Tile: A ceramic tile or paver tile that is generally made by the dust-pressed method of a composition resulting in a tile that is dense, impervious, fine grained, and smooth with sharply formed face.
- H. Wall Tile: A glazed tile with a body that is suitable for interior use and which is usually non-vitreous and is not required nor expected to withstand excessive impact or be subject to freezing and thawing conditions.

1.3 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
 - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
- B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components and attachments to other work. Distinguish between shop and field-assembled work.

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1. Include plans of rooms and elevations of walls showing tile and patterns; include sections showing underlayments, setting materials, and grouting materials.
 2. Include details showing widths and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
- C. Samples for Verification Purposes: Submit samples for each item listed below of size and construction indicated. Where products involve normal color and texture variations, include sample sets showing the full range of variations expected.
1. Tile: Each type and composition of tile and for each color and finish required, at least **12 in (300 mm)** square, mounted on rigid panel, and with grouted joints using product complying with specified requirements and in color approved for completed work.
 2. Tile Trim and Accessories: Full-size units of each type and for each color required.
 3. Stone Thresholds: **6 in (150 mm)** lengths of specified profile.
 4. Metal Edge Strips: **6 in (150 mm)** lengths of specified profile.
- 1.4 INFORMATIONAL SUBMITTALS
- A. List of Materials for Layered Mock-Up for Construction Quality Purposes:
1. Product, material, and equipment names, model numbers, lot numbers, batch numbers, source of supply, and other information required to identify items used.
 2. Receipt of list does not constitute acceptance of deviations from Contract Documents, unless such deviations are specifically approved by Architect in writing.
- B. Master Grade Certificates: Submit for each shipment, type, and composition of tile, signed by tile manufacturer and installer.
- C. Product Test Reports: Written reports based on evaluation of comprehensive tests performed by qualified testing agency indicating that each product complies with requirements.
- D. Field Quality Control Reports: Written report of testing and inspection required by "Field Quality Control".
- E. Manufacturer's Project Acceptance Document: Certification by the manufacturer that its product(s) are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required, and that a warranty will be issued.
- F. Qualification Data:
1. For firms and persons specified in "Quality Assurance" to demonstrate their capabilities and experience. Include list of completed projects.
- G. Warranty: Sample of warranty.
1. Provide manufacturer's written warranty covering materials and installation (labor) stating obligations, remedies, limitations, and exclusions.

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1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Instructions: Include in operation and maintenance manual required by Division 01 Section "Closeout Requirements". Submit manufacturer's instructions for maintenance of installed work, including methods and frequency for maintaining optimum condition under anticipated use. Include precautions against cleaning materials and methods which may be detrimental to finishes and performance.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Materials: Furnish the following extra materials that match and are from same production runs as products installed, packaged with protective covering for storage and identified with labels describing contents:
 - 1. Furnish quantity of full-size tile and trim units equal to 2 percent of amount installed, for each type, composition, color, pattern, and size.

1.7 QUALITY ASSURANCE

- A. Mock-ups: Prior to fabrication and installation, build mock-up for each form of construction and finish required to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mock-up to comply with the following requirements, using materials indicated for the completed Work:
 - 1. Build mock-up in the location and of the size indicated or, if not indicated, as directed by Architect. Contractor shall provide structural support framework.
 - a. Show typical components, attachments to building structure, and requirements of installation.
 - b. Build mock-ups in a layered fashion omitting tile in particular areas to reveal underlayment membranes and setting bed installation including but not limited to the following:
 - 1) Tiled floor conditions at thin-set mortar setting beds.
 - 2) Tiled floor conditions at LHT mortar setting beds.
 - 3) Movement joints at tiled floor conditions.
 - 4) Tiled shower stall including three walls, floor, curb, and threshold.
 - 5) Tiled wall conditions, including one interior corner.
 - 2. Notify Architect seven days in advance of the dates and times when mock-up will be installed.
 - 3. Obtain Architect's acceptance of mock-ups before starting fabrication or installation.
 - 4. Acceptance of mock-ups does not constitute acceptance of deviations from the Contract Documents contained in mock-ups unless such deviations are specifically noted by Contractor and accepted by Architect in writing.
 - 5. Demolish and remove mock-ups when directed by Architect unless accepted to become part of the completed Work.

1.8 PRE-INSTALLATION CONFERENCE

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.

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1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.
- D. Store liquid materials in unopened containers and protected from freezing.
- E. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.10 PROJECT CONDITIONS

- A. Environmental Limitations: Install tile only when construction in room is completed and ambient temperature and humidity conditions are being maintained to comply with referenced standards and manufacturer's written instructions.

1.11 COORDINATION

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

1.12 WARRANTY

- A. Installer's Warranty: Furnish installer's written workmanship warranty signed by an authorized representative using installer's standard form agreeing to provide labor required to repair or replace work which exhibits workmanship defects. "Defects" is defined to include but not limited to deterioration or failure to perform as required.
 - 1. Warranty Period: Installer shall warrant the installation to be free from workmanship Defects for a period of 2 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND PRODUCTS

- A. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".
- B. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other manufacturers offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.

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1. Selections: As scheduled or as indicated in Design Selections.

2.2 MATERIALS, GENERAL

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.
 1. Tile: For each tile, obtain of same color, finish, composition, and type, from same source and production run.
 2. Setting and Grouting Materials: Obtain ingredients of uniform quality for each mortar and grout component from single manufacturer.

2.3 PERFORMANCE REQUIREMENTS

- A. Slip Resistance Requirements for Floor Tile:
 1. Standards: Products and installation shall comply with ANSI A137.1, and state and local accessibility standards.
 2. Floor Tile Slip Resistance: For tile installed on walkway surfaces, provide products with the following value as determined by testing identical products by the DCOF AcuTest Method per ANSI A137.1:
 - a. Walkway Surfaces: Minimum 0.42.

2.4 CERAMIC TILE PRODUCTS

- A. Material Quality Standard: ANSI A137.1 "Specifications for Ceramic Tiling" for types, compositions, and grades of tiling indicated.
 1. Furnish tiling complying with "Standard Grade" requirements, unless otherwise indicated.
- B. Ceramic Tile, General: Thin ceramic surfacing unit made from clay, porcelain, or mixture of ceramic materials, glazed or unglazed, fired above red heat to temperature sufficient to produce specific physical properties and characteristics specified.
- C. Factory Blending: For tile exhibiting color variations, blend tile in factory and package so that tile units taken from one package show the same range in colors as those taken from other packages and match approved samples.
- D. Mounting: Where factory-mounted tile is used, provide back- or edge-mounted tile assemblies as standard with manufacturer. Where tile is intended for installation in wet exposure areas, do not use factory mounted tile assemblies unless tile manufacturer states that this type of mounting is suitable for installation indicated.

2.5 WATERPROOF MEMBRANE UNDERLAYMENTS FOR INTERIOR APPLICATIONS

- A. General: Manufacturer's standard product that complies with ANSI A118.10 and is acceptable to authorities having jurisdiction for use as shower pan waterproofing, as selected from one of the following available options. Include primer, pre-fabricated corners, seaming cement, detail tape, sealant, and other standard accessory products required for application provided by membrane manufacturer.

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B. Faced Plastic Waterproof Membrane Underlayments:

1. Faced Chlorinated Polyethylene (CPE):

- a. Description: Non-plasticized, chlorinated polyethylene faced on both sides with high-strength, nonwoven polyester fabric; minimum 0.030 in (0.75 mm) nominal thickness.
- b. Manufacturers and Products:
 - 1) The Noble Company; Nobleseal TS.
 - 2) Laticrete; Hydro Ban Sheet Membrane.

2. Faced Polyvinyl Chloride (PVC):

- a. Description: ASTM D 4551, multiple layers of polyvinyl chloride sheet heat-fused together and to facings of bondable nonwoven polyester; minimum 0.040 in (1.0 mm) nominal thickness.
- b. Manufacturer and Product: Compotite Corporation; Composeal Gold.

3. Locations: Thin-set installations at floors, walls, and ceiling; including thin-set shower pan floor installations.

2.6 CRACK ISOLATION MEMBRANE UNDERLAYMENTS

A. General: Manufacturer's standard product that complies with ANSI A118.12 as selected from one of the following available options. Include primer, pre-fabricated corners, seaming cement, detail tape, sealant, and other standard accessory products required for application provided by membrane manufacturer.

B. Fluid-Applied Crack Isolation Membrane Underlayment: Not permitted or allowed within shower and bathtub areas.

1. Description: Manufacturer's proprietary system consisting of liquid applied component and synthetic fabric sheet reinforcement.
2. Manufacturers and Products:

- a. ARDEX Engineered Cements; Ardex 8 + 9 Waterproofing and Crack Isolation Membrane.
- b. Custom Building Products; 9240 Waterproofing and Crack Isolation Membrane.
- c. Laticrete International Inc.; Laticrete 9235 Waterproof Membrane.
- d. Laticrete International Inc.; Blue 92 Anti-Fracture Membrane.
- e. Mapei Corp.; Mapelastic 400.

C. Faced Chlorinated Polyethylene (CPE) Crack Isolation Membrane Underlayment:

1. Description: Non-plasticized, chlorinated polyethylene faced on both sides with high-strength, nonwoven polyester fabric; minimum 0.030 in (0.75 mm) nominal thickness.
2. Manufacturer and Product: The Noble Company; NobleSeal CIS.

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2.7 SETTING (MORTAR AND GROUT) MATERIALS

A. Material Quality Standards: ANSI A118 Series as indicated.

B. LHT Latex-Portland Cement Mortar:

1. Material Quality Standard: ANSI A118.4, with the following physical properties:

- a. Manufacturer's premium polymer modified LHT mortar product; gray color. Use white color with light colored stone, translucent marble or light color grout as recommended by manufacturer.
- b. Integral antimicrobial product added during manufacturing to resist mold and mildew growth.
- c. Non-sag capability.
- d. Suitable for use in LHT mortar beds up to **1/2 in (12 mm)** thick.

2. Manufacturers and Products - Floor Tiling:

- a. ARDEX Engineered Cements; X 77 Microtec.
- b. Custom Building Products; ProLite Tile & Stone Mortar.
- c. Laticrete International, Inc.; Laticrete 255 MultiMax.
- d. Mapei Corp.; Ultraflex LFT Mortar.

C. Thin-Set Latex-Portland Cement Mortar (For All Tile Types Except Glass):

1. Material Quality Standard: ANSI A118.4, with the following physical properties:

- a. Manufacturer's premium polymer modified thin-set product; gray color. Use white color with light colored stone, translucent marble or light color grout as recommended by manufacturer.
- b. Integral antimicrobial product added during manufacturing to resist mold and mildew growth.
- c. Non-sag capability.
- d. Suitable for use in thin set mortar beds up to **1/4 in (6 mm)** thick.

2. Manufacturers and Products - Floor Tiling:

- a. ARDEX Engineered Cements; X 77 Microtec.
- b. Custom Building Products; ProLite Tile & Stone Mortar.
- c. Laticrete International, Inc.; Laticrete 254 Platinum Thin-Set Mortar.
- d. Mapei Corp.; Ultraflex 3 Mortar.

3. Manufacturers and Products - Wall Tiling:

- a. ARDEX Engineered Cements; X 77 Microtec.
- b. Custom Building Products; ProLite Tile & Stone Mortar.
- c. Laticrete International, Inc.; Laticrete 255 MultiMax Multipurpose Thin-Set Mortar.
- d. Mapei Corp.; Ultralite Mortar.

D. Latex-Portland Cement Grout for Tile Joints:

1. Unsanded Grout:

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- a. Material Quality Standard: ANSI A118.7, with following physical properties:
 - 1) Manufacturer's premium polymer modified unsanded grout product.
 - 2) Integral antimicrobial product added during manufacturing to resist mold and mildew growth.
 - b. Manufacturers and Products:
 - 1) ARDEX Engineered Cements; FG-C Unsanded Grout.
 - 2) Custom Building Products; Prism Surecolor Grout.
 - 3) Laticrete International, Inc.; Permacolor Grout.
 - 4) Mapei Corp.; Ultracolor Plus Grout.
 - c. Locations: Tile Joints less than **1/8 in (3 mm)** wide.
2. Sanded Grout:
- a. Material Quality Standard: ANSI A118.7, with following physical properties:
 - 1) Manufacturer's premium polymer modified sanded grout product.
 - 2) Integral antimicrobial product added during manufacturing to resist mold and mildew growth.
 - b. Manufacturers and Products:
 - 1) ARDEX Engineered Cements; FL Rapid Set, Flexible, Sanded Grout.
 - 2) Custom Building Products; Prism Surecolor Grout.
 - 3) Laticrete International, Inc.; Permacolor Grout.
 - 4) Mapei Corp.; Ultracolor Plus Grout.
 - c. Locations: Tile Joints **1/8 in (3 mm)** wide and larger.

2.8 ELASTOMERIC SEALANTS

A. Sealant Colors: Match color of adjacent grout unless otherwise indicated.

B. Mildew-Resistant Floor or Wall Joint Sealant:

- 1. Material Quality Standard: ASTM C 920, Type S, Grade NS, Class 25, with following physical properties:
 - a. Integral antimicrobial product added during manufacturing to resist mold and mildew growth.
 - b. Intended for sealing interior ceramic tile joints and other nonporous substrates.
 - c. Resistant to in-service exposures of high humidity and temperature extremes.
- 2. Description: One-part mildew-resistant silicone sealant.
- 3. Manufacturers and Products:
 - a. ARDEX Engineered Cements; SX.
 - b. Custom Building Products; Commercial 100% Silicone Caulk.
 - c. Dow Corning Corp.; 786.

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- d. Laticrete International, Inc.; Latasil.
- e. Pecora Corp.; 898.
- f. Tremco Inc.; Tremsil 200.

C. Backer Rods:

- 1. Material Quality Standard: ASTM C 1330, Type B.
- 2. Description: Non-gassing (when punctured), bi-cellular polyethylene or polyolefin foam rod with a surface skin, of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- 3. Manufacturers and Products:
 - a. BASF Construction Chemicals; MasterSeal 921 (Formerly Sonneborn Soft Backer Rod).
 - b. Nomaco Inc.; Sof Rod.

D. Backer Tape: Bond-breaking polyethylene or other plastic tape, self-adhesive where applicable, recommended by sealant manufacturer for preventing sealant from adhering to back of joint where such adhesion would result in sealant failure.

2.9 RELATED MATERIALS

- A. Cementitious Underlayments: Trowelable or self-leveling as required by conditions; pre-mixed, latex-modified, Portland cement based formulation provided by or specifically approved by setting material manufacturer; include primers if required for concrete substrate condition.
- B. Patching Compounds: Trowelable pre-mixed, latex-modified, Portland cement based formulation provided by or specifically approved by setting material manufacturer; include primers if required for concrete substrate condition.
- C. Metal Transition Strips (Tile to Adjacent Flooring Material):
 - 1. Schluter Systems LP; Schiene, stainless steel.
- D. Stone Threshold:
 - 1. Material Quality Standard: MIA Group A.
 - 2. Description: White marble with honed finish.
 - 3. Fabrication: Of shape and width to allow top at no more than 1/2 in (12 mm) above adjoining finished floor surface and both edges beveled on a slope no greater than 1:2 and as indicated in the Drawings.
- E. Glass-Fiber Tape: Self-adhering, alkali-resistant, glass-fiber tape, 10 by 10 or 10 by 20 threads per 1 in (25 mm).; minimum 2 in (50 mm) wide.
- F. Tile Cleaner: Neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, provided by or specifically approved by tile and grout manufacturers.
- G. Grout Sealer: Manufacturer's standard silicone product for sealing grout joints and that does not change color or appearance of grout.

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2.10 MIXING MORTARS AND GROUT

A. General Procedures:

1. Mix to comply with referenced quality standards and manufacturers' written instructions.
2. Add materials, water, and additives in accurate proportions.
3. Use type of mixing equipment, speeds, containers, time, and other procedures to produce uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Acceptance of Surfaces and Conditions: Examine substrate surfaces to which tile will be installed for compliance with requirements, installation tolerances, and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with the Contract Documents. Starting work within a particular area will be construed as acceptance.

1. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
2. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

3.2 INSTALLATION, GENERAL

A. Installation Quality Standard: In addition to standards listed elsewhere, perform tile work according to following, unless otherwise specified:

1. Respective manufacturer's written installation instructions.
2. Accepted submittals.
3. Contract Documents.
4. ANSI A108 installation method indicated.
5. TCNA installation method indicated.

B. General Requirements:

1. Extend tile into recesses and under or behind equipment and fixtures to form a complete covering without interruptions unless otherwise indicated.
2. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
3. Accurately form intersections and returns.
4. Perform cutting and drilling of tile without marring visible surfaces.
5. Grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints, to form smooth edges.
6. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so that plates, collars, or covers overlap tile by not less than **1/8 in (3 mm)**.

C. Jointing Pattern:

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1. Unless otherwise indicated, lay tile in grid pattern.
2. Align joints when adjoining tiles on floor, base, walls, and trim are same size.
3. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting.
4. Provide uniform joint widths of size recommended by tile and grout manufacturer unless otherwise indicated.
5. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so that extent of each sheet is not apparent in finished work.

- D. Wainscots: Lay out tile to next full tile beyond dimensions indicated, and finish with bullnose shape.

3.3 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.
- B. Substrate Cleaning: Remove curing compounds, coatings, laitance, efflorescence, concrete dust, dirt, oil, gypsum board dust, paint, and other residue that would adversely affect or reduce bonding.
- C. Concrete Floor Preparation:
1. Prepare concrete floor substrates to comply with flatness tolerance of **1/4 in in 10 ft (6 mm in 3 m)** as follows:
 - a. Fill cracks, holes and depressions with trowelable cementitious underlayments and patching compounds.
 - b. Remove concrete protrusions, bumps, and ridges by sanding or grinding.
 2. If substrate does not have fine broom finish, mechanically scarify concrete substrates to not less than ICRI CSP 4 finish.
 3. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped **1/4 in per foot (1:50)** toward drains.
- D. Substrate Joints, Gaps, Penetrations, and Different Substrates within Shower and Tub Enclosures: Prior to installing tile, seal the following joints, gaps, and spaces between differing materials as follows:
1. Base of Wall Joints within Shower and Tub Enclosures: Apply wall joint sealant at joint between Coated Glass-Mat Water Resistant Board (specified in Division 09 Section "Gypsum Board Assemblies") and Tub Enclosure or Prefabricated Shower Receptor, Thick-set Mortar Bed, or floor slab to create water resistant barrier in accordance with TCNA Installation B420.
 2. Penetrations: Apply wall joint sealant at penetrations through wall substrates to create water resistant barrier; especially at piping and valve penetrations.
 3. Toilet Accessories: Apply wall joint sealant at fastener penetrations and around perimeter of backing plates to create water resistant barrier.

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4. Joints and Corners: Apply glass-fiber tape to joints and corners of substrates within Showers and Tub Enclosures with thin-set mortar.
 - E. Blending: Verify tile has been factory blended and packaged as specified; if not, either return to manufacturer or blend tiles at site before installing.
 - F. Field-Applied Temporary Protective Coating: Where needed to prevent grout from staining or adhering to exposed tile surfaces, pre-coat with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.
- 3.4 WATERPROOF MEMBRANE UNDERLAYMENT INSTALLATION
- A. Installation Quality Standard: ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness and bonded securely to substrate.
 - B. General Requirements:
 1. If required by manufacturer, prime concrete substrate.
 2. Install to produce a continuous waterproof membrane of uniform thickness bonded securely to substrate, without wrinkles, bubbles, buckles or kinks.
 3. For sheets, overlap and seal seams.
 4. Turn membrane up wall at locations where tile is scheduled for wall or base.
 5. Roll installed sheet if required by manufacturer.
 6. Install tile after waterproofing has cured and been tested determined it is watertight.
- 3.5 CRACK ISOLATION MEMBRANE UNDERLAYMENT INSTALLATION
- A. General Requirements:
 1. If required by manufacturer, prime concrete substrate.
 2. Install to produce a continuous crack isolation membrane of uniform thickness bonded securely to substrate, without wrinkles, bubbles, buckles, or kinks.
 3. For sheets, overlap and seal seams.
 4. For liquid applied products, brush or roll liquid uniformly over area in number of coats required and install reinforcing fabric.
 5. Roll installed sheet if required by manufacturer.
 6. After installation of tile, install floor joint sealant in tile joints recommended by manufacturer to coordinate with membrane strips.
- 3.6 TILE INSTALLATION
- A. Comply with TCNA's "Handbook for Ceramic Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
 - B. Installation Quality Standard: Install tile according to following standards:
 1. LHT Mortar: ANSI A108.5; for floor tiles larger than 8 in by 8 in (200 mm by 200 mm) or with at least one side greater than 15 in (375 mm) and where subfloor is not recessed.

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2. Thin-set Latex-Portland Cement Mortar: ANSI A108.5; for floor tiles **8 in by 8 in (200 mm by 200 mm)** and smaller where subfloor is not recessed; and for interior wall tiles.
 3. Latex-Portland Grout: ANSI A108.10, typical unless indicated otherwise.
- C. Back Buttering: For following installations, obtain minimum 95 percent mortar coverage as in referenced ANSI A108 series of installation standards:
1. Tile floors and ceilings in wet and limited water exposures.
 2. Tile floors composed of tiles **12 in by 12 in (300 mm by 300 mm)** or larger.
 3. Tile floors composed of rib-backed tiles.
- D. Grout Joint Widths: Install the respective types of tile with the following grout joint widths, unless otherwise recommended by tiling and grout manufacturers.
1. Ceramic Mosaic Tile - Less than **6 sq in (3900 mm²): 1/16 in (1.5 mm)**.
 2. Paver Tile - **6 sq in (3900 mm²) or More: 1/4 in (6 mm)**.
- E. Stone Thresholds: Install at locations indicated; set in same type of setting bed as abutting field tile, unless otherwise indicated. Where edge of mortar bed would be exposed, set in thin-set mortar.
- F. Metal Trim: Install at locations indicated and where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile.
- G. Grout Sealer: Apply grout sealer to cementitious grout joints in tile floors according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.
- 3.7 MOVEMENT JOINTS
- A. Movement Joints, General: Installation Quality Standard: In accordance with TCNA Movement Joint Design Essentials EJ171 and as specified below.
- B. Wall Joints: The following conditions shall not be grouted; install wall joint sealant and backer rod or backer tape:
1. Gypsum board assembly control joints.
 2. Building expansion joints, unless scheduled for expansion joint cover.
 3. Interior corners of tiled walls, including shower and bathtub walls.
 4. Around substrates and tile at penetrations through tiled substrates.
 5. At one side of changes in direction or plane of wall.
 6. At joint closest and parallel to changes in substrates supporting tile between wall and floor.
- C. Floor Joints:
1. General Requirements:
 - a. Continue construction, contraction (control), and expansion joints in building structure through tile work.
 - b. Isolate tile work that abuts a restraining structure or assembly.

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- c. When metal trim or sealant/backer is used for joint, width shall not be less than width of joint in building structure.
 - d. Tile shall not be placed over building expansion joints.
- 2. Schedule of Sealant Products and Locations:
 - a. Latex-Portland Cement Grouted Floors: Install floor joint sealant with backer rod at horizontal joints in mortar and grout setting conditions.
- 3. Interior Movement Joint Spacing: As indicated on Drawings and as specified below:
 - a. Tile Exposed to Direct Sunlight or Moisture: 8 ft to 12 ft (2.4 m to 3.6 m) on center each way.
 - b. Tile Not Exposed to Sunlight: 20 ft to 25 ft (6 m to 7.5 m) on center each way.
- D. Interior Floor Joint Installation Schedule: Seal interior floor movement joints, as defined by TCNA, according to following schedule:
 - 1. Construction Joints: Floor joint sealant and backer rod.
 - 2. Contraction (Control) Joints: Floor joint sealant and backer rod.
 - 3. Isolation Joints: Floor joint sealant and backer rod.
 - 4. Tile Expansion Joints: Floor joint sealant and backer rod.
 - 5. Perimeter Joints between Wall and Floors: Floor joint sealant with backer tape.

3.8 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Manufacturer's qualified technical representative shall periodically inspect Work to ensure installation is proceeding in accordance with manufacturer's designs, recommendations, instructions, and warranty requirements. Representative shall submit written reports of each visit indicating observations, findings, and conclusions of inspection.
 - 1. Manufacturer's Technical Representative Qualifications: Direct employee of technical services department of manufacturer with experience in providing recommendations, observations, evaluations, and problem diagnostics.

3.9 TESTING

- A. Shower Receptor Test: Where shower floors and receptors are made water-tight by the application of the waterproof membrane, the completed membrane installation shall be tested at each installation.
 - 1. The pipe from the shower drain shall be plugged and the receptor area shall be filled with water to a depth of not less than 2 in (50 mm) measured at the threshold.
 - 2. Where a threshold of adequate height does not exist a temporary threshold shall be constructed to retain the test water to the stated depth.
 - 3. The water shall be retained for a test period of not less than 24 hours, and there shall not be evidence of leakage.
 - 4. Report results of tests, both successful and unsuccessful. In addition to results, report shall include date of test, project name, list of products being applied and tested, name of applicator, name of Contractor, and conditions causing failure of waterproofing membrane in event of an unsuccessful test.

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5. Materials and installations failing to meet specified requirements shall be replaced at Contractor's expense. Retesting of materials and installations failing to meet specified requirements shall be done at Contractor's expense.

3.10 CLEANING

A. Cleaning:

1. Acids are not permitted, nor will they be allowed.
2. Clean tile surfaces so they are free of foreign matter.
3. Remove grout residue from tile as soon as possible.
4. No sooner than 10 days after installation, clean grout smears and haze from tile according to tile and grout manufacturer's written instructions. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned.
5. Protect metal surfaces and plumbing fixtures from effects of cleaning.
6. Flush surfaces with clean water before and after cleaning.
7. Remove temporary protective coating by method recommended by coating manufacturer that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent it from clogging drains.

3.11 DEMONSTRATION

- A. Cleaning and Maintenance Training: Provide instruction to Owner's personnel for cleaning and maintenance of installed work, including methods and frequency for maintaining optimum condition under anticipated use; include precautions against cleaning materials and methods which may be detrimental to finishes and performance.

3.12 PROTECTION

- A. Coverings: When recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.
- B. Traffic Restrictions: Prohibit foot and wheel traffic from tiled floors for at least 7 days after grouting is completed.

3.13 INTERIOR TILE INSTALLATION SCHEDULE

A. Floors, Concrete Substrate:

1. TCNA Installation Method F125A (Crack Isolation Membrane; full coverage): Thin-set Latex-Portland cement mortar over crack isolation membrane over concrete subfloor; Latex-Portland Cement Grout.
 - a. Location: Where scheduled in the Room Finish Schedule located on the drawings and in all thin-set tile locations which have neither waterproofing nor sound isolation scheduled.

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2. TCNA Installation Method F122 (Waterproof Membrane): Thin-set Latex-Portland cement mortar over waterproof membrane over concrete subfloor; Latex-Portland Cement Grout.
 - a. Location: As scheduled in the Room Finish Schedule located on the drawings.
- B. Walls, Gypsum Board Substrate:
 1. TCNA Installation Method W243: Thin-set Latex-Portland cement mortar over coated-glass-mat gypsum board; Latex-Portland Cement Grout.
- C. Walls, Gypsum Board Substrate, Bathtub / Shower Surfaces:
 1. Walls, Including Tub Unit or Pre-Fabricated Shower Receptors: TCNA Installation Method B419 (Waterproof Membrane): Thin-set Latex-Portland cement mortar over waterproof membrane over coated-glass-mat gypsum board; Latex-Portland Cement Grout.
 2. Shower Receptors: TCNA Installation Method B420 (Waterproof Membrane): Thin-set Latex-Portland cement mortar over waterproof membrane over coated-glass-mat gypsum board walls and concrete subfloors; Latex-Portland Cement Grout.

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SECTION 09 5113

ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Acoustical lay-in ceiling panels, exposed metal suspension systems, and supplementary items necessary for installation.

1.2 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
 - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
- B. Product Schedule: Use same designations indicated on the Finish Schedule and Drawings.
- C. Samples for Verification Purposes: Full-size units of each type of ceiling assembly indicated; in sets for each color, texture, and pattern specified, showing the full range of variations expected in these characteristics.
 - 1. Acoustical Panels: Set of 6 in (150 mm) square samples of each type, color, pattern, and texture.
 - 2. Exposed Suspension-System Members, Moldings, and Trim: Set of 12 in (300 mm) long samples of each type, finish, and color.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Written reports based on evaluation of comprehensive tests performed by qualified testing agency indicating that each product complies with requirements.
- B. Qualification Data:
 - 1. For firms and persons specified in "Quality Assurance" to demonstrate their capabilities and experience. Include list of completed projects.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: To include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Materials: Furnish the following extra materials that match and are from same production runs as products installed, packaged with protective covering for storage and identified with labels describing contents:
 - 1. Acoustical Ceiling Panels: Full-size units equal to 2 percent of amount installed.

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2. Suspension System Components: Quantity of each exposed component equal to 2 percent of amount installed.

1.6 PRE-INSTALLATION CONFERENCE

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.9 COORDINATION

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".
 1. Armstrong World Industries, Inc.
 2. CertainTeed Corporation.
 3. Chicago Metallic / Rockfon.
 4. Lindner Ceiling Systems.
 5. OWA USA.
 6. USG Interiors, Inc.; Subsidiary of USG Corporation.
- B. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other manufacturers offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.

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2.2 MATERIALS, GENERAL

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.
 - 1. Obtain both acoustical ceiling panels and suspension system from the same manufacturer if both are offered by the manufacturer.

2.3 PERFORMANCE REQUIREMENTS

- A. General Performance: Products and systems shall be engineered to withstand loads within limits of allowable working stresses of the materials involved under conditions indicated and without permanent deformation or failure of materials.
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.
 - 2. Smoke-Developed Index: 450 or less.
- C. [Seismic Standards](#): Provide acoustical panel ceilings designed and installed to withstand the effects of earthquake motions according to the following:
 - 1. Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with ASTM E 580.

2.4 ACOUSTICAL PANELS, GENERAL

- A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectance's, unless otherwise indicated.
 - 1. Selections: As scheduled or as indicated in Design Selections.

2.5 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635/C 635M.
- B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.
 - 1. High-Humidity Finish: Comply with ASTM C 635/C 635M requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.
- C. Attachment Devices: Size for five times design load indicated in ASTM C 635/C 635, Table 1, "Direct Hung", unless otherwise indicated.
 - 1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops

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for attaching hangers and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing per ASTM E 488/E 488M or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.

- a. Cast-in-place anchors, designed for attachment to concrete.
 - b. Post-installed expansion anchors.
 - c. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 for Class SC1 service condition.
2. Powder-Actuated Anchors: Suitable for application indicated, ANSI A10.3; low velocity, powder-actuated fasteners; drive pins and clip angles fabricated from corrosion-resistant materials, with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, an ultimate load capacity not less than 10 times that imposed by construction as determined by testing according to ASTM E 1190 by a qualified independent testing agency.
- a. Manufacturers:
 - 1) Construction Materials, Inc.
 - 2) Heckman Building Products, Inc.
 - 3) Hilti Corp.
 - 4) ITW Ramset/Red Head.
 - 5) Powers Fasteners.
 - 6) Simpson Strong Tie Anchor Systems.
3. For post-tensioned concrete, anchors shall not exceed **1 in (25 mm)** embedment. Obtain Structural Engineer's written approval for all proposed anchors in post-tensioned concrete prior to installation.

D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:

1. Wire:
 - a. Zinc-Coated Carbon-Steel Wire: ASTM A 641 / A 641M, Class 1 zinc coating, soft temper.
2. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than **0.106 in (2.69 mm)** diameter wire.

E. Edge Moldings and Trim: Manufacturer's standard moldings for edges and penetrations that fit acoustical panel edge details and suspension systems indicated; formed from sheet metal of same material and finish as that used for exposed flanges of suspension system runners.

1. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
2. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
3. For narrow-face suspension systems, provide suspension system and manufacturer's standard edge moldings that match width and configuration of exposed runners.

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4. Where required by Code or authorities having jurisdiction, provide **2 in (50 mm)** wide wall angle around the ceiling perimeter in Seismic Design Categories D, E, and F.

F. Specialty Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements.

1. Baked-Enamel or Powder-Coat Finish: Minimum dry film thickness of **1.5 mils (0.04 mm)**. Comply with ASTM C 635/C 635M and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
2. Basis of Design (Product Standard) Manufacturer and Product: Armstrong World Industries, Inc.; Axiom series, with manufacturer's 30 year warranty.

2.6 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILINGS

A. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653 / A 653M, not less than G30 (Z90) coating designation, with prefinished **15/16 in (24 mm)** wide metal caps on flanges.

1. Structural Classification: Heavy-duty system.
2. End Condition of Cross Runners: Override (stepped) type.
3. Face Design: Flush face.
4. Cap Material: Steel sheet.
5. Cap Finish: Painted white, unless indicated otherwise.
6. Manufacturers and Products:
 - a. Armstrong World Industries, Inc.; Prelude XL.
 - b. CertainTeed Corporation; Classic Stab.
 - c. Chicago Metallic Corporation; 1200 System.
 - d. USG Interiors, Inc.; Donn DX.

B. Wide-Face, Capped, Double-Web, Hot-Dip Galvanized, G60 (Z180), Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, hot-dip galvanized according to ASTM A 653 / A 653M, G60 (Z180) coating designation, with prefinished, cold-rolled, 15/16 in (24 mm) wide, aluminum caps on flanges.

1. Structural Classification: Heavy-duty system, standard of manufacturer.
2. End Condition of Cross Runners: Override (stepped) type.
3. Face Design: Flush face.
4. Cap Material: Aluminum sheet.
5. Cap Finish: Painted white, unless indicated otherwise.
6. Cap Finish: Clear anodized.
7. Manufacturers and Products:
 - a. Armstrong World Industries Inc.; Prelude Plus XL Fire Guard.
 - b. CertainTeed Corporation; FireSecure 15/16" Classic Environmental Stab System.
 - c. Chicago Metallic Corporation; 1830 HDG-60 Steel with Aluminum Cap.
 - d. USG Interiors Inc.; ZXLA.

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PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

3.2 INSTALLATION, GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
 - 1. ASTM C 636 / C 636M.
 - 2. Respective manufacturer's written installation instructions.
 - 3. Accepted submittals.
 - 4. Contract Documents.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by isolating metals and other materials from direct contact with incompatible materials.

3.3 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.
- B. Coordination: Furnish layouts for cast-in-place anchors, clips, and other ceiling anchors. Furnish cast-in-place anchors and similar devices to other trades for installation well in advance of time needed for coordinating other work.
- C. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.4 INSTALLATION OF ACOUSTICAL PANEL CEILINGS

- A. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with mechanical and electrical equipment, insulation, or other objects within ceiling plenum that are not part of supporting structural frame or ceiling suspension system. Within limitations allowed by installation quality standards, splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by installation

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- quality standards.
3. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 4. Do not support ceilings directly from permanent metal forms. Fasten hangers to cast-in-place hanger inserts, power-actuated fasteners, or drilled-in anchors that extend through forms into concrete.
 5. Do not attach hangers to steel deck tabs.
 6. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 7. Space hangers not more than 48 in (1200 mm) on center along each member supported directly from hangers, unless otherwise indicated; and provide hangers not more than 8 in (200 mm) from ends of each member.
 8. Do not connect or suspend any ceiling components from ducts, pipes or conduit.
 9. Do not make local kinks or bends in hanger wires as a means of leveling.
- B. Install edge moldings and trim at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
1. Screw attach moldings to substrate at intervals not more than 16 in (400 mm) on center and not more than 3 in (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 in per 12 ft (3 mm per 3.6 m). Miter corners accurately and connect securely.
 2. Do not use exposed fasteners, including pop rivets, on moldings and trim.
 3. Provide control joints where joints occur in abutting surfaces.
 4. Hold tees in place with concealed clips.
- C. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
1. Space steel main runners at 48 in (1200 mm) on center.
- D. Install acoustical panels with undamaged edges and fitted accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
1. Arrange directionally patterned acoustical panels with pattern running in one direction parallel to long axis of space.
 2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.
 3. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 4. For reveal-edged panels on suspension system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension system surfaces and panel faces flush with bottom face of runners.
 5. Paint cut panel edges remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.

3.5 PROTECTION

- A. Protect products and systems from damage during installation and remainder of construction

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period according to manufacturer's instructions.

3.6 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

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SECTION 096500
RESILIENT FLOORING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Resilient flooring products and systems and supplementary items necessary for installation.
 - 1. Resilient tile flooring.
 - 2. Resilient sheet flooring.
 - 3. Luxury vinyl tile flooring.
- B. Related Section:
 - 1. Resilient wall base, reducer strips, and other accessories installed with resilient flooring are specified in Division 09 Section "Resilient Base and Accessories".

1.2 ALLOWANCES

- A. Concrete Moisture Barrier Allowance: Include allowance to provide Concrete Moisture Barrier Floor Treatment to concrete floor decks.

1.3 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
 - 1. Include manufacturer's specifications for materials, finishes, recommended adhesives, construction details, installation instructions, and recommendations for maintenance.
- B. Shop Drawings for Special Patterns: Show layout and details of special patterns for resilient flooring.
- C. Product Schedule: Use same designations indicated on the Finish Schedule and Drawings.
- D. Samples for Verification Purposes: In manufacturer's standard size, but not less than 6 in by 9 in (150 mm by 230 mm) sample of each different color and pattern of resilient flooring product specified, showing the full range of variations expected in these characteristics. Label each sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in Schedules.
 - 1. Heat-Welded Sheet Flooring: For heat-welding bead, manufacturer's standard-size samples, but not less than 9 in (225 mm) long, of each color specified.
 - 2. Seam Samples for Sheet Flooring: For each color and pattern of resilient sheet flooring product required; with seam running lengthwise and in center of 6 in by 9 in (150 mm by 230 mm) sample applied to a rigid backing and prepared by installer for this Project.

1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Project Acceptance Document: Certification by the manufacturer that its product(s) are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required.
 - 1. Product Compatibility: On installations incorporating products provided by more than one manufacturer, each manufacturer's certificate shall include specific reference to and approval of the other manufacturer's products.

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1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Instructions: Include in operation and maintenance manual as required by Division 01 Section "Closeout Procedures". Submit manufacturer's instructions for maintenance of installed work, including methods and frequency for maintaining optimum condition under anticipated use. Include precautions against cleaning materials and methods which may be detrimental to finishes and performance.

1.6 QUALITY ASSURANCE

- A. Slip Resistance: Provide products identical to those tested for slip resistance per ASTM D 2047 with a static coefficient of friction not less than 0.6 for level surfaces and 0.8 for ramped surfaces.
- B. Fire-Test-Response Characteristics: Provide products with the following fire-test-response characteristics as determined by testing identical products per test method indicated below by a testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Critical Radiant Flux: Class I, 0.45 W/sq. cm or greater when tested per ASTM E 648.
 - 2. Smoke Density: Maximum specific optical density of 450 or less when tested per ASTM E 662.

1.7 PRE-INSTALLATION CONFERENCE

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.
 - 1. Participants:
 - a. Architect.
 - b. Contractor, including superintendent.
 - c. Installer, including project manager and supervisor.
 - d. LVT manufacturer's qualified technical representative for each product specified
 - e. Installers of other construction interfaced with Work.
 - 2. Minimum Agenda: Installer shall demonstrate understanding of the Work required by describing detailed procedures for preparing, installing, and cleaning the Work. Demonstration shall include, but not be limited to, following topics:
 - a. Tour representative areas of Work, inspect and discuss condition of substrate, and other preparatory work performed by other trades.
 - b. Review Contract Document requirements.
 - c. Review approved submittals.
 - d. Review inspection and testing requirements.
 - e. Review environmental conditions and procedures for coping with unfavorable conditions.
 - f. Resolve deviations or differences between Contract Documents and the manufacturer's specifications.
 - 3. Record discussions, including decisions and agreements, and prepare report.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store flooring products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 85 deg F (29 deg C).
 - 1. Resilient Tile Flooring: Store floor tiles on flat surfaces.
 - 2. Resilient Sheet Flooring: Store sheet flooring rolls upright.

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1.9 PROJECT CONDITIONS

- A. Unless otherwise approved in writing by the manufacturer, do not begin flooring installation unless permanent building HVAC system is operational and capable of maintaining relative humidity and temperature of not less than 70 deg F (21 deg C) or more than 85 deg F (29 deg C) for at least 48 hours before installation, during installation, and after installation.
 - 1. Maintain relative humidity of not more than the designed relative humidity for spaces to receive flooring.
- B. Maintain flooring products prior to installation at the same temperature as the space where they are to be installed.
- C. Close spaces to traffic during flooring installation and for time period after installation recommended by manufacturer.
- D. Install flooring products after other finishing operations, including painting, have been completed.
- E. Do not install flooring over concrete substrates until slabs have cured and are sufficiently dry to bond with adhesive, as determined by flooring manufacturer's recommended tests. Refer to "Preparation" Article for requirements.

1.10 COORDINATION

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

1.11 WARRANTY FOR LUXURY VINYL TILE

- A. Manufacturer's Warranty: Furnish manufacturer's written material and labor warranty signed by an authorized representative using manufacturer's standard form agreeing to furnish materials and labor required to repair or replace work which exhibits material defects caused by manufacture or design and installation of product. "Defects" are defined to include but not limited to deterioration or failure to perform as required.
 - 1. Guestrooms Warranty Period: Manufacturer shall warrant the products to be free from material and labor Defects for a period of 20 years from date of Substantial Completion.
 - 2. Public Areas Warranty Period: Manufacturer shall warrant the products to be free from material and labor Defects for a period of 10 years from date of Substantial Completion.
- B. Installers Warranty: Furnish installer's written workmanship warranty signed by an authorized representative using installers standard form agreeing to provide labor required to repair or replace work which exhibits workmanship defects. "Defects" is defined to include but not limited to deterioration or failure to perform as required.
 - 1. Warranty Period: Installer shall warrant the installation to be free from workmanship Defects for a period of 2 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".
- B. Manufacturers:

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1. Vinyl Flooring:
 - a. Altro Group.
 - b. Armstrong World Industries, Inc.
 - c. Congoleum Corporation.
 - d. Forbo Flooring, Inc.
 - e. Gerflor, Architectural Floor Systems, Inc.
 - f. Lonseal, Inc.
 - g. Mannington Mills, Inc.
 - h. Tarkett, Inc.
 2. Rubber Flooring
 - a. AB; American Biltrite.
 - b. Flexco.
 - c. Nora Systems, inc.
 - d. PRF USA, Inc.
 - e. R.C.A. Rubber Company (The).
 - f. VPI, LLC, Floor Products Division.
 3. Linoleum Flooring:
 - a. Armstrong World Industries, Inc.
 - b. Forbo Industries, Inc.
 - c. Johnsonite; A Tarkett Company.
- C. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other manufacturers offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.
1. Selections: As scheduled or as indicated in Design Selections.
- 2.2 MATERIALS, GENERAL
- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.
- 2.3 RESILIENT TILE FLOORING MATERIALS
- A. Vinyl Composition Floor Tile Standard: ASTM F 1066, Class 2, through-pattern tile, unless otherwise indicated.
1. Size: 12 in by 12 in by 0.125 in (300 mm by 300 mm by 3 mm).
- B. Solid Vinyl Floor Tile Standard: ASTM F 1700, Class 1, monolithic vinyl tile, unless otherwise indicated.
1. Size: 12 in by 12 in by 0.125 in (300 mm by 300 mm by 3 mm).
- C. Linoleum Floor Tile Standard: ASTM F 2195, Type I, linoleum floor tile with fibrous backing, unless otherwise indicated.
1. Size: 12 in by 12 in by 0.125 in (300 mm by 300 mm by 3 mm).
- D. Rubber Floor Tile: ASTM F 1344, Class I, unless otherwise indicated.
1. Size: 12 in by 12 in by 0.125 in (300 mm by 300 mm by 3 mm).

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2.4 RESILIENT SHEET FLOORING MATERIALS

- A. Vinyl Sheet Floor Coverings: ASTM F 1303, Type I or II, Grade 1, Class A (fibrous) or B (nonfoamed plastic) backing or ASTM F 1913 unbacked as required by product selection.
- B. Rubber Sheet Floor Coverings: ASTM F 1859, Type I (homogeneous rubber sheet).
- C. Sheet Linoleum Floor Coverings: Consisting of oxidized linseed or other vegetable drying oil and rosin, mixed with ground cork or wood flour, mineral filler, and pigments. Mixture is bonded and keyed to burlap (jute) or other suitable fibrous backing to that backing is partially embedded in mixture. Patterns and colors extend through entire floor covering thickness.
- D. Sheet Flooring Thickness: 0.125 in (3 mm).
- E. Heat-Welding Seam Bead: Solid-strand product of floor covering manufacturer for heat welding seams.
 - 1. Selections: As scheduled or as indicated in Design Selections.
- F. Integral Cove Base Accessories: Resilient accessories recommended by flooring manufacturer with selections as follows:
 - 1. Basis of Design: Burke Mercer Flooring Products; Division of Burke Industries, Inc.
 - a. Cap Strip: No. 040 round vinyl cap.
 - b. Cove Strip: No. 070 flexible vinyl cove stick with nominal 1 in (25 mm) radius.
 - c. Reducer: No. 633 vinyl reducer, 1 in (25 mm) wide by 1/8 in (3 mm) high.

2.5 LUXURY VINYL TILE FLOORING MATERIALS

- A. LVT Class: ASTM F1700 Composition of Material: Class III Printed Film Vinyl Plank or Tile, Type B (Embossed).
 - 1. Size and Squareness: ASTM F 2055, plus or minus 0.016-inch per linear foot in size and less than 0.010-inch for squareness.
 - 2. Overall Thickness: 0.1875-inch (4 mm and thicker).
 - a. Wear Layer Thickness: ASTM F386, plus or minus 0.020-inch (0.5 mm).
 - 3. Backing Class: Commercial Grade.
 - 4. Dimensional Stability: ASTM F2199, less than 0.020-inch per linear foot.
 - 5. Residual Indentation: ASTM 1914, less than 8 percent total thickness.
 - 6. Flexibility: ASTM F137, less than 1.0-inch diameter, no cracks or breaks.
 - 7. Chemical Resistance: ASTM F 925, no more than slight change in surface dulling, attack or color change.
 - 8. Heat resistance: ASTM F1514, less than 8 color change.
 - 9. Light Resistance: ASTM F1515, less than 8 color change.
 - 10. Static Load Limit: ASTM F 970, 750 psi minimum.
- B. Floor Assembly Sound Reduction Requirements: Sound reduction membrane underlayments shall contribute to achieving following ratings in floor assemblies when tested by qualified independent testing agency acceptable to authorities having jurisdiction.
 - 1. In addition to laboratory test, the installation shall be field tested to determine the acoustic performance:
 - a. Sound Transmission Class (STC): Not less than 60 according to ASTM E 90.
 - b. Laboratory Impact Insulation or Isolation Class (IIC): Not less than 57 according to ASTM E 492.

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- c. Field Impact Insulation or Isolation Class (AIIC): Not less than 53 according to ASTM E 1007, Standard Test Method for Field Measurement of Tapping Machine Impact Sound Transmission Through Floor-Ceiling Assemblies and Associated Support Structures.
- d. Sound reduction underlayment may be a separate component as recommended by the LVT flooring manufacturer and compatible with the LVT flooring material or the underlayment may be a composite component integral to the LVT flooring material

2.6 ACCESSORY MATERIALS

- A. Concrete Slab Primer: Non-staining type as recommended by flooring manufacturer.
- B. Trowelable Leveling and Patching Compounds: Latex-modified, Portland-cement-based formulation provided or approved by flooring manufacturer for products and applications indicated.
- C. Adhesives: Water-resistant type recommended by flooring manufacturer suitable for products, applications, and substrate conditions indicated.
 - 1. Product Compatibility: Provide Manufacturer's written recommendation for each product within an assembly. On installations incorporating products provided by more than one manufacturer, each manufacturer shall approve in writing all adhesives that are in contact with their products.
- D. Concrete Moisture Barrier Floor Treatment:
 - 1. Epoxy-Based Moisture Barrier Floor Treatment: Two-component, high-performance, non-flammable, rapid drying, water based, low odor, low VOC, two-component, penetrating epoxy; formulated to reduce moisture vapor transmission and surface alkalinity from concrete substrates, including aged or freshly placed ("green") concrete, prior to installation of impervious glued-down finish flooring specified in other Division 09 sections.
 - a. Basis of Design (Product Standard): Bostik, Inc.; D-250.
 - 2. Cementitious Overcoat: Fast-setting latex-fortified Portland cement skim coating intended for interior uses.
 - a. Basis of Design (Product Standard): Bostik, Inc.; Webcrete 95.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

3.2 INSTALLATION, GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
 - 1. Respective manufacturer's written installation instructions.
 - 2. Accepted submittals.
 - 3. Contract Documents.

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3.3 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.
- B. Concrete Substrates: Prepare according to ASTM F 710.
 - 1. Verify that concrete substrate finishes comply with requirements specified in Division 03 Section "Concrete Finishing" for concrete substrates receiving resilient flooring.
 - 2. Verify that concrete substrates are free of cracks, ridges, depressions, scale, and foreign deposits.
 - 3. Verify that concrete substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Unless concrete has been water-cured, then proceed with the following:
 - a. Bead-blast concrete substrate with an apparatus that abrades the surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
 - b. Repair damaged and deteriorated concrete according to flooring manufacturer's written recommendations.
 - 4. Determine adhesion and dryness characteristics by performing the following tests as recommended by flooring manufacturer.
 - 5. Alkalinity and Adhesion Testing: Perform tests recommended by flooring manufacturer. A pH range of 5 to 9 is required when substrate is wetted with distilled water and pHHydron paper is applied. Proceed with installation only after concrete substrates pass testing.
 - 6. Moisture Testing: Perform one or both of the following tests as recommended by flooring manufacturer. Perform 3 moisture tests for first 1000 sf (92.9 sm) of concrete substrate scheduled to receive flooring and 1 test for each additional 1000 sf (92.9 sm) or fraction thereof. Proceed with installation only after concrete substrates pass testing.
 - a. Perform anhydrous calcium chloride test in accordance with ASTM F 1869. Proceed with installation only after concrete substrates have maximum moisture-vapor-emission rate of 3 lbs of water/1000 sf (1.36 kg of water/92.9 sm) in 24 hours.
 - b. Perform relative humidity test using in situ probes in accordance with ASTM F 2170. Proceed with installation only after concrete substrates have a maximum 75 percent relative humidity level measurement.
 - 7. Moisture Barrier Floor Treatment: For concrete substrates not meeting moisture test standards specified above, apply epoxy-based moisture floor treatment and cementitious overcoat to concrete substrate in accordance with manufacturer's written instructions.
- C. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.
- D. Broom and vacuum clean substrates to be covered immediately before flooring product installation. After cleaning, reexamine substrates for moisture, alkaline salts, carbonation, or dust. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.4 INSTALLATION OF RESILIENT FLOORING, GENERAL

- A. Apply concrete slab primer, if recommended by flooring manufacturer, prior to applying adhesive. Apply according to manufacturer's directions.

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- B. Scribe, cut, and fit flooring to butt neatly and tightly to vertical surfaces and permanent fixtures, including built-in furniture, cabinets, pipes, outlets, edgings, door frames, thresholds, and nosings.
- C. Extend flooring into toe spaces, door reveals, closets, and similar openings. Extend flooring to center of door openings.
- D. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on substrate. Use chalk or other nonpermanent, non-staining marking device.
- E. Adhere flooring to substrates using a full spread of adhesive applied to substrate to comply with flooring manufacturer's written instructions, including those for trowel notching, adhesive mixing, and adhesive open and working times.
 - 1. Provide completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- F. Hand-roll flooring in both directions from center out to embed flooring in adhesive and eliminate trapped air according to manufacturer's written instructions. At walls, door casings, and other locations where access by roller is impractical, press flooring firmly in place with flat-bladed instrument.

3.5 INSTALLATION OF RESILIENT TILE FLOORING

- A. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half of a tile at perimeter.
- B. Match tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Cut tiles neatly around all fixtures. Discard broken, cracked, chipped, or deformed tiles.
 - 1. Lay tiles square with room axis, unless otherwise indicated.
 - 2. Lay tiles with grain running in one direction, unless otherwise indicated.
- C. Access Flooring Panel Substrate: Do not install tile over panel substrate seams.

3.6 INSTALLATION OF RESILIENT SHEET FLOORING

- A. Unroll sheet flooring and allow it to stabilize before cutting and fitting, if recommended in writing by manufacturer.
- B. Lay out sheet flooring to comply with the following requirements:
 - 1. Maintain uniformity of sheet flooring direction.
 - 2. Arrange for a minimum number of seams and place them in inconspicuous and low-traffic areas, and not less than 6 in (150 mm) away from parallel joints in flooring substrates.
 - 3. Match edges of sheet flooring for color shading and pattern at seams according to manufacturer's written recommendations.
 - 4. Avoid cross seams.
- C. Integral Cove Base: Form integral cove base by flashing sheet flooring up vertical surfaces. Support flooring at horizontal and vertical junction with cove strip. Butt flooring at top of base against cap strip.
- D. Heat-Welded Seams: Rout joints and heat weld with welding bead, permanently fusing sections into seamless flooring. Prepare, weld, and finish seams according to manufacturer's written instructions and ASTM F 1516 to produce surfaces flush with adjoining flooring surfaces.

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- E. Access Flooring Panel Substrate: Install cement board substrate over access flooring panel substrate before installation of resilient flooring.

3.7 INSTALLATION OF LUXURY VINYL FLOORING, GENERAL

- A. Apply concrete slab primer, if recommended by LVT flooring manufacturer, prior to applying adhesive. Apply according to manufacturer's directions.
- B. Scribe, cut, and fit flooring and underlayment to allow for thermal movement to gap to vertical surfaces and permanent fixtures, including built-in furniture, cabinets, pipes, outlets, edgings, door frames, thresholds, and nosings.
- C. Extend flooring into toe spaces, door reveals, closets, and similar openings. Extend flooring to center of door openings.
- D. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on substrate. Use chalk or other nonpermanent, non-staining marking device.
- E. Where floating installation is indicated or required, maintain a minimum 5/16 inch expansion around perimeter of the room.
- F. Where adhered installation is indicated or required, adhere flooring components to substrates using a full spread of adhesive applied to substrate to comply with flooring manufacturer's written instructions, including those for trowel notching, adhesive mixing, and adhesive open and working times.
 - 1. Provide completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- G. Hand-roll flooring in both directions from center out to embed flooring in adhesive and eliminate trapped air according to manufacturer's written instructions. At walls, door casings, and other locations where access by roller is impractical, press flooring firmly in place with flat-bladed instruments.

3.8 CLEANING AND PROTECTING

- A. Perform the following operations immediately after installing flooring products:
 - 1. Remove adhesive and other surface blemishes from exposed surfaces using cleaner recommended by flooring manufacturer.
 - 2. Sweep or vacuum floor thoroughly.
 - 3. Do not wash floor until after time period recommended by flooring manufacturer.
 - 4. Damp-mop floor to remove marks and soil.
- B. Protect flooring against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods recommended in writing by flooring manufacturer.
 - 1. Cover products installed on floor surfaces with undyed, untreated building paper until just prior to Substantial Completion.
 - 2. Do not move heavy and sharp objects directly over floor surfaces. Place plywood or hardboard panels over flooring and under objects while they are being moved. Slide or roll objects over panels without moving panels.
 - 3. Apply two coats.

3.9 RESILIENT FLOORING SCHEDULE

- A. Vinyl Composition Tile:

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1. VCT01:
 - a. Manufacturer:
 - b. Pattern:
 - c. Size:
 - d. Color Selection:
 2. Selections: As selected by Architect from full range of industry colors.
- B. Solid Vinyl Tile:
1. VT01:
 - a. Manufacturer:
 - b. Pattern:
 - c. Size:
 - d. Color Selection:
- C. Rubber Floor Tile:
1. RT01:
 - a. Manufacturer:
 - b. Pattern:
 - c. Size:
 - d. Color Selection:
- D. Linoleum Floor Tile:
1. LT01:
 - a. Manufacturer:
 - b. Pattern:
 - c. Size:
 - d. Color Selection:
- E. Sheet Vinyl Flooring:
1. SHV01:
 - a. Manufacturer:
 - b. Product:
 - c. Color Selection:
 - d. Seam Treatment: Heat-weld.
 - e. Seam Treatment: Chemical-bonded
 - f. Base: Integral, 6 in (150 mm) high
 - g. Base: Separate; refer to Division 09 Section "Resilient Base and Accessories."
 - h. Welding Rod Color: As selected by Architect from full range of industry colors.
 - i. Welding Rod Color: Match field color of sheet floor covering.
 - j. Welding Rod Color:
- F. Sheet Rubber Flooring:
1. SHR01:
 - a. Manufacturer:
 - b. Product:
 - c. Color Selection:

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- d. Seam Treatment: Heat-weld.
- e. Seam Treatment: Chemical-bonded
- f. Base: Integral, 6 in (150 mm) high
- g. Base: Separate; refer to Division 09 Section "Resilient Base and Accessories."
- h. Welding Rod Color: As selected by Architect from full range of industry colors.
- i. Welding Rod Color: Match field color of sheet floor covering.
- j. Welding Rod Color:

G. Sheet Linoleum Flooring:

1. SHL01:

- a. Manufacturer:
- b. Product:
- c. Color Selection:
- d. Seam Treatment: Heat-weld.
- e. Seam Treatment: Chemical-bonded
- f. Base: Integral, 6 in (150 mm) high
- g. Base: Separate; refer to Division 09 Section "Resilient Base and Accessories."
- h. Welding Rod Color: As selected by Architect from full range of industry colors.
- i. Welding Rod Color: Match field color of sheet floor covering.
- j. Welding Rod Color:

H. Luxury Vinyl Tile:

1. LVT01:

- a. Manufacturer: Shaw Contract; Hard Surface.
- b. Pattern: Quitecover #1086V Wood Look Floating Vinyl Plank
- c. Size: 7' x 48" Plank.
- d. Color Selection: Cottonwood.
- e. Acoustic Underlayment: Shaw Groundworks Acoustical Underlayment

END OF SECTION

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SECTION 096513
RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Resilient wall base, resilient flooring accessories, and supplementary items necessary for installation.

1.2 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
 - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
- B. Product Schedule: Use same designations indicated on the Finish Schedule and Drawings.
- C. Samples for Verification Purposes: In manufacturer's standard size, but not less than 12 in (300 mm) sample of each different color and pattern of resilient product specified, showing the full range of variations expected in these characteristics.

1.3 CLOSEOUT SUBMITTALS

- A. Maintenance Data: To include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Provide products with the following fire-test-response characteristics as determined by testing identical products per test method indicated below by a testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Critical Radiant Flux: Class I, 0.45 W/sq. cm or greater when tested per ASTM E 648.
 - 2. Smoke Density: Maximum specific optical density of 450 or less when tested per ASTM E 662.

1.5 PRE-INSTALLATION CONFERENCE

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by product manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1.7 PROJECT CONDITIONS

- A. Maintain a temperature of not less than 70 deg F (21 deg C) or more than 85 deg F (29 deg C) in spaces to receive resilient products for at least 48 hours before installation, during installation, and for at least 48 hours after installation, unless otherwise recommended by product manufacturer.
- B. Maintain resilient products prior to installation at the same temperature as the space where they are to be installed.
- C. Close spaces to traffic during installation and for time period after installation recommended by manufacturer.

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- D. Install resilient products after other finishing operations, including painting, have been completed.
- E. Resilient Stair Accessories: Do not install resilient stair accessories over concrete substrates until slabs have cured and are sufficiently dry to bond with adhesive, as determined by resilient accessory manufacturer's recommended tests. Refer to "Examination" Article for requirements.

1.8 COORDINATION

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".
- B. Manufacturer:
 - 1. Armstrong World Industries, Inc.
 - 2. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
 - 3. Endura Rubber Flooring; Division of Burke Industries, Inc.
 - 4. Flexco, Inc.
 - 5. Johnsonite.
 - 6. Mondo Rubber International, Inc.
 - 7. Musson, R. C. Rubber Co.
 - 8. Nora Rubber Flooring; Freudenberg Building Systems, Inc.
 - 9. Roppe Corporation, USA.
- C. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other manufacturers offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.
 - 1. Selections: As scheduled or as indicated in Design Selections.

2.2 MATERIALS, GENERAL

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

2.3 RESILIENT MATERIALS

- A. Rubber Wall Base:
 - 1. Standard: ASTM F 1861, Type TS (rubber, vulcanized thermoset) or TP (rubber, thermoplastic), Group 1 and 2.
 - 2. Thickness: Nominal 1/8 in (3 mm).
 - 3. Lengths: Provide longest length(s) available per manufacturer. Provide coils if available in profile(s) indicated.
 - 4. Outside and Inside Corners:
 - a. Job-formed.
 - b. Pre-formed.

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B. Resilient Molding Accessories:

1. Carpeting Accessories: Carpet cove cap, carpet step-off, carpet reducer, carpet edge bar.
2. Resilient Flooring Accessories: Reducer strip and others as required.
3. Material: Rubber.
4. Lengths: Provide longest length(s) available per manufacturer. Provide coils if available in profile(s) indicated.
5. Color and finish as selected by Architect from manufacturer's standard colors.

C. Resilient Stair Accessories:

1. Standard: ASTM F 2169, Type TS (rubber, vulcanized thermoset) or TP (rubber, thermoplastic), Class 1 and 2.
2. Rubber Stair Treads:
 - a. Nosing Style: Square, adjustable to cover angles between 60 and 90 degrees.
 - b. Nosing Height: 1-1/2 in (38 mm) to 2 in (50 mm).
 - c. Thickness: 1/4 in (6 mm) at nosing, tapered to 1/8 in (3 mm).
 - d. Size: Lengths and depths to fit each stair tread in one piece or, for treads exceeding maximum lengths manufactured, in equal-length units.
 - e. Manufacturing Method: Group 1, tread with embedded abrasive strips; and Group 2, tread with contrasting color for the visually impaired; as selected by Architect.
3. Risers: Smooth, flat, coved-toe, 1/4 in (6 mm) thick by 7 in (175 mm) high by length matching treads produced by same manufacturer as treads and recommended by manufacturer for installation with treads.
4. Stringers: Of same thickness as risers, height and length after cutting to fit risers and treads and to cover stair stringers; produced by same manufacturer as treads and recommended by manufacturer for installation with treads.

2.4 ACCESSORY MATERIALS

A. Adhesives: Water-resistant type recommended by product manufacturer suitable for products, applications, and substrate conditions indicated.

B. Resilient Stair Accessory Materials:

1. Concrete Slab Primer: Non-staining type as recommended by product manufacturer.
2. Trowelable Leveling and Patching Compounds: Latex-modified, Portland cement based formulation provided or approved by product manufacturer for products and applications indicated.
3. Stair Tread-Nose Filler: Two-part epoxy compound recommended by rubber stair tread manufacturer to fill nosing substrates that do not conform to tread contours.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.
- B. Concrete Substrates for Resilient Stair Accessories: Prepare according to ASTM F 710.

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1. Verify that concrete substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing the following tests as recommended by resilient accessory manufacturer.
2. Verify that concrete substrate finishes comply with requirements specified in Division 03 Section "Concrete Finishing" for concrete substrates receiving resilient flooring.
3. Verify that concrete substrates are free of cracks, ridges, depressions, scale, and foreign deposits.
4. Alkalinity and Adhesion Testing: Perform tests recommended by resilient accessory manufacturer. A pH range of 5 to 9 is required when substrate is wetted with distilled water and pHDrion paper is applied. Proceed with installation only after concrete substrates pass testing.
5. Moisture Testing: Perform one or both of the following tests as recommended by resilient accessory manufacturer. Perform 3 moisture tests for first 1000 sf (92.9 sm) of concrete substrate scheduled to receive resilient stair accessories. Proceed with installation only after concrete substrates pass testing.
 - a. Perform anhydrous calcium chloride test in accordance with ASTM F 1869. Proceed with installation only after concrete substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sf (1.36 kg of water/92.9 sm) in 24 hours.
 - b. Perform relative humidity test using in situ probes in accordance with ASTM F 2170. Proceed with installation only after concrete substrates have a maximum 75 percent relative humidity level measurement.

3.2 INSTALLATION, GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
 1. Respective manufacturer's written installation instructions.
 2. Accepted submittals.
 3. Contract Documents.

3.3 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.
- B. Resilient Stair Accessories:
 1. Remove substrate coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 2. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.
 3. Broom and vacuum clean substrates to be covered by resilient stair accessories immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.
 4. Apply concrete slab primer, if recommended by product manufacturer, prior to applying adhesive. Apply according to manufacturer's directions.

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3.4 INSTALLATION OF RESILIENT WALL BASE

- A. Apply wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- B. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
- C. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- D. Do not stretch wall base during installation.
- E. Masonry Wall Surfaces: On masonry surfaces or other similar irregular substrates, fill voids along top edge of wall base with manufacturer's recommended adhesive filler material.
- F. Job-Formed Corners: Use straight pieces of maximum lengths possible.
 - 1. Outside Corners: Form without producing discoloration (whitening) at bends. Shave back of base at points where bends occur and remove strips perpendicular to length of base that are only deep enough to produce a snug fit without removing more than half the wall base thickness.
 - 2. Inside Corners: Form by cutting an inverted V-shaped notch in toe of wall base at the point where corner is formed. Shave back of base where necessary to produce a snug fit to substrate.
- G. Pre-formed Corners: Install pre-formed corners before installing straight pieces.

3.5 INSTALLATION OF RESILIENT FLOORING ACCESSORIES

- A. Resilient Stair Accessories:
 - 1. Use stair tread-nose filler to fill nosing substrates that do not conform to tread contours.
 - 2. Tightly adhere to substrates throughout length of each piece.
 - 3. For treads installed as separate, equal-length units, install to produce a flush joint between units.
- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor coverings that would otherwise be exposed.

3.6 CLEANING AND PROTECTING

- A. Perform the following operations immediately after installing resilient products:
 - 1. Remove adhesive and other surface blemishes from exposed surfaces using cleaner recommended by manufacturer.
 - 2. Sweep or vacuum horizontal surfaces thoroughly.
 - 3. Do not wash resilient products until after time period recommended by manufacturer.
 - 4. Damp-mop surfaces to remove marks and soil.
- B. Protect resilient products against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by resilient product manufacturer.

3.7 RESILIENT PRODUCT SCHEDULE

- A. Resilient Wall Base:
 - 1. RB01:

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- a. Manufacturer:
 - b. Height: 2-1/2 in (62 mm)
 - c. Height: 4 in (100 mm)
 - d. Height: 6 in (150 mm)
 - e. Type: Straight at carpet; coved elsewhere.
 - f. Type: Coved.
 - g. Color Selection: As selected by Architect from full range of industry colors.
 - h. Color Selection:
- B. Resilient Stair Accessories:
- 1. Manufacturer:
 - 2. Style:
 - 3. Color Selection:

END OF SECTION

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SECTION 098433
ACOUSTICAL WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work required for this section includes acoustical wall panels and supplementary items necessary to complete their installation.
- B. Refer to Division 9 "Fabric-Wrapped Panels" for custom-fabricated wall panels.
- C. Refer to Division 9 Section "Stretched-Fabric Wall Systems" for site-upholstered wall systems.
- D. Refer to Division 9 Section "Wall Coverings" for direct glued fabric wall covering.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for acoustical wall panels, including plans, elevations, sections, details, and attachments to other Work. Show orientation of fabric application, pattern matching, and seams.
- C. Samples for Verification: 8 in (200 mm) by 11 in (275 mm) units of each type of acoustical wall panel indicated; in sets for each color, texture, and pattern specified for facing materials, showing the full range of variations expected in these characteristics. Include samples of installation devices and accessories.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Certificates: Signed by manufacturers of acoustical wall panels certifying that products furnished comply with requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For acoustical wall panels and facings to include in maintenance manuals specified in Division 1.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing acoustical wall panels similar to those indicated for this Project and with a record of successful in-service performance.
- B. Fire-Test-Response Characteristics: Provide acoustical wall panels with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify acoustical wall panels with appropriate markings of applicable testing and inspecting agency.
 - 1. Flame Spread: 25 or less.
 - 2. Smoke Developed: 450 or less.
- C. Mockup: Before installing acoustical wall panels, build mockup for each form of construction and finish required to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mockups to comply with the following requirements, using materials indicated for the completed Work:
 - 1. Build mockup in the location and of the size indicated or, if not indicated, a minimum of three panels.

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2. Notify Architect seven days in advance of the dates and times when mock-up will be installed.
3. Obtain Architect's acceptance of mock-ups before starting fabrication or installation.
4. Acceptance of mock-ups does not constitute acceptance of deviations from the Contract Documents contained in mock-ups unless such deviations are specifically noted by Contractor and accepted by Architect in writing.
5. Demolish and remove mock-ups when directed by Architect unless accepted to become part of the completed Work.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect acoustical wall panels from excessive moisture when shipping, storing, and handling. Deliver in unopened bundles and store in a dry place with adequate air circulation. Do not deliver material to building until wet-work, such as concrete and plaster, has been completed and cured to a condition of equilibrium. Protect panel edges from crushing and impact.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install acoustical wall panels until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Air-Quality Limitations: Protect acoustical wall panels from exposure to airborne odors, such as tobacco smoke, and install panels under conditions free from odor contamination of ambient air.
- C. Field Measurements: Where products and systems are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication.

1.8 WARRANTY

- A. Special Warranty: Written warranty, signed by manufacturer agreeing to repair or replace components of acoustical wall panel system that fail in performance, materials, or workmanship within specified warranty period. Failure in performance includes, but is not limited to, acoustical performance. Failure in materials includes, but is not limited to, sagging or distortion of facing or warping of core.
- B. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Source Limitations for Acoustical Wall Panels: Obtain acoustical wall panels from one source with resources to provide products of consistent quality in appearance and physical properties.

2.2 ACOUSTICAL WALL PANELS

- A. Provide manufacturer's standard panel construction consisting of facing material laminated to front face, edges, and back border of dimensionally stable, rigid glass fiber board core; with edges chemically hardened to reinforce panel perimeter against warpage and damage.
 1. Panel Selection: Refer to Schedule at end of this Section.
 2. Panel Selection: Refer to Division 1 Section "Design Selections"
- B. Fabricate panels to sizes and configurations indicated; attach facing materials to cores to produce installed panels with visible surfaces fully covered and free from waves in fabric weave, wrinkles, sags, blisters, seams, adhesive, or other foreign matter.

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1. Fabricate back-mounted panels in factory to exact sizes required to fit wall surfaces, based on field measurements of completed substrates indicated to receive acoustical wall panels.
 2. Tailor corners and attach facing material so there are no seams or gathering of material.
 3. Where fabrics with directional or repeating patterns, or directional weave, are indicated, mark fabric top and attach fabric in same direction.
 4. Where fabric facings with seams are indicated, fabricate invisible seams and comply with Shop Drawings for location.
- C. Dimensional Tolerances of Finished Units: Plus or minus **1/16 in (1.5 mm)** for width length, straightness, squareness, and thickness.
- D. Sound-Absorption Performance: Provide acoustical wall panels with minimum noise reduction coefficients indicated, as determined by testing per ASTM C 423 for mounting type specified under individual product requirements in the Acoustical Wall Panel Schedule.
- E. Panel Characteristics: Comply with requirements indicated in the Acoustical Wall Panel Schedule.
- F. Spline-Mounting Accessories: Manufacturer's standard concealed, extruded-aluminum or plastic connecting splines designed and fabricated for screw attachment to walls, with other moldings and trim for interior and exterior corners, leveling and base support, and as required. Provide panel manufacturer's standard factory-applied finish on exposed items in color as selected.
- G. Back-Mounting Accessories: Manufacturer's standard or recommended accessories for securely mounting panels, of type and size indicated, to substrates provided; and complying with the following requirements:
1. Mechanically Mounted Edge-Reinforced Panels: Metal panel-clip and base-support bracket system consisting of two-part panel clips, with one part of each clip mechanically attached to back of panel and the other part to wall substrate, designed to support panels laterally; and base-support brackets designed to support full weight of panels; with both designed to allow for panel removal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates surfaces to receive acoustical wall panels and associated work and conditions under which work will be installed. Do not proceed with installation until unsatisfactory conditions have been corrected in a manner acceptable to installer. Starting work within a particular area will be construed as installer's acceptance of surface conditions.

3.2 INSTALLATION

- A. Install acoustical wall panels in locations indicated with vertical surfaces and edges plumb, top edges level and in alignment with other panels, and scribed to fit adjoining work accurately at borders and at penetrations. Comply with panel manufacturer's written instructions for installation of panels using type of mounting accessories indicated or, if not indicated, as recommended by manufacturer.
- B. Construction Tolerances: As follows:
1. Variation from Plumb and Level: Plus or minus **1/16 in (1.5 mm)**.
 2. Variation of Joints from Hairline: Not more than **1/16 in (1.5 mm)**.

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3.3 CLEANING

- A. Clip loose threads; remove pills and extraneous materials.
- B. Clean panels with fabric facing, on completion of installation, to remove dust and other foreign materials according to manufacturer's written instructions.
- C. Remove surplus materials, rubbish, and debris resulting from acoustical wall panel installation, on completion of the Work, and leave areas of installation in a neat and clean condition.

3.4 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure acoustical wall panels are without damage or deterioration at time of Substantial Completion.
- B. Replace panels that cannot be cleaned and repaired, before time of Substantial Completion.

3.5 ACOUSTICAL WALL PANEL SCHEDULE

A. AP01:

- 1. Manufacturer:
- 2. Panel designation:
- 3. Facing Material: Manufacturer's standard fabric from same dye lot; color and pattern as selected by Architect from manufacturer's full range.
- 4. Nominal Core Density: Not less than 13 lb/cu. ft.
- 5. Panel Thickness: 3/4 inch unless otherwise indicated.
- 6. Noise Reduction Coefficient: For Type A mounting per ASTM E 795 NRC 0.50 to 0.90.
- 7. Panel Width: Manufacturer's standard.
- 8. Panel Height: As indicated

B. AP02:

- 1. Manufacturer:
- 2. Panel designation:
- 3. Facing Material: Manufacturer's standard fabric from same dye lot; color and pattern as selected by Architect from manufacturer's full range.
- 4. Nominal Core Density: Not less than 13 lb/cu. ft.
- 5. Panel Thickness: 3/4 inch unless otherwise indicated.
- 6. Noise Reduction Coefficient: For Type A mounting per ASTM E 795 NRC 0.50 to 0.90.
- 7. Panel Width: Manufacturer's standard.
- 8. Panel Height: As indicated

END OF SECTION

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SECTION 099100
PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Surface preparation and field painting of exposed interior items, exterior items and surfaces.
 - 1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
- B. Paint exposed surfaces, except where indicated that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Architect will select from standard colors and finishes available.
 - 1. Painting includes field painting of exposed bare and covered pipes and ducts, hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory-applied final finish.
- C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels, unless indicated otherwise.
 - 1. Prefinished items include the following factory-finished components:
 - a. Prefinished wood doors.
 - b. Acoustical materials.
 - c. Prefinished Architectural woodwork and cabinets.
 - d. Elevator equipment.
 - e. Finished mechanical and electrical equipment.
 - f. Light fixtures.
 - g. Distribution cabinets.
 - h. Baked enamel coated items.
 - i. Fluoropolymer coated items.
 - j. Integral colored plaster.
 - k. Integral colored PVC.
 - 2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:
 - a. Foundation spaces.
 - b. Furred areas.
 - c. Ceiling plenums.
 - d. Utility tunnels.
 - e. Pipe spaces.
 - f. Duct shafts.
 - g. Elevator shafts.
 - 3. Finished metal surfaces include the following:
 - a. Anodized aluminum.
 - b. Stainless steel.
 - c. Chromium plate.
 - d. Copper and copper alloys.
 - e. Bronze and brass.
 - 4. Operating parts include moving parts of operating equipment and the following:

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- a. Valve and damper operators.
 - b. Linkages.
 - c. Sensing devices.
 - d. Motor and fan shafts.
5. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.
- a. Embossed UL labels may be used and painted where acceptable to authority having jurisdiction

D. Related Sections:

- 1. Division 09 Section "Gypsum Board Assemblies" for surface preparation of gypsum board assemblies.
- 2. Division 09 Section "High-Performance Coatings" for coatings applied over such substrates as concrete and GFRP, steel, galvanized metal, and aluminum (not anodized or otherwise coated) that are not specified in this Section.

1.2 DEFINITIONS

- A. MPI Gloss Levels: MPI Gloss and Sheen Standard values are measured per ASTM D523, Method D and are as follows:
- 1. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees.
 - 2. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees.
 - 3. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees.
 - 4. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees.
 - 5. Gloss Level 5: 35 to 70 units at 60 degrees.
 - 6. Gloss Level 6: 70 to 85 units at 60 degrees.
 - 7. Gloss Level 7: More than 85 units at 60 degrees.
- B. Exterior Painting: Generally includes surfaces located in unconditioned spaces.
- C. Interior Painting: Generally includes surfaces located in conditioned spaces.

1.3 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
- 1. Include manufacturer's specifications for materials, finishes, installation instructions, and recommendations for maintenance.
- B. Product List: For each product indicated, include the following:
- 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 - 2. Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
- C. Samples for Verification: For each type of paint system and each color and gloss of topcoat indicated.
- 1. Submit Samples on rigid backing, 8 in (200 mm) square.
 - 2. Step coats on Samples to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.

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1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturers Project Acceptance Document: Certification that products are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required, and that warranty will be issued.
1. Certifications by manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs).

1.5 QUALITY ASSURANCE

- A. MPI Standards:
1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
 2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" and "MPI Maintenance Repainting Manual" for products and paint systems indicated.
- B. Mockups: Apply benchmark samples of each paint system indicated and each color and finish selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Install mockup in the location and of the size indicated or, if not indicated, as directed by Architect.
 - a. Architect will select one surface to represent surfaces and conditions for application of each paint system.
 - 1) Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - 2) Other Items: Architect will designate items or areas required.
 - 3) Demonstrate repair procedures for damaged surfaces.
 - b. Apply samples, according to requirements for the completed Work, after permanent lighting and other environmental services have been activated. Provide required sheen, color, and texture on each surface.
 - c. Final approval of color selections will be based on benchmark samples.
 - 1) If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Architect at no added cost to Owner.
 2. Notify Architect seven days in advance of the dates and times when mock-up will be installed.
 3. Obtain Architect's acceptance of mock-ups before starting fabrication or installation.
 4. Acceptance of mock-ups does not constitute acceptance of deviations from the Contract Documents contained in mock-ups unless such deviations are specifically noted by Contractor and accepted by Architect in writing.
 5. Demolish and remove mock-ups when directed by Architect unless accepted to become part of the completed Work.

1.6 PRE-INSTALLATION CONFERENCE

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

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1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.8 PROJECT CONDITIONS

- A. Apply paints only when temperatures of surfaces to be painted and surrounding air are between minimum and maximum range recommended by manufacturer.
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

1.9 COORDINATION

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".
- B. Manufacturers:
 1. Behr.
 2. Benjamin Moore & Co.
 3. Dunn-Edwards Corporation.
 4. Pittsburg Paints Company.
 5. Sherwin-Williams Company (The).
 6. Valspar.
- C. Color and Gloss: As scheduled or as indicated in Design Selections.

2.2 PAINT, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."
- B. Source Limitations: Obtain block fillers and field applied primers for each coating system from the same manufacturer as the finish coats.
- C. Material Compatibility:
 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner

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complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

- B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to shop applicators to ensure use of compatible primers.

3.2 INSTALLATION

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform work according to the following, unless otherwise specified in this Section:
 - 1. Respective manufacturer's written installation instructions.
 - 2. Approved submittals.
 - 3. Contract Documents.
 - 4. MPI Architectural Painting Specification Manual" or "MPI Maintenance Repainting Manual", as applicable.

3.3 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations and specifications for cleaning and surface preparation. Surfaces shall have no defects or errors which would result in poor or potentially defective installation or would cause latent defects in Work.
- B. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" and "MPI Maintenance Repainting Manual" applicable to substrates and paint systems indicated.
- C. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
 - 2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates, unless expressly permitted by authorities having jurisdiction for labels intended to be painted.
- D. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.
- E. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
 - 1. Use mechanical methods of surface preparation recommended by paint manufacturer.
 - 2. Do not paint surfaces where moisture content exceeds that permitted in manufacturer's printed directions.
- F. Concrete Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- G. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.

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1. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.
- H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
 1. Galvanized metal substrates shall not be chromate passivated. If galvanized metal is chromate passivated, provide surface preparation and primers recommended by manufacturer.
- I. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.
- J. Plaster Substrates: Do not begin paint application until plaster is fully cured and dry.
- K. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.4 APPLICATION

- A. Apply paints according to manufacturer's written instructions.
 1. Use applicators and techniques suited for paint and substrate indicated.
 2. Paint surfaces behind movable items, equipment, and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items, equipment, or furniture with prime coat only.
 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 4. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
 5. The number of coats and film thickness required are the same regardless of application method.
 6. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
 7. Omit primer over metal surfaces that have been shop primed and touchup painted.
 8. Allow sufficient time between successive coats to permit proper drying.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat. Tint per manufacturer's technical data for each type of primer or undercoat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve total dry film thickness of the entire system as recommended by manufacturer.

3.5 MECHANICAL AND ELECTRICAL WORK PAINTING AND IDENTIFICATION

- A. Painting of Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work to be done when exposed in the following locations:

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1. Occupied Spaces.
 - B. Equipment includes, but is not limited to, the following:
 1. Tanks that do not have factory-applied final finishes.
 2. Equipment that is indicated to have a factory-primed finish for field painting.
 - C. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces. Paint with a flat, nonspecular black paint.
- 3.6 FIRE AND SMOKE BARRIER IDENTIFICATION
- A. Fire and smoke resistant rated walls shall be effectively and permanently identified with signs, labels or stencils in a manner acceptable to authority having jurisdiction.
 1. Identification shall be above decorative ceiling and in concealed spaces, on each
- 3.7 CLEANING AND PROTECTION
- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
 - B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
 - C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
 - D. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.
 - E. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces to match approved samples.
- 3.8 EXTERIOR PAINTING SCHEDULE
- A. Steel Substrates (Ferrous Metal):
 1. Water-Based, Light-Industrial Coating System: MPI EXT 5.1M
 - a. Prime Coat: Rust-inhibitive primer, (water based), primer, MPI #107.
 - 1) Basis of Design: Sherwin Williams; Pro Ind Pro-Cryl Primer B66-1300.
 - b. Intermediate Coat: Water-based, light-industrial coating, matching topcoat.
 - c. Topcoat: Light industrial coating, exterior, water based (MPI Gloss Level 3), MPI #161.
 - 1) Basis of Design: Sherwin Williams; Pro Industrial DTM Acrylic B66-1200 Series.
 - d. Topcoat: Light industrial coating, exterior, water based, semi-gloss (MPI Gloss Level 5), MPI #163.
 - 1) Basis of Design: Sherwin Williams; Pro Industrial DTM Acrylic B66-1100 Series.
 - e. Topcoat: Light industrial coating, exterior, water based, gloss (MPI Gloss Level 6), MPI #164.

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- 1) Basis of Design: Sherwin Williams; Pro Industrial DTM Acrylic B66-1000 Series.
- f. Gloss and Sheen: As scheduled or as indicated in Design Selections.
- B. Galvanized-Metal Substrates:
 - 1. Water-Based, Light-Industrial Coating System: MPI EXT 5.3J.
 - a. Prime Coat: Waterborne galvanized-metal primer, MPI #134.
 - 1) Basis of Design: Sherwin Williams; Pro Ind Pro-Cryl Primer B66-1300 .
 - b. Intermediate Coat: Water-based, light-industrial coating, matching topcoat.
 - c. Topcoat: Light industrial coating, exterior, water based (MPI Gloss Level 3), MPI #161.
 - 1) Basis of Design: Sherwin Williams; Pro Industrial DTM Acrylic B66-1200 Series .
 - d. Topcoat: Light industrial coating, exterior, water based, semi-gloss (MPI Gloss Level 5), MPI #163.
 - 1) Basis of Design: Sherwin Williams; Pro Industrial DTM Acrylic B66-1100 Series
 - e. Topcoat: Light industrial coating, exterior, water based, gloss (MPI Gloss Level 6), MPI #164.
 - 1) Basis of Design: Sherwin Williams; Pro Industrial DTM Acrylic B66-1000 Series
 - f. Gloss and Sheen: As scheduled or as indicated in Design Selections.

3.9 INTERIOR PAINTING SCHEDULE

- A. CMU Substrates:
 - 1. Water-Based Epoxy Coating System: MPI INT 4.2J.
 - a. Prime Coat: Interior/exterior latex block filler, MPI #4.
 - 1) Basis of Design: Sherwin Williams; Pro Industrial Heavy Duty Block Filler B42W150.
 - b. Intermediate Coat: Epoxy-Modified Latex, Interior, matching topcoat.
 - c. Topcoat: Epoxy-Modified Latex, Interior, semi-gloss (MPI Gloss Level 5), MPI #215.
 - 1) Basis of Design: Sherwin Williams; Pro Industrial Waterbased Catalyzed Epoxy B73-360 Series.
 - d. Topcoat: Epoxy-Modified Latex, Interior, gloss (MPI Gloss Level 6), MPI #115.
 - 1) Basis of Design: Sherwin Williams; Pro Industrial Waterbased Catalyzed Epoxy B73-300 Series.
 - e. Gloss and Sheen: As scheduled or as indicated in Design Selections.
- B. Steel Substrates:
 - 1. Water-Based Dry-Fall System: MPI INT 5.1C.
 - a. Prime Coat: Quick-drying alkyd metal primer (shop primed, MPI #76.

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- 1) Basis of Design: Sherwin Williams; Pro Industrial Kem Bond HS B50WZ4.
 - b. Topcoat: Dry fall, latex, flat, MPI #118.
 - 1) Basis of Design: Sherwin Williams; Pro Industrial Waterborne Acrylic Dryfall Low Gloss Eg-shel B41-1100 Series..
 - c. Topcoat: Dry fall, water based, for galvanized steel, flat (MPI Gloss Level 1), MPI #133.
 - 1) Basis of Design: Sherwin Williams; Pro Industrial Multi-Surface Acrylic Matte B66-1570 Series.
 - d. Topcoat: Dry fall, latex (MPI Gloss Level 3), MPI #155.
 - 1) Basis of Design: Sherwin Williams; Pro Industrial Waterborne Acrylic Dryfall Eg-shel B42W182 Series..
 - e. Topcoat: Dry fall, latex (MPI Gloss Level 5), MPI #226.
 - 1) Basis of Design: Sherwin Williams; Pro Industrial Waterborne Acrylic Dryfall Semi-gloss B42W83. .
 - f. Gloss and Sheen: As scheduled or as indicated in Design Selections.
2. High-Performance Architectural Latex System: MPI INT 5.1R.
- a. Prime Coat: Quick-drying alkyd metal primer (shop primed), MPI #76.
 - 1) Basis of Design: Sherwin Williams; Pro Industrial Kem Bond HS B50WZ4 .
 - b. Intermediate Coat: High-performance architectural latex matching topcoat.
 - c. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5), MPI #141.
 - 1) Basis of Design: Sherwin Williams; Pro Industrial Acrylic Semi-gloss B66-650 Series.
 - d. Gloss and Sheen: As scheduled or as indicated in Design Selections.
- C. Galvanized-Metal Substrates:
1. Water-Based Dry-Fall System: MPI INT 5.3H.
- a. Prime Coat: Dry fall, water based, for galvanized steel, matching topcoat.
 - b. Topcoat: Dry fall, water based, for galvanized steel, flat (MPI Gloss Level 1), MPI #133.
 - 1) Basis of Design: Sherwin Williams; Pro Industrial Multi-Surface Acrylic Matte B66-1570 Series.
 - c. Gloss and Sheen: As scheduled or as indicated in Design Selections.
2. High-Performance Architectural Latex System: MPI INT 5.3M.
- a. Prime Coat: Waterborne galvanized-metal primer, MPI #134.
 - 1) Basis of Design: Sherwin Williams; Pro Ind Pro-Cryl Primer B66-1300 Series.
 - b. Intermediate Coat: High-performance architectural latex matching topcoat.
 - c. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5), MPI #141.

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- 1) Basis of Design: Sherwin Williams; Pro Industrial Acrylic Semi-gloss B66-650 Series.
 - d. Gloss and Sheen: As scheduled or as indicated in Design Selections.
- D. Gypsum Board and Plaster (Gypsum and Portland Cement) Substrates:
- 1. High-Performance Architectural Latex System: MPI INT 9.2B.
 - a. Prime Coat: Interior latex primer/sealer, MPI #50.
 - 1) Basis of Design: Sherwin Williams; ProMar 200 0 VOC Primer B28W2600.
 - b. Intermediate Coat: High-performance architectural latex matching topcoat.
 - c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2), MPI #138.
 - 1) Basis of Design: Sherwin Williams; ProMar 200 HP 0 VOC Low Gloss Eg-shel B41-1900 Series.
 - d. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3), MPI #139.
 - 1) Basis of Design: Sherwin Williams; ProMar 200 HP 0 VOC Eg-shel B20-1900 Series.
 - e. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 4), MPI #140.
 - 1) Basis of Design: Sherwin Williams; ProMar 200 HP 0 VOC Semi-gloss B31-1900 Series.
 - f. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5), MPI #141.
 - 1) Basis of Design: Sherwin Williams; Pro Industrial Acrylic Semi-gloss B66-650 Series.
 - g. Gloss and Sheen: As scheduled or as indicated in Design Selections.
 - 2. Water-Based Epoxy Coating System: MPI INT 9.2F.
 - a. Prime Coat: Interior latex primer/sealer, MPI #50.
 - 1) Basis of Design: Sherwin Williams; ProMar 200 0 VOC Primer B28W2600.
 - b. Intermediate Coat: Epoxy-Modified Latex, Interior, matching topcoat.
 - c. Topcoat: Epoxy-Modified Latex, Interior, semi-gloss (MPI Gloss Level 5), MPI #215.
 - 1) Basis of Design: Sherwin Williams; Pro Industrial Waterbased Catalyzed Epoxy B73-360 Series.
 - d. Topcoat: Epoxy-Modified Latex, Interior, gloss (MPI Gloss Level 6), MPI #115.
 - 1) Basis of Design: Sherwin Williams; Pro Industrial Waterbased Catalyzed Epoxy B73-300 Series.
 - e. Gloss and Sheen: As scheduled or as indicated in Design Selections.

END OF SECTION

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SECTION 101100
VISUAL DISPLAY BOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work for this section includes visual display surfaces and supplementary items necessary to complete their installation for the following:
 - 1. Metal-framed markerboards.
 - 2. Metal-framed tackboards.
 - 3. Glass markerboards.

1.2 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
 - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
- B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components and attachments to other work. Distinguish between shop and field-assembled work.
- C. Samples for Verification: For each type of visual display unit indicated.
 - 1. Visual Display Panel: Not less than 8-1/2 by 11 in (215 by 275 mm), with facing, core, and backing indicated for final Work. Include one panel for each type, color, and texture required.
 - 2. Trim: 6 in (150 mm) long sections of each trim profile.
 - 3. Display Rail: 6 in (150 mm) long section of each type.
 - 4. Accessories: Full-size Sample of each type of accessory.
- D. Product Schedule: For visual display boards. Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

- A. Warranty:
 - 1. Provide manufacturer's written warranty covering materials and installation (labor) stating obligations, remedies, limitations and exclusions.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For visual display units to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics for Vinyl-Fabric-Faced Tackboards: Provide vinyl-fabric-faced tackboards with the following surface-burning characteristics as determined by testing assembled materials composed of facings and backings identical to those required in this Section per ASTM E 84 by a testing and inspecting agency acceptable to authorities having jurisdiction. Identify vinyl-fabric-faced tackboards with appropriate markings of applicable testing and inspecting agency.
 - 1. Flame Spread: 25 or less (Class A).
 - 2. Smoke Developed: 10 or less.

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1.6 WARRANTY

- A. Porcelain Enamel Warranty: Submit a written warranty executed by manufacturer agreeing to replace porcelain enamel boards that do not retain their original writing and erasing qualities, exhibit excessive fading of color, or exhibit crazing, cracking, or flaking for the lifetime of the original installation, provided the manufacturer's written instructions for handling, installation, protection, and maintenance have been followed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND PRODUCTS

- A. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".
- B. Manufacturers:
1. ADP Lemco, Inc.
 2. Best-Rite Manufacturing.
 3. Claridge Products and Equipment, Inc.
 4. Ghent Manufacturing, Inc.
 5. Marsh Industries, Inc.; Visual Products Group.

2.2 MATERIALS, GENERAL

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

2.3 MARKERBOARDS

- A. Porcelain Enamel Panels: Balanced, high-pressure-laminated, porcelain enamel panels of 3-ply construction consisting of face sheet, core material, and backing.
1. Face Sheet: 0.024 in (0.61 mm) enameling grade steel especially processed for temperatures used in coating porcelain on steel. Coat exposed face and edges with a 3-coat process consisting of primer, ground coat, and color cover coat. Coat concealed face with a 2-coat process consisting of primer and ground coat. Fuse cover and ground coats to steel at manufacturer's standard firing temperatures, but not less than 1200 deg F (649 deg C).
 - a. Markerboard Cover Coat: Provide manufacturer's standard, light-colored, special writing surface with gloss finish intended for use with erasable dry markers.
 2. Core: 3/8 in (10 mm) thick, particleboard core material complying with requirements of ANSI A208.1, Grade 1-M-1.
 3. Backing Sheet: 0.015 in (0.38 mm) thick, aluminum-sheet backing.
 4. Laminating Adhesive: Manufacturer's standard, moisture-resistant, thermoplastic-type adhesive.

2.4 TACKBOARDS

- A. Natural-Cork Tackboards: Single-layer, 1/4 in (6 mm) thick, seamless, compressed fine-grain, bulletin board quality, natural-cork sheet; face sanded for natural finish.
- B. Plastic-Impregnated Cork Tackboards: Seamless sheet, 1/4 in (6 mm) thick, ground natural cork compressed with a resinous binder with washable vinyl finish and integral color throughout, laminated to burlap backing.

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1. Color: As scheduled or as indicated in Design Selections.
- C. Vinyl-Fabric-Faced Tackboards: Mildew-resistant, washable vinyl fabric complying with FS CCC-W-408, Type II, weighing not less than 13 oz./sq. yd. (440 g/sq. m), laminated to 1/4 in (6 mm) thick cork sheet. Provide fabric with a flame-spread rating of 25 or less when tested according to ASTM E 84.
1. Color: As scheduled or as indicated in Design Selections.
- D. Backing: Factory laminate cork face sheet under pressure to 1/4 in (6 mm) thick hardboard backing.

2.5 GLASS MARKERBOARDS

- A. Glass Markerboards: 1/4 inch (6 mm) tempered glass markerboard, with smooth polished edge and eased corners.
1. Clear Tempered Glass: ASTM C 1048, Kind FT, Condition A, Type I, Class 1, Quality Q3, with exposed edges seamed before tempering.
 2. Mounting: Round, stainless-steel standoffs, holding glass approximately 1 inch (25 mm) from wall surface; mounted in notches in standoffs at top and bottom edges of markerboard.
 3. Color and Surface: clear.
 4. Marker Tray: Glass, supported by stainless-steel clips.
 5. Sizes: as indicated on drawings.

2.6 ACCESSORIES

- A. Metal Trim and Accessories: Fabricate frames and trim of not less than 0.062 in (1.57 mm) thick, extruded-aluminum alloy, size and shape as indicated, to suit type of installation. Provide straight, single-length units. Keep joints to a minimum. Miter corners to a neat, hairline closure.
1. Where size of visual display surfaces or other conditions require support in addition to normal trim, provide structural supports or modify trim as selected by Architect from manufacturer's standard structural support accessories to suit conditions indicated.
 2. Factory-Applied Trim: Manufacturer's standard narrow trim with no visible screws or exposed joints.
 3. Chalktray: Manufacturer's standard, continuous, solid, extrusion-type, aluminum chalktray with ribbed section and smoothly curved exposed ends for each chalkboard.
 4. Map Rail: Furnish map rail at top of each unit, complete with continuous cork display rail approximately 1 or 2 in (25 or 50 mm) wide, integral with map rail and end stops at each end of map rail.

2.7 FABRICATION

- A. Porcelain Enamel Boards: Laminate facing sheet and backing sheet to core material under pressure with manufacturer's recommended flexible, waterproof adhesive.
- B. Assembly: Provide factory-assembled units, unless field-assembled units are required.
1. Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, balanced around center of board, as acceptable to Architect.
 2. Provide manufacturer's standard vertical joint system between abutting sections of chalkboards.

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2.8 FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.
- B. Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.
- C. Aluminum Frame Finish: As scheduled or as indicated in Design Selections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

3.2 INSTALLATION, GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
 - 1. Respective manufacturer written installation instructions.
 - 2. Accepted submittals.
 - 3. Contract Documents.

3.3 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.

3.4 INSTALLATION

- A. Deliver factory-built visual display boards completely assembled in one piece without joints, where possible. If dimensions exceed panel size, provide 2 or more pieces of equal length as acceptable to Architect. When overall dimensions require delivery in separate units, prefit components at the factory, disassemble for delivery, and make final joints at the site. Use splines at joints to maintain surface alignment.
- B. Install units in locations and at mounting heights indicated and according to manufacturer's written instructions. Keep perimeter lines straight, plumb, and level. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

3.5 CLEANING AND PROTECTION

- A. Clean visual display boards according to manufacturer's written instructions. Attach one removable cleaning instructions label to visual display unit in each room.
- B. Touch up factory-applied finishes to restore damaged or soiled areas.
- C. Cover and protect visual display boards after installation and cleaning.

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3.6 FINISH SCHEDULE

A. Plastic-Impregnated Cork Tackboards:

1. Color: As selected by Architect from manufacturer's standard colors and patterns.
2. Color: <INSERT COLOR>.

B. Vinyl-Fabric-Faced Tackboards:

1. Color: As selected by Architect from manufacturer's standard colors and patterns.
2. Color: <INSERT COLOR>.

C. Aluminum Frame Finish:

1. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.
2. Color Anodic Finish: AAMA 611, AA-M12C22A32/A34, Class II, 0.010 mm or thicker.
 - a. Color: Light bronze.
 - b. Color: Medium bronze.
 - c. Color: Dark bronze.
 - d. Color: Black.
 - e. Color: As selected by Architect from the full range of industry colors and color densities.
3. Baked-Enamel or Powder-Coat Finish: AAMA 2603, except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - a. Color: As selected by Architect from manufacturer's full range of colors.
 - b. Color: <INSERT COLOR>.

END OF SECTION

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SECTION 10 1146
VISUAL DISPLAY FABRICS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work for this section includes visual display fabrics and supplementary items necessary to complete their installation for the following:
 - 1. Dry-erase wall coverings.

1.2 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
 - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
- B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components and attachments to other work. Indicate seams and termination points.
- C. Samples for Verification Purposes: Full width by 36 in (914 mm) long section of dry erase wall covering.
- D. Product Schedule: Use same designations indicated on the Finish Schedule and Drawings.

1.3 CLOSEOUT SUBMITTALS

- A. Maintenance Data: To include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing identical wall coverings applied with identical adhesives to substrates according to test method indicated below by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Surface-Burning Characteristics: As follows, per ASTM E 84:
 - a. Flame-Spread Index: 25 or less (Class A).
 - b. Smoke-Developed Index: 450 or less.
- B. Mock-ups: Prior to fabrication and installation, build mock-up for each form of construction and finish required to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mock-up to comply with the following requirements, using materials indicated for the completed Work:

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1. Build mock-up in the location and of the size indicated or, if not indicated, as directed by Architect. Contractor shall provide structural support framework.
 - a. Show typical components and requirements of installation.
2. Notify Architect seven days in advance of the dates and times when mock-up will be installed.
3. Obtain Architect's acceptance of mock-ups before starting fabrication or installation.
4. Acceptance of mock-ups does not constitute acceptance of deviations from the Contract Documents contained in mock-ups unless such deviations are specifically noted by Contractor and accepted by Architect in writing.
5. Demolish and remove mock-ups when directed by Architect unless accepted to become part of the completed Work.

1.5 PRE-INSTALLATION CONFERENCE

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.

1.6 PROJECT CONDITIONS

- A. Do not install wall coverings until space is enclosed and weatherproof, wet-work in space is completed and nominally dry, work above ceilings is complete, and ambient temperature and humidity conditions are and will be continuously maintained at values near those indicated for final occupancy.
- B. Environmental Limitations: Do not deliver or install wall coverings until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- C. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by the wall covering manufacturer for full drying or curing.

1.7 COORDINATION

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND PRODUCTS

- A. Available Manufacturers: Subject to compliance with requirements of Contract Documents as judged by the Architect, manufacturers offering products that may be incorporated into the Work include, but are not limited to, those listed.
 1. Egan Visual Inc.
 2. Marsh Industries, Inc.; Visual Products Group.
 3. Specified Solutions Inc.
 4. Walltalkers; a division of RJF International Corporation

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2.2 DRY-ERASE WALL COVERINGS

- A. Magnetic Dry-Erase Wall Covering: Intended for use with dry-erase markers and magnetic aids and consisting of moderate-gloss plastic film bonded to ferrous-powdered fabric backing.

1. Color: As scheduled or as indicated in Design Selections.

2.3 ACCESSORIES

- A. Adhesives for Field Application: Strippable, mildew-resistant, non-staining adhesive for use with dry-erase wall coverings; and for substrate application; as recommended in writing by dry-erase wall covering manufacturer.
- B. Primer/Sealer: Mildew-resistant primer/sealer for level 5 finish and complying with requirements in Division 09 Section "Gypsum Board Assemblies" and recommended in writing by dry-erase wall covering manufacturer for intended substrate.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.
- B. Gypsum Board Substrate Finish: Verify that gypsum board substrate finish is a level 5 finish per requirements of Division 09 Section "Gypsum Board Assemblies".

3.2 INSTALLATION, GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
1. Respective manufacturer written installation instructions.
 2. Accepted submittals.
 3. Contract Documents.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by isolating metals and other materials from direct contact with incompatible materials.

3.3 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.
- B. Comply with manufacturer's written instructions for surface preparation.

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- C. Clean substrates of substances, including dirt, mold, and mildew, that could impair the bond of dry-erase wall coverings or affect the smooth, finished surfaces of dry-erase wall coverings.
- D. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, and depressions.
- E. Prepare substrates indicated to receive dry-erase wall covering as required by manufacturer's written instructions to achieve a smooth, dry, clean, structurally sound surface that is uniform in color.
 - 1. Moisture Content: Maximum of 4 percent when tested with an electronic moisture meter.
 - 2. Gypsum Board: Prime with primer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer for a level 5 substrate finish per requirements of Division 09 Section "Gypsum Board Assemblies".

3.4 INSTALLATION, VISUAL DISPLAY FABRICS

- A. Dry-Erase Wall Covering: Comply with dry-erase wall-covering manufacturers' written installation instructions.
 - 1. Install seams horizontal and level, with lowest seam 24 in (610 mm) above finished floor. Railroad fabric (reverse roll direction) to ensure color matching.
 - 2. Double cut seams, with no gaps or overlaps. Remove air bubbles, wrinkles, blisters, and other defects.
 - 3. After installation, clean dry-erase wall covering according to manufacturer's written instructions. Remove excess adhesive at finished seams, perimeter edges, and adjacent surfaces.

3.5 CLEANING AND PROTECTION

- A. Remove excess adhesive at finished seams, perimeter edges, and adjacent surfaces.
- B. Clean dry-erase wall covering according to manufacturer's written instructions. Attach one removable cleaning instructions label to dry-erase wall covering in each room.
- C. Reinstall hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

END OF SECTION

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SECTION 101400
INTERIOR SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. Work required for this section includes code required signs, including ADA, and supplementary items necessary to complete their installation.

1.2 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
 - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
- B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, mounting heights, spacing, reinforcement, details of components and attachments to other work. Distinguish between shop and field-assembled work.
 - 1. Provide message list for each sign, including large-scale details of wording, lettering, and Braille layout.
- C. Samples for Verification: For each type of sign, include the following Samples to verify color selected:
 - 1. Panel Signs: Full-size Samples of each type of sign required.
 - 2. Dimensional Characters: Full-size Samples of each type of dimensional character (letter and number) required. Show character style, material, finish, and method of attachment.
 - 3. Approved samples will not be returned for installation into Project.

1.3 QUALITY ASSURANCE

- A. Manufacturer/Fabricator Qualifications: Manufacturer with experience in the successful production and in-service performance of products and systems similar to scope of this Project.
- B. Regulatory Requirements: Comply with code provisions as adopted by authorities having jurisdiction and with Americans with Disabilities Act (ADA) for the following:
 - 1. Tactile and Braille Characters.
 - 2. Typestyles.
 - 3. Character Height.
 - 4. Pictograms (Symbols).
 - 5. Finish and Contrast.
 - 6. Mounting Location and Height.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".
- B. Manufacturers:
 - 1. ASI Sign Systems, Inc.

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2. Best Manufacturing Company.
3. Mohawk Sign Systems.
4. Seton Identification Products
5. The Supersine Company.

2.2 MATERIALS, GENERAL

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

2.3 MATERIALS

- A. Plastic Laminate: Provide melamine plastic laminate engraving stock with face and core plies in contrasting colors.
- B. Cast Acrylic Sheet: Provide cast (not extruded or continuous cast) methyl methacrylate monomer plastic sheet, in sizes and thicknesses indicated, with a minimum flexural strength of 16,000 psi when tested according to ASTM D 790, with a minimum allowable continuous service temperature of 176 deg F.
 1. Colored Coatings: Use colored coatings, including inks and paints for copy and background colors, that are recommended by acrylic manufacturers for optimum adherence to acrylic surface and are nonfading for the application intended.
 2. Mounting Fasteners: Use concealed fasteners fabricated from materials that are not corrosive to the sign material and mounting surface.

2.4 FABRICATION

- A. Unframed Panel Signs: Fabricate signs with edges mechanically and smoothly finished with square coat edge condition and square corner condition.
- B. Graphic Content and Style: Provide sign copy that complies with requirements indicated and ADA for size, style, spacing, content, mounting height and location, material, finishes, and colors of signage.
- C. Tactile and Braille Copy: Manufacturer's standard process for producing copy complying with ADA Accessibility Guidelines and ICC/ANSI A117.1. Text shall be accompanied by Grade 2 Braille. Produce precisely formed characters with square cut edges free from burrs and cut marks.
- D. Typical Sign Design:
- E. Material: Cast-acrylic sheet or Plastic laminate.
- F. Perimeter: Unframed.
- G. Copy: Tactile and Braille.
- H. Character Style: Helvetica.
- I. Text: As indicated in the Sign Schedule to identify location.
- J. Message: Fixed.
- K. Sizes: Minimum required to meet code and ADA requirements.
- L. Colors: As selected from manufacturer's standard colors.

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2.5 FINISHES

- A. Colors and Surface Textures: For exposed sign material that requires selection of materials with integral or applied colors, surface textures or other characteristics related to appearance, provide color matches indicated, or if not indicated, as selected by the Architect from the manufacturer's standards.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

3.2 INSTALLATION, GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
 - 1. Respective manufacturer written installation instructions.
 - 2. Accepted submittals.
 - 3. Contract Documents.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by isolating metals and other materials from direct contact with incompatible materials.

3.3 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.

3.4 INSTALLATION

- A. General: Locate sign units and accessories where indicated, using mounting methods of the type described and in compliance with the manufacturer's instructions.
 - 1. Install signs level, plumb, and at the height indicated, with sign surfaces free from distortion or other defects in appearance.
 - 2. Wall Signs: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within 3 in (75 mm) of sign without encountering protruding objects or standing within swing of door.
- B. Wall-Mounted Panel Signs: Attach panel signs to wall surfaces using one method indicated below:
 - 1. Vinyl-Tape Mounting: Use double-sided foam tape to mount signs to smooth, nonporous surfaces. Do not use this method for vinyl-covered or rough surfaces.
 - 2. Hook-and-Loop Tapes: Use hook-and-loop tapes to mount signs to smooth, nonporous surfaces.
 - 3. Magnetic Tape: Use magnetic tape to mount signs to smooth, nonporous surfaces.
 - 4. Silicone-Adhesive Mounting: Use liquid-silicone adhesive recommended in writing by sign manufacturer to attach signs to irregular, porous, or vinyl-covered surfaces. Use

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double-sided vinyl tape where recommended in writing by sign manufacturer to hold sign in place until adhesive has fully cured.

3.5 CLEANING AND PROTECTION

- A. After installation, clean soiled sign surfaces according to the manufacturer's instructions. Protect units from damage until acceptance by the Owner.

3.6 SCHEDULE OF SIGNS

A. Stairs:

1. Provide a sign at each door to each stairway on each floor.
2. Message:
 - a. Required wording for exiting as required by the local code authorities. **"STAIR WAY"**.
 - b. Braille message as required by ADA.

B. Stairs To Roof:

1. Provide a sign at each door on Level One to each stairway that goes to Roof.
2. Message: Required wording as required by the local code authorities. **"STAIRS GOES TO ROOF"**.

C. Inside Stairs:

1. Provide a sign at each door in stairways.
2. Message: As required by local code authorities.
 - a. Identify stair location.
 - b. Identify floor level.
 - c. Identify all floors served.
 - d. Identify stairway's upper terminus.
3. Braille message as required by ADA.

D. Elevator Lobbies:

1. Provide a sign at each elevator group on other than Level One.
2. Provide a sign at each elevator group on all levels.
 - a. Message:
 - 1) Required wording and diagram for exiting as required by the local code authorities.

"IN CASE OF FIRE
DO NOT USE ELEVATORS
USE STAIRS"

- 2) Graphic symbols that are appropriate, including Fire Evacuation Map.
- 3) Braille message as required by ADA.

- b. Mount above elevator call button.

E. Toilet Rooms:

1. Provide a sign at the door to each public toilet room.
2. Message:
 - a. **"MEN"** or **"WOMEN"** as appropriate for the room.
 - b. Graphic symbol that is appropriate for the room.

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- c. Symbol of accessibility.
- d. Braille message as required by ADA.

F. Other Rooms:

- 1. Provide a sign at each door that leads into the following rooms:
- 2. **TELEPHONE ROOM**
- 3. **ELECTRICAL ROOM**
- 4. **JANITOR CLOSET**
- 5. **MECHANICAL ROOM**
- 6. **MAIN TELEPHONE ROOM**
- 7. **MAIN ELECTRICAL ROOM**
- 8. **FIRE PUMP ROOM**
- 9. **FIRE CONTROL ROOM**
- 10. **SERVICE ELEVATOR**
- 11. **ELEVATOR MACHINE ROOM**
- 12. Braille message as required by ADA.

END OF SECTION

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SECTION 10 2113

TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Toilet compartments and supplementary items necessary for installation.

1.2 SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
 - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
- B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components and attachments to other work. Distinguish between shop and field-assembled work.
 - 1. Show locations of cutouts for compartment-mounted toilet accessories.
 - 2. Show locations of centerlines of toilet fixtures.
 - 3. Show overhead support or bracing locations on reflected ceiling plan, including, but not limited to, ceiling grid, lighting, diffusers, and speakers.
- C. Samples for Initial Selection: For each type of unit indicated. Include Samples of hardware and accessories involving material and color selection.
- D. Samples for Verification Purposes: For the following products, in manufacturer's standard sizes unless otherwise indicated:
 - 1. Each type of material, color, and finish required for units, prepared on 6 in (150 mm) square Samples of same thickness and material indicated for Work.
 - 2. Each type of hardware and accessory.
- E. Product Certificates: For each type of toilet compartment, from manufacturer.
- F. Maintenance Data: To include in maintenance manuals.

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities" and ICC/ANSI A117.1 for toilet compartments designated as accessible.

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1.4 PROJECT CONDITIONS

- A. Field Measurements: Where products and systems are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.5 COORDINATION

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND PRODUCTS

- A. Available Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, manufacturers offering products that may be incorporated into the Work include, but are not limited to, those listed.

- 1. Solid-Polymer (HDPE) Units:

- a. Comtec Industries/Capitol Partitions.
 - b. Global Steel Products Corp.
 - c. Hadrian Manufacturing inc.
 - d. Santana Products, Inc.
 - e. Sanymetal; a Crane Plumbing company.
 - f. Scranton.

2.2 MATERIALS

- A. Aluminum Castings: ASTM B 26 / B 26M.
- B. Aluminum Extrusions: ASTM B 221 / B 221M.
- C. Stainless-Steel Castings: ASTM A 743 / A 743M.
- D. Zamac: ASTM B 86, commercial zinc-alloy die castings.

2.3 SOLID-POLYMER UNITS

- A. Toilet-Enclosure Style: Overhead braced.
- B. Door, Panel, Screen, and Pilaster Construction: Solid, high-density polyethylene (HDPE) or polypropylene (PP) panel material, not less than 1 in (25 mm) thick, seamless, with eased edges, and with homogenous color and pattern throughout thickness of material.
 - 1. Heat-Sink Strip: Manufacturer's standard continuous, extruded-aluminum or stainless-steel strip fastened to exposed bottom edges of solid-polymer components to prevent burning.
 - 2. Color(s) and Pattern(s): As selected by Architect from manufacturer's full range.
- C. Pilaster Shoes and Sleeves (Caps): Manufacturer's standard design; stainless steel.

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- D. Full-Height (Continuous) Type Brackets (Fittings): Manufacturer's standard design; stainless steel for attaching panels to walls and pilasters.

2.4 ACCESSORIES

- A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.

- 1. Material:
 - a. Chrome-plated zamac.
 - b. Clear-anodized aluminum.
 - c. Stainless steel.
- 2. Hinges: Manufacturer's standard continuous self-closing type.
- 3. Latch and Keeper: Manufacturer's standard surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
- 4. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.
- 5. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
- 6. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.

- B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.

- C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel.

2.5 FABRICATION

- A. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.
- B. Door Size and Swings: Unless otherwise indicated, provide 24 in (600 mm) wide, in-swinging doors for standard toilet compartments and 36 in (900 mm) wide, out-swinging doors with a minimum 32 in (800 mm) wide, clear opening for compartments designated as accessible.

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PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

3.2 INSTALLATION, GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
 - 1. Respective manufacturer's written installation instructions.
 - 2. Accepted submittals.
 - 3. Contract Documents.

3.3 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.

3.4 INSTALLATION

- A. General: Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
 - 1. Maximum Clearances:
 - a. Pilasters and Panels: 1/2 in (12 mm).
 - b. Panels and Walls: 1 in (25 mm).
 - 2. Full-Height (Continuous) Type Brackets (Fittings): Secure panels to walls and to pilasters with continuous brackets.
- B. Overhead-Braced-and-Floor-Anchored Compartments: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, fasteners, and anchors at pilasters to suit floor conditions. Make provisions for setting and securing continuous head rail at top of each pilaster. Provide shoes at pilasters to conceal supports and leveling mechanism.
- C. Floor and Wall-Anchored Screens: Provide pilasters and panels of same construction and finish as toilet compartments. Provide manufacturer's standard corrosion-resistant anchoring assemblies complete with threaded rods, lock washers, and leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.

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3.5 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors and doors in entrance screens to return doors to fully closed position.

END OF SECTION

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SECTION 10 2613

WALL AND CORNER GUARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Impact-resistant wall protection systems and supplementary items necessary for installation.

1.2 SUBMITTALS

- A. Product Data: Include physical characteristics, such as durability, resistance to fading, and flame resistance, for each impact-resistant wall protection system component indicated.
- B. Samples for Verification: For the following products, showing the full range of color and texture variations expected in each impact-resistant wall protection system component. Prepare Samples from the same material to be used for the Work.
 - 1. Wall and Corner Guards: 12-inch- long Samples of each type of impact-resistant wall protection system component required. Include examples of joinery, corners, and field splices.
- C. Material Test Reports: From a qualified testing agency indicating compliance of each impact-resistant wall protection system component with requirements indicated, based on tests performed by testing agency within the past five years.
- D. Maintenance Data: For each impact-resistant wall protection system component to include in maintenance manuals specified in Division 01.
 - 1. Include recommended methods and frequency for maintaining optimum condition of vinyl plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to vinyl plastic finishes and performance.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed installation of impact-resistant wall protection system components similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Manufacturer Qualifications: A firm experienced in manufacturing impact-resistant wall protection system components similar to those required for this Project and with a record of successful in-service performance.
- C. Source Limitations: Obtain each color, grade, finish, and type of impact-resistant wall protection system component from a single source with resources to provide components of consistent quality in appearance and physical properties.

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- D. Product Options: Information on Drawings and in Specifications establishes requirements for systems aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, or in-service performance.
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architects approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- E. Fire-Test-Response Characteristics: Provide wall protection system components with surface-burning characteristics indicated, as determined by testing identical materials according to ASTM E 84 by a testing and inspecting agency acceptable to authorities having jurisdiction. Identify wall protection system components with appropriate markings of applicable testing and inspecting agency.
- F. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines.
- G. Impact Strength: Provide impact-resistant wall protection system components with a minimum impact resistance of 25.4 ft-lbf/in. of width when tested according to ASTM D 256, Test Method A.

1.4 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver, store or install wall surface-protection system components until the space is enclosed and weatherproof and ambient temperature within the building is maintained at not less than 70 deg F for not less than 72 hours before beginning installation. Do not install rigid plastic wall surface-protection systems until that temperature has been attained and is stabilized.

1.5 EXTRA MATERIALS

- A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Furnish full-size units of maximum length, including vinyl plastic cover and aluminum retainer, equal to 2 percent of each type, color, and texture of each type of unit installed, but not less than two units.
 - 2. Include accessory components as required. Replacement materials shall be from the same production run as materials installed. Package replacement materials with protective covering, identified with appropriate labels.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Following manufacturers listed are "acceptable" only if manufacturer can evidence product compliance with requirements of Contract Documents.
 - 1. Alpar Architectural Products.

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2. American Floor Products Co., Inc.
3. Arden Architectural Specialties, Inc.
4. Construction Specialties, Inc. (C/S Group)
5. IPC Door and Wall Protection Systems; Division of InPro Corporation.
6. Korogard Wall Protection Systems; a division of RJF International Corporation.
7. Pawling Corporation.
8. Tepromark International, Inc.

- B. For manufacturers not listed, submit as substitution according to the Conditions of the Contract and Division 01 Specification Sections.

2.2 MATERIALS

- A. Stainless-Steel Sheet: ASTM A 240/A 240M.
- B. PVC Plastic: ASTM D 1784, Class 1, textured, chemical- and stain-resistant, high-impact-resistant PVC or acrylic-modified vinyl plastic with integral color throughout; extruded and sheet material, thickness as indicated.
- C. Engineered PETG (Polyethylene Terephthalate Glycol) Material: Textured, chemical- and stain-resistant, high-impact-resistant co-polymer plastic with integral color throughout; PVC-free with no PBTs or BPA, extruded and sheet material, thickness as indicated.
- D. Fasteners: Provide aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with aluminum components, hardware, anchors, and other items being fastened. Use theft-proof fasteners where exposed to view.

2.3 WALL AND CORNER GUARDS

- A. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other manufacturers/fabricators offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.

1. Manufacturers and Products: As scheduled or as indicated in Design Selections.

2.4 FABRICATION

- A. General: Fabricate impact-resistant wall and door protection systems to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including thicknesses of components.
- B. Preassemble components in the shop to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.
- C. Fabricate components with tight seams and joints with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.
- D. Provide inserts and other anchoring devices for connecting components to concrete or masonry. Fabricate anchoring devices to withstand imposed loads. Coordinate anchoring devices with the supporting structure.

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2.5 FINISHES, GENERAL

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrate surfaces to receive impact-resistant wall protection and associated work and conditions under which work will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to installer. Starting work within a particular area will be construed as applicator's acceptance of surface conditions.

3.2 INSTALLATION

- A. General: Install impact-resistant wall protection units level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
 - 1. Install impact-resistant wall protection units in locations and at mounting heights indicated on Drawings.
 - 2. Provide splices, mounting hardware, anchors, and other accessories required for a complete installation.
 - a. Provide anchoring devices to withstand imposed loads.
- B. Impact-Resistant Wall Covering: Install top and edge moldings, corners, and divider bars as required for a complete installation.

3.3 CLEANING

- A. General: Immediately on completion of installation, clean plastic covers and accessories using a standard ammonia-based household cleaning agent. Clean metal components according to the manufacturer's written instructions.
- B. Remove surplus materials, rubbish, and debris, resulting from installation, on completion of work and leave installation areas in neat, clean condition.

END OF SECTION

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SECTION 10 2813

TOILET ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Toilet accessories and supplementary items necessary for installation.

1.2 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product indicated.
1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, dimensions, and profiles of individual components.
 2. Include details for cutouts required in other Work; include templates, substrate preparation instructions, and directions for preparing cutouts and installing anchoring devices.
- B. Accessory Schedule: Organized by rooms, indicating types, quantities, sizes, and installation locations of each accessory, using drawing designations and room names and numbers as indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data:
1. For firms and persons specified in "Quality Assurance" to demonstrate their capabilities and experience. Include list of completed projects.
- B. Warranty: Sample of special warranty.
1. Provide manufacturer's written warranty covering materials and installation (labor) stating obligations, remedies, limitations and exclusions.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For inclusion in operation and maintenance manual as required by Division 01 Section "Operation and Maintenance Data". Include manufacturer's instructions for maintenance of installed Work, including methods and frequency for maintaining optimum condition under anticipated use. Include precautions against cleaning products and methods which may be detrimental to finishes and performance.

1.5 PRE-INSTALLATION CONFERENCE

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.
1. Participants:

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- a. Architect.
 - b. Contractor, including superintendent.
 - c. Installer, including project manager and supervisor.
 - d. If requested, Manufacturer's qualified technical representative.
 - e. Installers of other construction interfaced with Work.
2. Minimum Agenda: Installer shall demonstrate understanding of the Work required by describing detailed procedures for preparing, installing, and cleaning the Work. Demonstration shall include, but not be limited to, following topics:
- a. Tour representative areas of Work, inspect and discuss condition of substrate, and other preparatory work performed by other trades.
 - b. Review Contract Document requirements.
 - c. Review approved submittals.
 - d. Review inspection and testing requirements.
 - e. Review environmental conditions and procedures for coping with unfavorable conditions.
 - f. Resolve deviations or differences between Contract Documents and the manufacturer's specifications.
3. Record discussions, including decisions and agreements, and prepare report.

1.6 COORDINATION

- A. Coordinate installation of products with interfacing and adjoining construction to provide a successful installation without failure.

1.7 WARRANTY

- A. Mirror Manufacturer's Warranty: Furnish warranty for a period of 15 years from date of Substantial Completion agreeing to replace mirrors that develop visible silver spoilage defects, signed by an authorized representative using manufacturer's standard form.
- B. Hand Dryer Manufacturer's Warranty: Furnish warranty for a period of 10 years from date of Substantial Completion agreeing to repair or replace defective or faulty dryers, signed by an authorized representative using manufacturer's standard form.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND PRODUCTS

- A. Available Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, manufacturers offering products that may be incorporated into Work include but are not limited to those listed.
1. A & J Washroom Accessories, Inc.
 2. American Specialties, Inc.
 3. Bobrick Washroom Equipment, Inc.
 4. Bradley Corp.
 5. Brey Krause Manufacturing
 6. GAMCO, a Division of Bobrick.

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B. Shower Curtain Products Only:

1. Barjan Manufacturing Ltd.
2. Brite Inc.
3. Gary Manufacturing

C. Child and Adult Care Products Only:

1. Brocar Products, Inc. (Foundations Quality Children's Products).
2. Koala Kare Products.

D. Hand Dryer Products Only:

1. American Dryer, Inc.
2. Excel Dryer Inc.
3. Saniflow Corporation, div of Mediclinics.
4. World Dryer Corp.

E. Basis of Design: Contract Documents are based on products specified to establish a standard of quality. Other manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and do not change intended aesthetic, functional and performance requirements as judged by Architect.

2.2 MATERIALS, GENERAL

A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

B. General Requirements:

1. Unless otherwise indicated, fabricate units of all-welded construction, with corners and returns as indicated, tight seams and joints, and exposed edges rolled.
2. Fabricate frames drawn and leveled, one-piece seamless construction.
3. Hang doors and access panels with full-length, stainless-steel hinges.
4. Equip units for concealed anchorage and with corrosion-resistant backing plates.

C. Manufacturer Names or Labels: Not permitted on exposed faces of accessories. Provide printed label or stamped metal nameplate indicating manufacturer's name and product model number on an easily noticeable interior surface or on back surface of each accessory.

D. Keys: Provide minimum of 6 universal keys for internal access to accessories for servicing and resupplying.

E. Accessibility Requirements: Products and installation shall comply with Americans with Disabilities Act (ADA), ANSI A 117.1, and state and local accessibility standards.

F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

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2.3 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, with No. 4 satin finish; minimum 0.0312 in (0.8 mm) (22 gage) nominal thickness unless otherwise indicated.
- B. Mirror Glass: ASTM C 1036, Type I, Class 1, Quality q2, nominal 1/4 in (6 mm) thick, with silvering, electroplated copper coating, and protective organic coating.
- C. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
- D. ABS Plastic: Moldable acrylonitrile-butadiene-styrene resin formulation.
- E. HDPE Plastic: Moldable high-density polyethylene resin formulation.
- F. Galvanized Steel Mounting Devices: ASTM A 153, hot-dip galvanized after fabrication.
- G. Fasteners: Screws, bolts, and other devices of same material as accessory unit, tamper and theft resistant when exposed, and of non-corrosive metal when concealed.
- H. Sealant: Silicone mildew resistant sealant specified in Division 07 Section "Joint Sealants".

2.4 PAPER TOWEL DISPENSERS

- A. Drawing Designation A1 - Surface-Mounted Paper Towel Dispenser:
 - 1. Description: Fabricated of stainless steel; with hinged front equipped with full length stainless steel piano hinge and tumbler lock; pierced slots at sides as refill indicators; and sized to dispense not less than 400 C-fold or 525 multi-fold paper towels without special adapters.
 - 2. Basis of Design: Bobrick Washroom Equipment, Inc. Model B-262.
- B. Drawing Designation A5 - Owner Furnished Paper Towel Dispenser: Refer to Division 01 Sections "Summary" and "Execution" for general requirements.
- C. Drawing Designation D4 - Surface Mounted Automatic Paper Towel (Roll) Dispenser:
 - 1. Description: Surface mounted, automatic motion sensing mechanism with user-adjustable delay and paper towel length; battery powered. Sized to dispense 8 in (203 mm) wide, 800 ft (244 m) long roll. Lockset: Tumbler type.
 - 2. Basis of Design: Bobrick Washroom Equipment, Inc. Model B-72974

2.5 TOILET TISSUE DISPENSERS

- A. Drawing Designation B6 - Owner Furnished Partition Mounted Toilet Tissue Dispenser: Refer to Division 01 Sections "Summary" and "Execution" for general requirements.

2.6 GRAB BARS

- A. Drawing Designation E1, E2, E3, E4, E5, E15 - Straight Surface-Mounted Satin Finish Grab Bar with Slip-Resistant Gripping Surface:
 - 1. Description: Fabricated of stainless steel tube; with minimum 0.050 in (1.25 mm) (18

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gage) wall thickness and 1-1/2 in (38 mm) outside diameter, with 1-1/2 in (38 mm) clearance between wall surface and inside face of bar.

- a. Gripping Surfaces: Satin texture with peened gripping surfaces.
- b. Shapes: Either as indicated, or as required by condition requiring grab bar.
- c. Mounting: Concealed flanged steel plate welded to end of bar, as required by mounting condition, with snap-on cover; engineered to support minimum 300 lbs (136 kg).

2. Basis of Design:

- a. E1: Bobrick Washroom Equipment, Inc. Model B-6806.99 x 12; 12 in (300 mm)
- b. E2: Bobrick Washroom Equipment, Inc. Model B-6806.99 x 18; 18 in (450 mm)
- c. E3: Bobrick Washroom Equipment, Inc. Model B-6806.99 x 24; 24 in (600 mm)
- d. E4: Bobrick Washroom Equipment, Inc. Model B-6806.99 x 36 36 in (900 mm)
- e. E5: Bobrick Washroom Equipment, Inc. Model B-6806.99 x 42; 42 in (1050 mm)
- f. E15: Bobrick Washroom Equipment, Inc. Model B-6806.99 x 18; 18 in (450 mm)

B. Drawing Designation E7, E14, E16 - Configured Surface-Mounted Satin Finish Grab Bar with Slip-Resistant Gripping Surface:

1. Description: Fabricated of stainless steel tube; with minimum 0.050 in (1.25 mm) (18 gage) wall thickness and 1-1/2 in (38 mm) outside diameter, with 1-1/2 in (38 mm) clearance between wall surface and inside face of bar.

- a. Gripping Surfaces: Satin texture with peened gripping surfaces.
- b. Shapes: Either as indicated, or as required by condition requiring the grab bar.
- c. Mounting: Concealed flanged steel plate welded to end of bar, as required by mounting condition, with snap-on cover; engineered to support minimum 300 lbs (136 kg).

2. Basis of Design:

- a. E7: Bobrick Washroom Equipment, Inc. Model B-6861.99 16 in x 31 in (400 mm x 775 mm) unit.
- b. E14: Bobrick Washroom Equipment, Inc. Model B-68616.99, modified for 24 in x 42 in (600 mm x 1050 mm) unit.
- c. E16: Bobrick Washroom Equipment, Inc. Model B-68616.99, modified for 42 in x 54 in (1050 mm x 1350 mm) unit.

2.7 SANITARY NAPKIN VENDORS

A. Drawing Designation F1 - Surface-Mounted Sanitary Napkin Vendor:

1. Description: Fabricated of stainless steel; with seamless door with returned edges, minimum 0.050 in (1.25 mm) (18 gage) thick, equipped with full length stainless steel piano hinge, door-swing cable limiter, and two tumbler locks; identification reading "Napkins" and "Tampons" at coin slots; brand name advertising not allowed.

- a. Capacity: Not less than 20 napkins and 30 tampons.

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- b. Coin Mechanism: Field convertible, impact-resistant mechanism with pull-knob, with locked coin box keyed separately from door and other toilet accessory units; factory set at fifty cent coin operation.
 - 2. Basis of Design: Bobrick Washroom Equipment, Inc. Model B-2706 50.
- B. Drawing Designation F2 - Recessed-Mounted Sanitary Napkin Vendor:
 - 1. Description: Fabricated of stainless steel; with seamless door with returned edges, minimum 0.050 in (1.25 mm) (18 gage) thick, equipped with full length stainless steel piano hinge, door-swing cable limiter, and two tumbler locks; identification reading "Napkins" and "Tampons" at coin slots; brand name advertising not allowed; for nominal 4 in (100 mm) wall depth.
 - a. Capacity: Not less than 20 napkins and 30 tampons.
 - b. Coin Mechanism: Field convertible, impact-resistant mechanism with pull-knob, with locked coin box keyed separately from door and other toilet accessory units; factory set at fifty cent coin operation.
 - 2. Basis of Design: Bobrick Washroom Equipment, Inc. Model B-3706 50.

2.8 SANITARY NAPKIN DISPOSAL UNITS

- A. Drawing Designation G1 - Surface-Mounted Sanitary Napkin Disposal Unit:
 - 1. Description: Fabricated of stainless steel; with flush door equipped with continuous piano hinge and tumbler lock; self-closing disposal panel with spring-loaded full length stainless steel piano hinge and international symbol for sanitary napkin disposal; with removable 1.2 gal (4.6 L) capacity molded polyethylene receptacle.
 - 2. Basis of Design: Bobrick Washroom Equipment, Inc. Model B-254
- B. Drawing Designation G3 - Partition-Mounted Dual-Access Sanitary Napkin Disposal Unit:
 - 1. Description: Fabricated of stainless steel; with seamless adjustable exposed flange at both partition faces; self-closing disposal panel at both partition faces with spring-loaded full length stainless steel piano hinge and international symbol for sanitary napkin disposal; with removable 1.2 gal (4.6 L) capacity molded polyethylene receptacle.
 - 2. Basis of Design: Bobrick Washroom Equipment, Inc. Model B-354

2.9 SOAP DISPENSERS

- A. Drawing Designation J4 - Owner Furnished Surface Mounted Soap Dispenser: Refer to Division 01 Sections "Summary" and "Execution" for general requirements.

2.10 SHOWER CURTAIN ROD, HOOKS, AND CURTAIN

- A. Drawing Designation L1 - Extra-Heavy-Duty Shower Curtain Rod, Hooks, and Curtain:
 - 1. Rod: As specified below:
 - a. Description: Fabricated of stainless steel tube; 1-1/4 in (30 mm) outside diameter, 0.050 in (1.2 mm) (18 gage), satin finish; with die-formed nominal 2-1/2 in (62 mm)

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square minimum 0.0375 in (0.9 mm) (20 gage) stainless steel flanges with satin finish, and designed for exposed fasteners; length to accommodate opening width.

- b. Basis of Design: Bobrick Washroom Equipment, Inc. Model B-6047
2. Hooks: As specified below:
- a. Description: Fabricated of stainless steel; 0.09 in (2 mm) diameter spring wire curtain hooks with snap fasteners, sized to accommodate specified curtain rod size; one hook per curtain grommet.
 - b. Basis of Design: Bobrick Washroom Equipment, Inc. Part 204-1
3. Curtain: As specified below:
- a. Description: Custom fabricated of white nylon with sides and bottom hemmed, with hemmed reinforced top header containing corrosion-resistant grommets; containing anti-static, anti-bacterial and flame-retardant agents, minimum 10 mils (0.25 mm) thick.
 - b. Manufacturers:
 - 1) Barjan Manufacturing Ltd.
 - 2) Brite Inc.
 - 3) Gary Manufacturing

2.11 FOLDING SHOWER SEATS

A. Drawing Designation N1 - Surface-Mounted Folding Shower Seat:

- 1. Description: Fabricated of stainless steel minimum 0.0625 in (1.6 mm) (16 gage) square tubing and with 0.050 in (1.25 mm) (18 gage) round tubing; reversible L-shaped hinged seat made of phenolic or polymeric composite of either slat type or one-piece construction, with support braces, hinges, and frame designed to fold up against wall when not in use; color as selected by Architect from selections available. Shower seat shall comply with barrier-free accessibility guidelines.
- 2. Basis of Design: Bobrick Washroom Equipment, Inc. Model B-5181

B. Drawing Designation N2 - Surface-Mounted Folding Shower Seat:

- 1. Description: Fabricated of stainless steel minimum 0.0625 in (1.6 mm) (16 gage) square tubing and with 0.050 in (1.25 mm) (18 gage) round tubing; one piece, rectangular-shaped hinged seat made of phenolic or polymeric composite of either slat type or one-piece construction, with support braces, hinges, and frame designed to fold up against wall when not in use; color as selected by Architect from selections available. Shower seat shall comply with barrier-free accessibility guidelines.
- 2. Basis of Design: Bobrick Washroom Equipment, Inc. Model B-5193.

2.12 MOP AND BROOM HOLDERS

A. Drawing Designation P1 - Surface-Mounted Mop and Broom Holder with Utility Shelf:

- 1. Description: Fabricated of stainless steel, minimum 0.050 in (1.25 mm) (18 gage) thick shelf with returned edges, and support brackets for wall mounting; with three 0.0625 in (1.6 mm) (16 gage) stainless steel rag hooks on front of shelf, together with four

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spring-loaded, rubber hat, cam-type mop/broom holders; 1/4 in (6 mm) diameter stainless steel drying rod suspended beneath shelf; 36 in (900 mm) long.

2. Basis of Design: Bobrick Washroom Equipment, Inc. Model B-224 X 36

2.13 CHILD CARE PRODUCTS

A. Drawing Designation Q1 - Surface-Mounted Diaper Changing Station:

1. Product Quality Standard: ASTM F 2285.
2. Description: Fabricated of molded HDPE body with bed folding from vertical stored position to horizontal use position; with steel mounting plates; with concealed dampened pneumatic cylinder for controlled, slow opening and closing speed, and steel hinge mechanism fully concealed to eliminate potential for pinning; project not more than 4 in (100 mm) from wall when closed; engineered to support minimum 250 lbs (113 kg) when opened; with nylon or vinyl safety strap, hooks for hanging purse and bags, self-latching lock requiring no keys, built-in sanitary liner dispenser, and universal instruction graphics and safety messages.
3. Manufacturers and Products:
 - a. American Specialties, Inc. Model 9012.
 - b. Bradley Corporation Model 9612.
 - c. Brocar Products, Inc. Model 100-EH.
 - d. Koala Kare Products Model KB-200-00.

2.14 MIRRORS

A. Drawing Designation R1 - Surface-Mounted Stainless Steel Framed Mirror (without Shelf):

1. Description: Fabricated of stainless steel; exposed frame with angle shapes not less than 0.050 in (1.25 mm) (18 gage) thick, with square corners mitered, welded, and ground smooth, and to accommodate glass edge protection material; with galvanized steel backing sheet, minimum 0.034 in (0.8 mm) (22 gage) in thick and full mirror size, with non-absorptive filler material (corrugated cardboard not acceptable), and with hanging brackets; glass mirror.
2. Basis of Design: Bobrick Washroom Equipment, Inc. Model B-290 2436.

B. Drawing Designation R3 - Surface-Mounted Stainless Steel Framed Mirror Full Length:

1. Description: Fabricated of stainless steel; exposed frame with angle shapes not less than 0.050 in (1.25 mm) (18 gage) thick, with square corners mitered, welded, and ground smooth, and to accommodate glass edge protection material; with galvanized steel backing sheet, minimum 0.034 in (0.8 mm) (22 gage) in thick and full mirror size, with non-absorptive filler material (corrugated cardboard not acceptable), and with hanging brackets; glass mirror.
2. Basis of Design: Bobrick Washroom Equipment, Inc. Model B-290 2472

2.15 ROBE HOOKS

A. Drawing Designation V1 - Surface-Mounted Single Robe Hook:

1. Description: Fabricated of stainless steel; rectangular profiled pin welded to backplate, with cover anchored with set-screws; project nominal 1-1/2 in (38 mm) from wall surface.

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2. Basis of Design: Bobrick Washroom Equipment, Inc. Model B-76717

B. Drawing Designation V2 - Surface-Mounted Double Robe Hook:

1. Description: Fabricated of stainless steel; rectangular profiled pin welded to backplate, with cover anchored with set-screws; project nominal 2 in (50 mm) from wall surface.
2. Basis of Design: Bobrick Washroom Equipment, Inc. Model B-76727

2.16 MISCELLANEOUS ACCESSORIES

A. Drawing Designation Y1 - Semi-Recessed-Mounted High-Speed Hand Dryer:

1. Description: One-piece rust-resistant zinc alloy outer case with finish as selected, with graphic operating instructions attached; minimum 5/8 horsepower motor on resilient mountings, sealed or self-lubricating bearings, thermally protected; dynamically balanced, single-inlet centrifugal fan directing air, minimum 135 deg F. (57 deg C) at 72 deg F. (22 deg C) ambient temperature at 16,000 lin ft/min (4.9 km/min), through coiled nickel-chrome heating element, mounted in ceramic frame, to chrome-plated air-outlet nozzle; electronic infrared optical sensor automatically turning dryer on when hands cross path of sensor and shutting off when hands are either removed or dryer operates for maximum 35 seconds; voltage indicated on Electrical Drawings.
2. Recessed Wall Box: Fabricated of stainless steel, exposed frame with angle shapes of minimum 0.034 in (0.8 mm) (22 gage) box with 0.0625 in (1.6 mm) (16 gage) mounting plate, with square corners mitered, welded, and ground smooth, of depth required to meet ADA Protrusion Requirement of 4 in (100 mm) from face of wall.
3. Basis of Design: Excel Dryer, Inc. "XLerator" Model XL Series-BW, White Thermoset Resin finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

3.2 INSTALLATION, GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, install toilet accessories according to the following, unless otherwise specified in this Section:
1. Respective manufacturer's written installation instructions.
 2. Accepted submittals.
 3. Contract Documents.

3.3 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors

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which would result in poor or potentially defective installation or would cause latent defects in Work.

3.4 INSTALLATION

- A. General Requirements: Install toilet accessories level, plumb, and firmly anchored in locations and at heights indicated. Use fasteners that are appropriate to substrate indicated and as recommended by respective product manufacturer.
- B. Grab Bars: Install to withstand downward load of minimum 250 lbf (1.10 kN) according to ASTM F 446.
- C. Accessories within Shower and Tub Alcoves: Set flanges of accessories in sealant, install sealant in screw holes prior setting screws, and cover screw head prior to snapping on cover, to prevent water infiltration.
- D. Mirrors: Secure to walls in concealed, tamper-resistant manner with special hangers, toggle bolts, or screws.

END OF SECTION

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SECTION 104116
EMERGENCY KEY CABINETS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Emergency key cabinets and supplementary items necessary for installation.

1.2 ACTION SUBMITTALS

- A. Product Data: Manufacturers technical literature for each product and system indicated.
1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
- B. Samples for Verification Purposes: 3 in (75 mm) square sample of exposed metal to indicate compliance with finish specified.

1.3 QUALITY ASSURANCE

- A. Local Authority Approval: Obtain approval of local fire department for keyway access and exact location and type of emergency key cabinet mounting prior to Product Data submittal.
- B. Emergency key cabinet will be required at building entrance(s) designated by the fire department or at the building's fire control room; as appropriate.

1.4 COORDINATION

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND PRODUCTS

- A. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other manufacturers offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.
1. Knox Company.

2.2 MATERIALS, GENERAL

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

2.3 EMERGENCY KEY CABINET

- A. Product Standard: Knox Company; Knox-Box 3200 Series Hinged or Lift-Off Door Model, as required by local jurisdiction. 1/4 in (6 mm) thick steel plate housing, 1/2 in (12 mm) thick steel door with interior gasket seal and stainless steel door hinge. Box and lock shall be UL Listed.
1. Lock shall have 1/8 in (3 mm) thick stainless steel dust cover with tamper seal mounting capability.
 2. Lock shall have double-action rotating tumblers and hardened steel pins accessed by a biased cut key.
 3. Coordinate other necessary requirements with local fire department.
 4. Provide UL Listed alarm tamper switches as required by local fire department.

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- B. Size: One of the following, recessed or surface mount; as indicated on drawings:
 - 1. Recessed Mount: 7 in (175 mm) wide by 7 in (175 mm) high by 3 in (75 mm) deep.
 - a. Provide manufacturers standard recessed mounting kit (RMK) including shell housing and mounting hardware for cast-in construction.
 - 2. Surface Mount: One of the following as required by local jurisdiction:
 - a. Hinged Door Model: 5 in (125 mm) wide by 4 in (100 mm) high by 3-3/4 in (94 mm) deep.
 - b. Surface Mount - Lift-Off Door Model: 4 in (100 mm) wide by 5 in (125 mm) high by 3-3/4 in (94 mm) deep.
- C. Finish: Manufacturers standard weather resistant polyester powder coat.
 - 1. Color: As selected by Architect from manufacturers standard colors.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

3.2 INSTALLATION, GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
 - 1. Respective manufacturers written installation instructions.
 - 2. Accepted submittals.
 - 3. Contract Documents.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by isolating metals and other materials from direct contact with incompatible materials.

3.3 PREPARATION

- A. General: Comply with manufacturers instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.

3.4 INSTALLATION OF EMERGENCY KEY CABINETS

- A. Install in accordance with manufacturer's latest published requirements.
- B. Recess Mount Units: Securely attach recessed mounting kit within cast-in wall construction. Shell housing box shall be flush with face of finished wall and plumb and level to ensure vertical alignment of box.
- C. Tamper Switches: Install switches, including control wiring, as follows:
 - 1. Refer to Division 26 Sections for connection to electrical power distribution system.
 - 2. Coordinate tamper switches with building security system.

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END OF SECTION

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SECTION 10 4400

FIRE-PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Work required for this section includes fire protection specialties (fire extinguishers, cabinets, accessories) and supplementary items necessary to complete their installation.
- B. Cabinets for fire protection standpipe and hose systems are specified in Division 21.

1.2 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire-protection specialties.
 - 1. Fire Extinguishers: Include rating and classification.
 - 2. Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
- B. Samples for Verification: For each type of exposed cabinet finish required, prepared on -6 by -6 inch square Samples and of same thickness and material indicated for the Work. If finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.

1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain fire extinguishers and cabinets through one source from a single manufacturer.
- B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Standard for Portable Fire Extinguishers."
- C. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Following manufacturers listed are "acceptable" only if manufacturer can evidence product compliance with requirements of Contract Documents.

J.L. Industries, Inc.
Larsen's Manufacturing Co.
Potter-Roemer, Div. of Smith Industries Inc.

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- B. For manufacturers not listed, submit as substitution according to the Conditions of the Contract and Division 1 Specification Sections.

2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: Carbon steel, complying with ASTM A 1008/A 1008M, commercial quality, stretcher leveled, temper rolled.

2.3 PORTABLE FIRE EXTINGUISHERS

- A. General: Provide fire extinguishers of type, size, and capacity for each cabinet and other locations indicated.
- B. Multipurpose Dry Chemical Type - Typical (unless otherwise indicated): UL-rated 2-A:10-B:C, 5-lb nominal capacity, in enameled steel container.

2.4 FIRE-PROTECTION CABINETS

- A. Cabinet Construction: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated. Weld joints and grind smooth. Miter and weld perimeter door frames.
- B. Fire-Rated Cabinets: Listed and labeled to meet requirements of ASTM E 814 for fire-resistance rating of wall where it is installed.
 - 1. Construct fire-rated cabinets with double walls fabricated from 0.0478-inch- thick, cold-rolled steel sheet lined with minimum 5/8-inch- thick, fire-barrier material.
 - 2. Provide factory-drilled mounting holes.
- C. Typical Cabinet: (Unless otherwise indicated)
 - 1. Cabinet Metal: Enameled-steel sheet.
 - 2. Cabinet Type: Suitable for 10 lb. Fire extinguisher.
 - 3. Cabinet Mounting: Recessed in walls of sufficient depth to suit style of trim indicated.
 - 4. Cabinet Trim Style: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.
 - a. Exposed Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
 - 1) Flat Trim: 1/4- to 5/16-inch backbend depth.
 - 2) Square-Edge Trim: 1-1/4- to 1-1/2-inch backbend depth.
 - 5. Cabinet Trim Material: Manufacturer's standard, same metal and finish as door.
 - 6. Door Material: Manufacturer's standard, enameled steel sheet.
 - 7. Door Style: Manufacturer's standard, without glass.
 - 8. Door Construction: Fabricate doors according to manufacturer's standards, of materials indicated, and coordinated with cabinet types and trim styles selected. Provide minimum 1/2-inch- thick door frames, fabricated with tubular stiles and rails, and hollow-metal design.

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9. Door Hardware: Provide manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated. Provide either lever handle with cam-action latch, or exposed or concealed door pull and friction latch. Provide concealed or continuous-type hinge permitting door to open 180 degrees.

2.5 ACCESSORIES

- A. Mounting Brackets: Manufacturer's standard steel, designed to secure extinguisher, of sizes required for types and capacities of extinguishers indicated, with plated or baked-enamel finish. Provide brackets for extinguishers not located in cabinets.
- B. Identification: Provide lettering to comply with authorities having jurisdiction for letter style, color, size, spacing, and location.
1. Bracket-Mounted Extinguishers: Identify with the words "FIRE EXTINGUISHER" in red letter decals applied to wall surface.
2. Fire Extinguisher Cabinet: Identify with the words "FIRE EXTINGUISHER" in black die cut vinyl letters applied to door.

2.6 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Cabinet and Door Finishes: Provide manufacturer's standard baked-enamel paint for interior of cabinets and doors. Provide manufacturer's standard baked-enamel primer for exterior of cabinets and doors suitable for field applied finish coat.
- E. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrate surfaces to receive fire extinguishers, cabinets and associated work and conditions under which work will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Installer. Starting work within a particular area will be construed as applicator's acceptance of surface conditions.

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3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing fire-protection specialties.
- B. Install in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.
 - 1. Prepare recesses for cabinets as required by type and size of cabinet and trim style.
 - 2. Fasten cabinets to structure, square and plumb.

3.3 ADJUSTING, CLEANING, AND PROTECTION

- A. Adjust cabinet doors that do not swing or operate freely.
- B. Refinish or replace cabinets and doors damaged during installation.
- C. Provide final protection and maintain conditions that ensure that cabinets and doors are without damage or deterioration at the time of Substantial Completion.

END OF SECTION

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SECTION 104450
AUTOMATED EXTERNAL DEFIBRILLATORS (AED)

PART 1 - GENERAL

1.1 SUMMARY

- A. Work required for this section includes cabinets and devices for automated external defibrillators (AED) and supplementary items necessary to complete their installation.

1.2 ACTION SUBMITTAL

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for AED devices and cabinets.
 - 1. AED Devices: Include manufacturer, model and rating information.
 - 2. Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
- B. Samples for Verification: For each type of exposed cabinet finish required, prepared on 6 by 6 in (150 by 150 mm) square samples and of same thickness and material indicated for the Work. If finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.

1.3 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Project Acceptance Document: Certification by the manufacturer that its product(s) are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required, and that a warranty will be issued. That all components meet the requirements of the specifications and are acceptable to the authorities having jurisdiction.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain AED devices and cabinets through one source from a single manufacturer.
- B. Regulatory Approval: Approved by the United States FDA and acceptable to authorities having jurisdiction.

1.5 COORDINATION

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

1.6 WARRANTY

- A. Manufacturer's Warranty: Furnish manufacturer's written material and labor warranty signed by an authorized representative using manufacturer's standard form agreeing to furnish materials and labor required to repair or replace work which exhibits material defects caused by manufacture or design and installation of product. "Defects" are defined to include but not limited to deterioration or failure to perform as required.
 - 1. Coverage of warranty includes but is not limited to the following:
 - 2. Warranty Period: Manufacturer shall warrant the products to be free from material and labor Defects for a period of 5 years from date of Substantial Completion.

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- B. Battery Replacement: Warranty shall include replacement of batteries that fail within the manufacturer's printed battery life warranty.
- C. Accessories: Manufacturer standard warranty for accessories.
- D. Extension of Warranty: Provide Owner with the option to purchase extended warranty on devices beyond the manufacturer standard warranty on all components.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND PRODUCTS

- A. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".
- B. Manufacturers:
 - 1. Philips Healthcare; Heartstart Onsite AED.
 - 2. Cardiac Science; Powerheart G3 Plus AED.
 - 3. Defibtech; Lifeline AED.
 - 4. ZOLL Medical Corporation; AED Plus.

2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: Carbon steel, complying with ASTM A 1008/A 1008M, commercial quality, stretcher leveled, temper rolled.

2.3 AED DEVICES

- A. Automated External Defibrillators: Portable devices capable of detecting cardiac arrhythmias and if necessary delivering automatic synchronized shock to victims of sudden cardiac arrest with the following minimum features:
 - 1. Design Standards: Meet the applicable requirements of UL 2601, AAMI DF-39, IEC 601-2-4, EN60601-1, IEC60601-1-2.
 - 2. Device Classification: Class II and internally powered per EN60601-1.
 - 3. Display written instructions to user through the rescue process.
 - 4. Battery status indicator.
 - 5. Automated synchronization features.
 - 6. Programmable.
 - 7. Pacemaker pulse detection feature.
 - 8. Pediatric capability.
 - 9. User replaceable batteries.

2.4 AED CABINETS

- A. Cabinet Construction: Provide manufacturer's standard box, with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated. Weld joints and grind smooth. Miter and weld perimeter door frames.
- B. Fire-Rated Cabinets: Listed and labeled to meet requirements of ASTM E 814 for fire-resistance rating of wall where it is installed.
 - 1. Construct fire-rated cabinets with double walls fabricated from 0.0478 in (1.2 mm) thick, cold-rolled steel sheet lined with minimum 5/8 in (15 mm) thick, fire-barrier material.
 - 2. Provide factory-drilled mounting holes.

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C. Cabinet:

1. Material: Steel sheet.
2. Mounting: Semi Recessed Cabinet: Recess cabinets in walls of sufficient depth to suit style of trim indicated.
3. Trim Style: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth. Same metal and finish as door.
 - a. Exposed Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend). Rolled-Edge Trim: backbend depth as standard with the manufacturer, but not exceeding 2 in (50mm).
4. Door Material: Steel sheet.
5. Door Glazing: Manufacturer's standard tempered float glass (clear).
6. Door Construction: Fabricate doors according to manufacturer's standards, of materials indicated, and coordinated with cabinet types and trim styles selected. Provide minimum 1/2 in (12 mm) thick door frames, fabricated with tubular stiles and rails, and hollow-metal design.
7. Door Hardware: Provide manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

2.5 ACCESSORIES

- A. Signage and Identification: Provide lettering to comply with authorities having jurisdiction for letter style, color, size, spacing, and location. Standard industry accepted signs must mark the location of the AED.
- B. Alarm: If required by the authorities having jurisdiction, provide strobes and local audible alarm at each location. Provide all electrical rough-in required and coordinate all electrical requirements for strobes and alarms.
- C. Cabinet Label: "EMERGENCY DEFIBRILLATOR".

2.6 AED CHARGING STATION

- A. Provide at least one charging station compatible with AED device rechargeable batteries.

2.7 GENERAL FINISH REQUIREMENTS, AED CABINETS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces of emergency equipment cabinets from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.8 STEEL FINISHES, AED CABINETS

- A. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning" or SSPC-SP 8, "Pickling". After cleaning, apply a conversion coating suited to the organic coating to be applied over it.
- B. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting

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topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.05 mm).

1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

3.2 INSTALLATION, GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified.
 1. Respective manufacturer's written installation instructions.
 2. Accepted submittals.
 3. Contract Documents.

3.3 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.

3.4 INSTALLATION

- A. Install in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.
 1. Prepare recesses for cabinets as required by type and size of cabinet and trim style.
 2. Fasten cabinets to structure, square and plumb.

3.5 ADJUSTING, CLEANING, AND PROTECTION

- A. Adjust cabinet doors that do not swing or operate freely.
- B. Refinish or replace cabinets and doors damaged during installation.
- C. Provide final protection and maintain conditions that ensure that cabinets and doors are without damage or deterioration at the time of Substantial Completion.

END OF SECTION

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SECTION 11 4911

GYMNASIUM EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Work required for this section includes gymnasium equipment, preparation, and supplementary items necessary to complete their installation.
 - 1. Basketball Equipment.
 - 2. Volleyball Equipment.
 - 3. Wall Safety Padding.

1.2 DEFINITIONS

- A. NFHS: The National Federation of State High School Associations.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. If applicable, include assembly, disassembly, and storage instructions for removable equipment.
 - 2. Motors: Show nameplate data, ratings, characteristics, and mounting arrangements.
- B. Shop Drawings: For gymnasium equipment. Include plans, elevations, sections, details, attachments to other work, and the following:
 - 1. Method of field assembly for removable equipment, connections, installation details, mountings, attachments to other work, and operational clearances.
- C. Structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation including loads, point reactions, and locations for attachment of gymnasium equipment to structure.
- D. Coordination Drawings: Court layout plans, drawn to scale, and coordinating floor inserts, game lines, and markers applied to finished flooring.
- E. Product Certificates: For each type of gymnasium equipment, signed by product manufacturer.
- F. Operation and Maintenance Data: For gymnasium equipment to include in emergency, operation, and maintenance manuals.
- G. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

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- B. Source Limitations: Obtain each type of gymnasium equipment through one source from a single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. All welding to be performed by personnel having passed Welder Qualification testing in accordance with American Welding Society (AWS) code D1.1 or higher. Manufacturer to provide certification and test results upon request.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Provide volleyball floor sleeves, covers and floor inserts in accordance with requirements of related trades that are responsible for installation. Do not deliver balance of athletic equipment until building is enclosed and other construction within gymnasium is substantially complete.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install gymnasium equipment until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Verify layout for gymnasium equipment.

1.7 COORDINATION

- A. Coordinate installation of floor inserts with structural floors and finish flooring installation and with court layout and game lines and markers on finish flooring.
- B. Coordinate layout and installation of overhead-supported gymnasium equipment and suspension system components with other construction including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of gymnasium equipment that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Basketball backboard failures including glass breakage.
 - b. Failure of operating components, connections and manufactured assemblies
 - c. Fading of finishes.
 - 2. Warranty Period: 10 years from date of Substantial Completion.

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PART 2 - PRODUCTS

2.1 PRODUCT STANDARD

- A. The Contract Documents are based on the following products to establish a standard of quality. Other acceptable manufacturers with products having equivalent characteristics may be considered provided deviations are minor and do not change the intended aesthetic, functional, and performance requirements as judged by the Architect.
 - 1. Manufacturer: Draper, Inc.
 - 2. Products: As indicated in the following Articles for the various Courts.
- B. Other Acceptable Manufacturers: Subject to compliance with requirements, products from one of the following may be used:
 - 1. AALCO Manufacturing.
 - 2. ADP Lemco Inc.
 - 3. Basketball Products International; a division of American Athletic, Inc.
 - 4. Bison Inc.
 - 5. Jaypro Sports, LLC.
 - 6. Nevco
 - 7. Performance Sports Systems.
 - 8. Porter Athletic Equipment Company
- C. For consideration of manufacturers other than the above named product standard and other acceptable manufacturers, submit as a substitution according to the Conditions of the Contract and Division 01 Specification Sections.

2.2 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - 1. Extruded Bars, Profiles, and Tubes: ASTM B 221.
 - 2. Cast Aluminum: ASTM B 179.
 - 3. Flat Sheet: ASTM B 209.
- B. Steel: Comply with the following:
 - 1. Steel Plates, Shapes, and Bars: ASTM A 36.
 - 2. Steel Tubing: ASTM A 500 or ASTM A 513, cold formed.
 - 3. Steel Sheet: ASTM A 1011/A 1011M.
- C. Support Cable: Manufacturer's standard galvanized steel aircraft cable. Provide fittings complying with cable manufacturer's written instructions for size, number, and method of installation.
- D. Support Chain and Fittings: Grade 80 hardened alloy steel chain rated for overhead lifting, ASTM A 391/A 391M, with commercial-quality, zinc-plated steel connectors and hangars.
- E. Castings and Hangers: Malleable iron, ASTM A 47/A 47M, grade required for structural loading.
- F. Equipment Wall-Mounting Board: Wood, transparent finish, size, and quantity as required to mount gymnasium equipment according to manufacturer's written instructions.

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- G. Anchors, Fasteners, Fittings and Hardware: Manufacturer's standard corrosion-resistant or noncorrodible units; concealed; tamperproof, vandal- and theft-resistant design.

2.3 MAIN BASKETBALL GOALS

- A. General: Provide equipment complying with requirements in NFHS's "NFHS Basketball Rule Book".
- B. Protruding fasteners or exposed bolt heads on front face of backboards are not permitted.
- C. Basketball Backstops:
1. Product Standard: Draper EZ FOLD Model TF-20S, ceiling-suspended, bent-stem, front-braced, forward folding. System shall be height adjustable for 8 foot to 10 foot height.
 2. Framing: Steel pipe, tubing, and shapes. Rigid tetrahedral "T" design of back-to-back right triangles framing designed to minimize vibration during play.
 - a. Welded and bolted or clamped with cross bracing. Provide manufacturer's standard assembly for manually-operated folding backstops with hardware and fittings to permit folding in direction indicated.
 - b. Finish: Manufacturer's standard powder-coat finish.
 3. Backboard Safety Device: Product Standard: Draper Model 503029 Posilok safety strap, designed to limit free fall if support cable, support chain, pulleys, fittings, winch, or related components fail; with mechanical automatic reset; 6000-lb load capacity; one per folding backboard.
 4. Backboard: Product Standard: Draper Model 503136 rectangular glass backboard, 3'-6" high by 6'-0" wide. Provide Draper Model 5032XX bolt-on backboard safety padding, color as selected by Architect.
 - a. Target Area and Border Markings: Permanently fired in white color, marked in manufacturer's standard pattern and stripe width.
 5. Goal: Product Standard: Draper Model 503576 breakaway goal with high quality white nylon anti-whip net. The rim shall deflect down when a static load of 230 pounds is applied and return to the playing position once the load is removed.
 - a. Goal Mounting Assembly: Compatible with goal, backboard, and support framing; with hole pattern that is manufacturer's standard for goal attachment.
 - b. Glass Backboard Goal Mounting Assembly: Goal support framing and reinforcement designed to transmit load from goal to backboard frame and to minimize stresses on glass backboard.
- D. Backboard Electric Operator: Product Standard: Draper Model 503085 electric winch. Provide operating machine of size and capacity recommended by manufacturer for equipment specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, and remote controls. Coordinate wiring requirements and electrical characteristics with building electrical system.
- a. Operator Type: Cable drum with grooved drum and cable tension device to automatically take up cable slack and retain cable in grooves.
 - b. Operator Mounting: Wall-mounting board.

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- c. Motor Characteristics: Sufficient to start, accelerate, reverse, and operate connected loads at designated speeds within installed environment and with indicated operating sequence, and without exceeding nameplate rating or considering service factor. Comply with NEMA MG 1, and the following:
- d. Voltage: 120 V.
- e. Horsepower: 3/4 hp.
- f. Enclosure: Manufacturer's standard.
- g. Duty: Continuous duty at ambient temperature of 105 deg F.
- h. Service Factor: 1.15 for open dripproof motors; 1.0 for totally enclosed motors.
- i. Phase: One.
- j. Remote-Control Station: NEMA ICS 6, Type 1 enclosure for recessed or flush mounting, momentary-contact, three-position switch-operated control with up, down, and off functions.
 - 1) Group Key Switch Control Stations: One switch per each backboard.
 - 2) Keys: Provide one key per station.
 - 3) Switches, Ganged: Single faceplate with multiple switch cut-outs.
- k. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop basketball equipment at fully retracted and fully lowered positions.

2.4 SIDE BASKETBALL GOALS

- A. General: Provide equipment complying with requirements in NFHS's "NFHS Basketball Rule Book".
- B. Protruding fasteners or exposed bolt heads on front face of backboards are not permitted.
- C. Basketball Backstops:
 - 1. Product Standard: Draper EZ FOLD Model DUW, wall-mounted, up folding backstop. System shall be height adjustable for 8 foot to 10 foot height.
 - 2. Framing: Backstop mounted to wall at four hinged points with two adjustable, rectangular top and bottom frames constructed from 2-1/2 inches [64 mm] diameter, 13 gauge [2.4 mm thick] outer tube and 2-1/4 inches [57 mm] diameter, 14 gauge [2 mm] inner tube.
 - a. Welded and bolted or clamped with cross bracing. Provide manufacturer's standard assembly for manually-operated folding backstops with hardware and fittings to permit folding in direction indicated.
 - b. Finish: Manufacturer's standard powder-coat finish.
 - 3. Backboard Safety Device: Product Standard: Draper Model 503029 Posilok safety strap, designed to limit free fall if support cable, support chain, pulleys, fittings, winch, or related components fail; with mechanical automatic reset; 6000-lb load capacity; one per folding backboard.
 - 4. Backboard: Product Standard: Draper Model 503148 fan fiberglass backboard, 3'-3" high by 4'-6" wide.
 - a. Target Area and Border Markings: Permanently molded in orange color, marked in manufacturer's standard pattern and stripe width.

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5. Goal: Product Standard: Draper Model 503570 stationary goal with high quality white nylon net.

- a. Goal Mounting Assembly: Compatible with goal, backboard, and support framing; with hole pattern that is manufacturer's standard for goal attachment.

- D. Backboard Electric Operator: Product Standard: Draper Model 503085 electric winch. Provide operating machine of size and capacity recommended by manufacturer for equipment specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, and remote controls. Coordinate wiring requirements and electrical characteristics with building electrical system.

- a. Operator Type: Cable drum with grooved drum and cable tension device to automatically take up cable slack and retain cable in grooves.
- b. Operator Mounting: Wall-mounting board.
- c. Motor Characteristics: Sufficient to start, accelerate, reverse, and operate connected loads at designated speeds within installed environment and with indicated operating sequence, and without exceeding nameplate rating or considering service factor. Comply with NEMA MG 1, and the following:
- d. Voltage: 120 V.
- e. Horsepower: 3/4 hp.
- f. Enclosure: Manufacturer's standard.
- g. Duty: Continuous duty at ambient temperature of 105 deg F.
- h. Service Factor: 1.15 for open dripproof motors; 1.0 for totally enclosed motors.
- i. Phase: One.
- j. Remote-Control Station: NEMA ICS 6, Type 1 enclosure for recessed or flush mounting, momentary-contact, three-position switch-operated control with up, down, and off functions.

- 1) Group Key Switch Control Stations: One switch per each backboard.
- 2) Keys: Provide one key per station.
- 3) Switches, Ganged: Single faceplate with multiple switch cut-outs.

- k. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop basketball equipment at fully retracted and fully lowered positions.

2.5 VOLLEYBALL EQUIPMENT

- A. Volleyball Court Systems: Total of 1 main court unit and floor sleeves and cover plates only for side units required: Product Standard: Draper PVS-01 Model 500001; systems shall include the following components as necessary for complete assembly:

1. Floor Sleeves: Product Standard: Draper Model 501006. Round, mechanical steel tube sleeve welded to steel anchor plate for casting in concrete floor to receive volleyball standard
- a. Size: 3-1/2 inches inside diameter tube by 8-1/2 inches long with 4 inch square anchor base plate.
2. Cover Plates: Product Standard: Draper Model 501001. Lockable swivel access cover, designed for use with floating wood floors and to be flush with adjacent flooring. Provide 2 tools for unlocking access covers.

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3. Post Standards: Removable, paired volleyball post standards as indicated. Adjustable, telescoping height. Designed for easy removal from permanently placed floor insert supports. Fabricated from extruded-aluminum pipe or tubing, with nonmarking plastic or rubber end cap or floor bumper to protect flooring. Finished with manufacturer's standard factory-applied, baked powder-coating finish complying with finish manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.
 - a. Telescopic and Net Height Adjuster System: Provide Manufacturer's standard telescoping system with locking device, telescopic post, and fittings for holding net at selected height; designed for height adjustment of post standard to position net at incremental heights.
4. Nets: Product Standard: Draper Model 50004. 32 feet long and as follows; 1 per pair of paired post standards:
 - a. Height and Mesh: 39-1/2 inches with 4 inch square mesh made of #36 black polyester cord.
 - b. Hem Band Edges: Double stitched, vinyl coated polyester hem around perimeter of net; white top binding and black bottom and side bindings; tie offs at top and bottom of each side end of net; and 1/8 inch diameter galvanized aircraft cable with nylon coating, threaded through top hem of binding. Equip ends of cable with loops formed with heavy swadged type fittings.
 - c. Dowels: Not less than 1/2 inch diameter fiberglass. Provide two dowels per net threaded through each side hem sleeve for straightening net side edges.
 - d. Boundary Markers: Product Standard: Draper Model 500006; 2 inch wide white polyester reinforced vinyl strips, one at each end of the net.
5. Antennas: Product Standard: Draper Model 500007, 3/8 inch diameter, high-tensile-strength, extruded fiberglass rods, 72 inches long, extending above top hem band of net, with alternating white and red bands according to competition rules. Provide two antennas per net.
 - a. Clamps: Designed to secure antenna to top and bottom of net.
6. Net Tensioning System: Product Standard: Draper Model A3020012; designed to adjust and hold tension of net. Fully enclosed, nonslip manufacturer's standard-type winch with cable length and fittings for connecting to net lines, positive-release mechanism, and manufacturer's standard handle. Provide end post with post top pulley. Provide opposing post with welded steel loops, hooks, pins, or other devices for net attachment and post top grooved line guide.
7. Bottom Net Lock Tightener: Provide manufacturer's standard quick-release-type tension strap, spring-loaded self-locking tensioner, turnbuckle, pulley, or other device and linkage fittings designed to quickly and easily tighten bottom line or net.
8. Judges' Stands: Product Standard: Draper Model 5013XX; movable platform attached to and supported by post standard. Fabricate units of welded steel tubing with finish and color to match post standards.
9. Safety Pads: Comply with NFHS requirements. Provide pads consisting of not less than 1-1/4 inch thick, multiple-impact-resistant manufacturer's standard foam filler covered by puncture- and tear-resistant 14 ounce PVC-coated polyester, treated with fungicide for mildew resistance, manufacturer's standard fabric cover; with fire-test-response characteristics indicated, and lined with fire-retardant liner. Provide pads with hook-and-loop closure or attachments for the following components:

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- a. Post Standards: Wraparound style, designed to totally enclose each standard to a height of not less than 68 inches; 1 per post.
 - b. Net Lines: Four per net.
 - c. Judges' Stands: Designed to totally enclose each unit.
 - d. Fabric Cover Flame-Resistance Ratings: Passes NFPA 701.
 - e. Fabric Color: As selected by Architect from manufacturer's full range.
- B. Post Standard Transporter: Product Standard: Draper Model 501016; heavy-duty unit with swivel casters designed to store and transport standards, net, protection pads, and other components and accessories required for setting up volleyball court.

2.6 WALL SAFETY PADS

- A. Safety Pad Surface-Burning Characteristics: ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
- 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 450 or less.
- B. Pad Coverings: Provide safety pad fabric covering fabricated from puncture- and tear-resistant, not less than 14-oz./sq. yd PVC-coated polyester or nylon-reinforced PVC fabric treated with fungicide for mildew resistance; with surface-burning characteristics indicated.
- C. Wall Safety Pads: Padded wall wainscot panels designed to be attached in a continuous row; each panel section consisting of fill laminated to backer board with visible surfaces fully covered by seamless fabric covering, free of sag and wrinkles and firmly attached to back of backer board.
- 1. Backer Board: Not less than 3/8-inch thick fire-retardant-treated plywood per AWPA C27, Interior Type A
 - 2. Fire-Resistive Fill: Multiple-impact-resistant foam not less than 2-inch thick fire-resistive neoprene, 6.0-lb/cu. ft. density].
 - 3. Size: Each panel section, 24 inches wide by not less than 60 inches.
 - 4. Number of Panel Sections: As required to cover the wall indicated.
 - 5. Installation Method: 1-inch top and bottom fabric attachment flange with exposed fasteners.
 - 6. Fabric Covering Color: As selected by Architect from manufacturer's full range for one color.
 - 7. Locations: As indicated on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for play court layout, alignment of mounting substrates, installation tolerances, operational clearances and other conditions affecting performance.
- 1. Verify critical dimensions.
 - 2. Examine supporting structure below finished floor.
 - 3. Examine wall assemblies, where reinforced to receive anchors and fasteners, to verify that locations of concealed reinforcements have been clearly marked. Locate reinforcements and mark locations.
 - 4. Proceed with installation only after unsatisfactory conditions have been corrected.

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3.2 INSTALLATION, GENERAL

- A. General: Comply with manufacturer's written installation instructions and competition rules indicated for each type of gymnasium equipment. Complete equipment field assembly, where required.
- B. Unless otherwise indicated, install gymnasium equipment after other finishing operations, including painting, have been completed.
- C. Provide block outs in concrete, for volleyball inserts, to avoid penetrating the under-slab vapor barrier.
- D. Permanently Placed Gymnasium Equipment and Components: Rigid, level, plumb, square, and true; anchored securely to supporting structure; positioned at locations and elevations indicated on Shop Drawings; in proper relation to adjacent construction; and aligned with court layout.
 - 1. Operating Gymnasium Equipment: Verify clearances for movable components of gymnasium equipment throughout entire range of operation and for access to operating components.
- E. Wall Safety Pads: Mount with bottom edge at 4 inches above finished floor.
- F. Anchoring to In-Place Construction: Use anchors and fasteners where necessary for securing built-in and permanently placed gymnasium equipment to structural support and for properly transferring load to in-place construction.
- G. Alternate Proposal Connections: Connect automatic operators to building electrical system.

3.3 ADJUSTING

- A. Adjust movable components of gymnasium equipment to operate safely, smoothly, easily, and quietly, free from binding, warp, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Lubricate hardware and moving parts.

3.4 CLEANING

- A. After completing gymnasium equipment installation, inspect components. Remove spots, dirt, and debris and touch up damaged shop-applied finishes according to manufacturer's written instructions.
- B. Replace gymnasium equipment and finishes that cannot be cleaned and repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain gymnasium equipment.

END OF SECTION

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SECTION 115213
PROJECTION SCREENS

PART 1 - GENERAL

1.1 SUMMARY

- A. Perform work required to complete the projection screens indicated by the contract documents and furnish supplementary items necessary for their proper installation.

1.2 ACTION SUBMITTALS

- A. Samples: Submit for approval samples of screen materials showing construction and finish specified.
- B. Shop Drawings: Submit manufacturer's literature and mark sufficiently to indicate compliance with these specifications. Show locations, methods of supporting, methods of anchoring and finishes of each projection screen.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".
 - 1. Da-Lite Screen Company
 - 2. Draper Inc.
 - 3. Stewart Filmscreen Corporation

2.2 MATERIALS

- A. Projection Screens (Electrically Operated): Da-Lite Screen Co., Inc., "Professional Electrol" Automatic Electric Projection Screen, size as indicated on the drawings.
 - 1. Screen shall be electrically operated with a 120 volt AC (60 Hz) 2.4 amp, three (3) wire quick reversal motor, especially designed for the purpose. Motor shall be ball bearing type, and oiled for life, with automatic thermal overload cut-out and integral interlocking gears.
 - 2. Screen operating system shall have pre-set but accessible limit switches to automatically stop screen fabric in the "up" and "down" positions. Stop action shall be positive, to prevent coasting.
 - 3. System shall include a rigid metal roller at least 3 in (75 mm) diameter (to be used for screens 12' or less in width), or 5-3/4 in (142 mm) diameter (to be used on screens 14' to 18' in width), or 7 in (175 mm) diameter (to be used on screens where either height or width exceeds 20'). Roller shall be mounted on two cast aluminum brackets equipped with self-aligning bearings.
 - 4. Screen surface shall be flame retardant and mildew resistant, black masking borders, and with the following viewing surface:
 - a. Matte white.
 - 5. Case shall be of wood with double top for extra rigidity and sound deadening.
 - 6. Case shall be finished with a primer coat, ready to accept final finish by others.
 - 7. Heavy metal adjustable brackets shall be furnished for mounting screen as follows:

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- a. Ceiling.
 - b. Walls.
 - c. Structure above ceiling.
8. System shall be complete with three (3) position control switch in box with cover plate.
9. The complete screen unit shall be "Listed by Underwriters' Laboratories, Inc.", and shall bear the re-examination markers of the Underwriters' Laboratories, Inc.
- B. Projection Screens (Manually Operated): Da-Lite Screen Co., Inc. Model "Video B", manually operated spring roller type Screen, size(s) as indicated.
- 1. Case: Heavy gage octagon shape steel case with flat back design with baked enamel finish, fitted with heavy duty chrome case end caps concealing roller ends with integral bearing surface or steel inner caps to support roller.
 - 2. Mounting Brackets: Plated steel brackets attached to end caps for wall mounting by means of slotted screw holes and ceiling mounted by means of plated steel hanger rings. Furnish heavy angle adjustable steel extension wall brackets.
 - 3. Screen Fabric:
 - a. Viewing surface shall be as follows with masking borders on flame retardant and mildew resistant fabric.
 - 1) Matte white.
 - 2) Glass-beaded.
 - b. Bottom of fabric shall be mounted into a metal strip in a tubular steel slat finished in baked enamel. Ends of slat shall be protected by plastic caps.
 - c. Fabric shall be mounted into a metal strip in a metal "camlok" roller system without tape, glue, staples or cords, so that fabric may be easily replaced yet, cannot be pulled from roller.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be as indicated on the Drawings.
- B. Installation shall be in accordance with the manufacturer's latest published requirements, specifications and details.

END OF SECTION

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SECTION 12 2413

ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Roller window shades and supplementary items necessary to complete their installation.
 - 1. Manually operated roller shades.
 - 2. Motor-operated roller shades.
- B. Related Requirements:
 - 1. Motorized Units: Division 26 Sections for electrical service and connections for motor operators, controls, limit switches, and other powered devices and for system disconnect switches for motorized shade operation.

1.2 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
 - 1. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.
- B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.
 - 1. Motor-Operated Shades: Include details of installation and diagrams for power, signal, and control wiring.
- C. Samples for Verification: For each type of roller shade.
 - 1. Shadeband Material: Not less than 10 in (250 mm) square. Mark inside face of material if applicable.
 - 2. Roller Shade: Full-size operating unit, not less than 16 in (400 mm) wide by 36 in (900 mm) long for each type of roller shade indicated.
 - 3. Installation Accessories: Full-size unit, not less than 10 in (250 mm) long.
- D. Roller-Shade Schedule: Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Project Acceptance Document: Certification by the manufacturer that its product(s) are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required, and that a warranty will be issued.

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- B. Field Quality Control Reports - Motor Operated Shades: Written report of testing and inspection required by "Field Quality Control".
- C. Product Test Reports: For each type of shadeband material, written reports based on evaluation of comprehensive tests performed by qualified testing agency indicating that each product complies with requirements.
- D. Warranty: Sample of warranty.
 - 1. Provide manufacturer's written warranty covering materials and installation (labor) stating obligations, remedies, limitations and exclusions.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For roller shades to include in maintenance manuals.
 - 1. Methods for maintaining roller window shades and finishes.
 - 2. Precautions about cleaning materials and methods that could be detrimental to fabrics, finishes, and performance.
 - 3. Operating hardware.
 - 4. Motorized shade operator.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Rollers Shades: Before installation begins, for each size, color, texture, and pattern indicated, full-size units equal to 5 percent of amount installed, but not fewer than 2 units.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.
 - 1. Experience: Installer's personnel with not less than 5 years of experience in the successful performance of Work similar to scope of this Project.
 - 2. Supervision: Installer shall maintain a competent supervisor at Project while the Work is in progress, and who has not less than 5 years of experience installing products and systems similar to scope of this Project.
 - 3. Manufacturer Acceptance: Installer shall be certified, approved, licensed, or acceptable to manufacturer to install products.
- B. Mock-ups: Prior to fabrication and installation, build mock-up for each form of construction and finish required to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mock-up using materials indicated for the completed Work.
 - 1. Build mock-up in the location and of the size indicated or, if not indicated, as directed by Architect. Contractor shall provide structural support framework.
 - a. Show typical components, attachments to building structure, and requirements of installation.

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2. Notify Architect seven days in advance of the dates and times when mock-up will be installed.
3. Obtain Architect's acceptance of mock-ups before starting fabrication or installation.
4. Acceptance of mock-ups does not constitute acceptance of deviations from the Contract Documents contained in mock-ups unless such deviations are specifically noted by Contractor and accepted by Architect in writing.
5. Demolish and remove mock-ups when directed by Architect unless accepted to become part of the completed Work.

1.7 PRE-INSTALLATION CONFERENCE

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.

1. Participants:
 - a. Architect.
 - b. Contractor, including superintendent.
 - c. Installer, including project manager and supervisor.
 - d. If requested, Manufacturer/fabricator's qualified technical representative.
 - e. Installers of other construction interfaced with Work.
2. Minimum Agenda: Installer shall demonstrate understanding of the Work required by describing detailed procedures for preparing, installing, and cleaning the Work. Demonstration shall include, but not be limited to, following topics:
 - a. Tour representative areas of Work, inspect and discuss condition of substrate, and other preparatory work performed by other trades.
 - b. Review Contract Document Requirements.
 - c. Review approved submittals.
 - d. Review inspection and testing requirements.
 - e. Review environmental conditions and procedures for coping with unfavorable conditions.
 - f. Resolve deviations or differences between Contract Documents and the manufacturer/fabricator's specifications.
3. Record discussions, including decisions and agreements reached and prepare report.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Where products and systems are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication.

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1.10 COORDINATION

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

1.11 WARRANTY

- A. Manufacturer's Warranty: Furnish manufacturer's written material and labor warranty signed by an authorized representative using manufacturer's standard form agreeing to furnish materials and labor required to repair or replace work which exhibits material defects caused by manufacture or design and installation of product. "Defects" is defined to include but not limited to deterioration or failure to perform as required.
 - 1. Coverage of warranty includes but is not limited to the following:
 - a. Fabric failure includes deterioration, sag, warp, fade or will not remain fit for use.
 - 2. Warranty Period: Manufacturer shall warrant the products to be free from material and labor Defects for the following periods from date of Substantial Completion.
 - a. Manual operating components: 10 years.
 - b. Shade Cloth: 10 years.
 - c. Motors and electronic components: 5 years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements of Contract Documents as judged by the Architect, manufacturers offering products that may be incorporated into the Work include, but are not limited to, those listed.
 - 1. Draper Inc.
 - 2. Hunter Douglas Contract.
 - 3. Knoll Textiles.
 - 4. Lutron Electronics Co., Inc.
 - 5. Mariak Contract
 - 6. MechoShade Systems, Inc.
- B. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other manufacturers offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.
 - 1. Manufacturer and Product: As scheduled or as indicated in Design Selections.

2.2 MATERIALS, GENERAL

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

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2.3 MANUALLY OPERATED SHADES

- A. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.
1. Bead Chains: Manufacturer's standard, Stainless steel.
 - a. Loop Length: Full length of roller shade, unless otherwise indicated.
 - b. Limit Stops: Provide upper and lower ball stops.
 - c. Chain-Retainer Type: Clip, Chain tensioner and mounting as selected by Architect.
 2. Spring Lift-Assist Mechanisms: Manufacturer's standard for balancing roller-shade weight and lifting heavy roller shades.
 - a. Provide for shadebands that weigh more than **10 lb (4.5 kg)** or for shades as recommended by manufacturer, whichever criteria are more stringent.
- B. Rollers - Single: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
1. Roller Drive-End Location: As indicated on Drawings.
 2. Direction of Shadeband Roll: Regular, from back of roller, unless otherwise indicated.
 3. Shadeband-to-Roller Attachment: Manufacturer's standard method.

2.4 MOTOR-OPERATED

- A. Motorized Operating System: Provide factory-assembled, shade-operator system of size and capacity and with features, characteristics, and accessories suitable for conditions indicated, complete with electric motor and factory-prewired motor controls, power disconnect switch, enclosures protecting controls and operating parts, and accessories required for reliable operation without malfunction. Include wiring from motor controls to motors. Coordinate operator wiring requirements and electrical characteristics with building electrical system.
1. Electrical Components: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Electric Motor: Manufacturer's standard tubular, enclosed in roller.
 - a. Electrical Characteristics: Single phase, 110 V, 60 Hz, unless recommended otherwise by manufacturer.
 3. Remote Control: Electric controls with NEMA ICS 6, Type 1 enclosure for recessed or flush mounting. Provide the following for remote-control activation of shades:
 - a. Individual/Group Control Station: Momentary-contact, three-position, rocker-style, wall-switch-operated control station with open, close, and center off functions for individual and group control.
 - b. Color: As selected by Architect from manufacturer's full range.
 4. Limit Switches: Adjustable switches interlocked with motor controls and set to stop shades automatically at fully raised and fully lowered positions.

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5. Operating Features:

- a. Group switching with integrated switch control; single faceplate for multiple switch cutouts.
 - b. Capable of interface with audiovisual control system.
 - c. Override switch, if applicable.
- B. Rollers - Single: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
- 1. Roller Drive-End Location: As indicated on Drawings.
 - 2. Direction of Shadeband Roll: Regular, from back of roller, unless otherwise indicated.
 - 3. Shadeband-to-Roller Attachment: Manufacturer's standard method.

2.5 SHADEBANDS AND ACCESSORIES

A. Shadebands – Single Roller:

- 1. Shadeband Material: Refer to Shade Schedule for type. Color as scheduled or as indicated in Design Selections.
- 2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
 - a. Type: Enclosed in sealed pocket of shadeband material, unless otherwise indicated.
 - b. Color and Finish: As selected by Architect from manufacturer's full range.

B. Installation Accessories:

- 1. Recessed Shade Pocket: Rectangular, extruded-aluminum enclosure designed for recessed ceiling installation; with front, top, and back formed as one piece, end plates, and removable bottom closure panel.
 - a. Height: Manufacturer's standard height required to enclose roller and shadeband when shade is fully open, but not less than 6 in (150 mm)
 - b. Provide pocket with lip at lower edge to support acoustical ceiling panel.
- 2. Installation Accessories Color and Finish: As selected from manufacturer's full range.

C. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller mounting configuration, roller assemblies, operating mechanisms, installation accessories, and installation locations and conditions indicated.

D. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.

2.6 SHADEBAND MATERIALS

A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

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- B. Shade Band Material: Manufacturer's standard PVC-free shade band material.

2.7 ROLLER-SHADE FABRICATION

- A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.
- B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at **74 deg F (23 deg C)**:
1. Outside of Jamb Installation: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.
- C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible except as follows:
1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material. Obtain approved locations from Architect prior to fabrication.
 2. Railroaded Materials: Railroad material where material roll width is less than the required width of shadeband and where indicated. Provide battens and seams as required by railroaded material to produce shadebands with full roll-width panel(s) plus, if required, one partial roll-width panel located at top of shadeband.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

3.2 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.

3.3 ROLLER-SHADE INSTALLATION

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
1. Respective manufacturer/fabricator's written installation instructions.
 2. Accepted submittals.
 3. Contract Documents.

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- B. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.

- 1. Opaque Shadebands: Located so shadeband is not closer than 2 in (50 mm) to interior face of glass. Allow clearances for window operation hardware.

- C. Electrical Connections: Connect motor-operated roller shades to building electrical system.

3.4 FIELD QUALITY CONTROL - MOTOR OPERATED SHADES

- A. Manufacturer's Field Service: Manufacturer's qualified technical representative shall periodically inspect Work to ensure installation is proceeding in accordance with manufacturer's designs, recommendations, instructions, and warranty requirements. Representative shall submit written reports of each visit indicating observations, findings, and conclusions of inspection.

- 1. Manufacturer's Technical Representative Qualifications: Direct employee of technical services department of manufacturer with experience in providing recommendations, observations, evaluations, and problem diagnostics.

3.5 ADJUSTING

- A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.6 CLEANING AND PROTECTION

- A. Clean roller-shade surfaces after installation, according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.
- C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain motor-operated roller shades.

3.8 FINISH SCHEDULE

- A. Color and Pattern Selection: As selected from manufacturer's standard patterns and colors.

END OF SECTION

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SECTION 12 3550

EDUCATIONAL CASEWORK

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Plastic-laminate-faced wood cabinets.
2. Plastic-laminate countertops.
3. Wall shelving.

B. Related Sections include the following:

1. Division 06 Section "Rough Carpentry" for wood blocking for anchoring educational casework and cabinet base material.
2. Division 09 Section "Gypsum Board Assemblies" for reinforcements in gypsum board partitions for anchoring educational casework.
3. Division 09 Section "Resilient Wall Base and Accessories" for resilient base applied to educational casework.

1.2 DEFINITIONS

- A. Exposed Portions of Cabinets: Surfaces visible when doors and drawers are closed, including bottoms of cabinets more than 48 inches above floor, and surfaces visible in open cabinets.
- B. Semi-exposed Portions of Cabinets: Surfaces behind opaque doors, such as interiors of cabinets, shelves, dividers, interiors and sides of drawers, and interior faces of doors. Tops of cases 78 inches or more above floor are defined as semi-exposed.
- C. Concealed Portions of Cabinets: Surfaces not usually visible after installation, including sleepers, web frames, dust panels, and ends and backs that are placed directly against walls, floors, or other cabinets.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and installation instruction indicating materials, hardware, and finishes used in fabrication of cabinets, as required to show compliance with specifications.
- B. Shop Drawings: Submit shop drawings indicating location and size of each type of cabinet and countertops, accessories, materials finishes, hardware types and locations, fillers. Include fully dimensioned plans and elevations and indicate details of anchorage to countertop and to walls.
- C. Samples for Initial Selection: Submit fully finished samples of following items required for cabinets:
1. Plastic laminate, 3 samples, 12 inch square, for each type of finish.
 2. PVC Edging.

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3. Exposed hardware, one unit of each type and finish.

D. Samples for Verification: 6 inch square Samples for each type of finish, including top material and the following:

1. Section of countertop showing top, front edging, and backsplash construction.
2. One full-size finished base cabinet complete with hardware, doors, and drawers, but without countertop.
3. One full-size finished wall cabinet complete with hardware, doors, and adjustable shelves.
4. Maintain full-size Samples at Project site during construction in an undisturbed condition as a standard for judging the completed Work. Unless otherwise indicated, approved sample units may become part of the completed Work if in undisturbed condition at time of Substantial Completion. Notify Architect of their exact locations.

E. Submit independent laboratory certified test reports from Stainless Steel casework manufacturer verifying conformance to test performance specified.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of educational casework through one source from a single manufacturer.

B. Quality Standards: Plastic-Laminate Faced Casework: Comply with AWI's "Architectural Woodwork Quality Standards," Section 1600, Custom Grade. Provide AWI Quality Certification Program certificate indicating that educational casework complies with requirements.

C. Fabricator Qualifications: A firm experienced in producing casework and equipment indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Load Testing for Plastic-Laminate Faced Casework: Product must be certified to meet the performance testing requirements listed below in accordance with ANSI A161.1, NEMA LD3 and general static load testing performed by the independent agency providing the certification.

1. Racking Test: Base Cabinet construction, 800 pounds.
2. Static Load Test: Drawer construction, 635 pounds; Cabinet adjustable shelf support device, 300 pounds; Wall cabinet, 2,200 pounds.
3. Joint Loading Test: Cabinet front, 425 pounds; Drawer front, 600 pounds.
4. Particleboard screw holding power: 350 pounds.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver educational casework only after painting, utility roughing-in, and similar operations that could damage, soil, or deteriorate casework have been completed in installation areas. If casework must be stored in other than installation areas, store only in areas where environmental conditions meet requirements specified in "Project Conditions" Article.

B. Keep finished surfaces covered with polyethylene film or other protective covering during handling and installation.

1.6 PROJECT CONDITIONS

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- A. Environmental Limitations: Do not deliver or install educational casework until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Where educational casework is indicated to fit to other construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Where countertops are indicated, do not begin fabrication until after field verification of installed base cabinets receiving countertops.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating educational casework without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.7 COORDINATION

- A. Coordinate layout and installation of metal framing and reinforcements in gypsum board assemblies for support of educational casework.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of educational casework that fails in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:
 - 1. Delamination of components or other failures of glue bond.
 - 2. Warping of components.
 - 3. Failure of operating hardware.
 - 4. Deterioration of finishes.
- B. Warranty Period: Five years from Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PLASTIC LAMINATE FACED CASEWORK - PRODUCT STANDARD

- A. The Contract Documents are based on shop fabricated casework.

2.2 MATERIALS

- A. General: Provide materials that comply with requirements of the referenced cabinet quality standard for each type of cabinet and quality grade indicated unless otherwise indicated.
- B. Wood Panel Products: Comply with the following:
 - 1. Maximum Moisture Content for Lumber: 7 percent for hardwood and 12 percent for softwood.
 - 2. Plywood: Hardwood, HPVA HP-1, veneer core.
 - 3. Particleboard: ANSI A208.1, Grade M-3, 47 lb. density, engineered board.
 - 4. Medium-Density Fiberboard: ANSI A208.2, Grade MD.

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- C. Thermoset Decorative Overlay: Particleboard complying with ANSI A208.1, Grade M-2, or medium-density fiberboard complying with ANSI A208.2, Grade MD, with surface of thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.
- D. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3.
1. Face Sheet:
 - a. Doors and Vertical Surfaces: General Purpose VGS, 0.028 inch thick.
 - b. Shelves and Horizontal Surfaces: General Purpose HGL, 0.039 inch thick.
 - c. Countertops: General Purpose HGS, 0.048 inch thick.
 - d. Colors and Patterns: Refer to Division 01 Section "Design Selections".
 2. Cabinet Liner: Cabinet Liner CLS, 0.020 inch thick, or Thermoset Decorative Overlay (Melamine).
 - a. Color: As selected from manufacturer's standard colors.
 - b. Backing Sheet: Backer BKL, 0.020 inch thick.
 3. Acceptable Manufacturers:

Formica Corporation.
International Paper
Laminart.
Pioneer Plastics Corp.
Wilsonart International
- E. Chemical-Resistant, High-Pressure Decorative Laminate: NEMA LD 3, Grade HGP, and as follows:
1. Laminate has the following ratings when tested with indicated reagents according to NEMA LD 3, Test Procedure 3.9.5:
 - a. Nitric Acid (30 Percent): Moderate effect.
 - b. Sulfuric Acid (77 Percent): Moderate effect.
 - c. Hydrochloric Acid (37 Percent): Moderate effect.
 - d. Phosphoric Acid (75 Percent): No effect.
 - e. Acetic Acid (98 Percent): No effect.
 - f. Formaldehyde: No effect.
 - g. Ethyl Acetate: No effect.
 - h. Ethyl Ether: No effect.
 - i. Phenol (85 Percent): Moderate effect.
 - j. Benzene: No effect.
 - k. Xylene: No effect.
 - l. Butyl Alcohol: No effect.
 - m. Furfural: No effect.
 - n. Methyl Ethyl Ketone: No effect.
 - o. Sodium Hydroxide (25 Percent): No effect.
 - p. Sodium Sulfide (15 Percent): No effect.
 - q. Ammonium Hydroxide (28 Percent): No effect.
 - r. Zinc Chloride: No effect.
 - s. Gentian Violet: No effect.
 - t. Methyl Red: No effect.

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2. Manufacturers and Products:

- a. Formica Corporation; Lab Grade 840 Black.
- b. Panolam Industries International Incorporated; Pionite Chemguard.
- c. Wilsonart International, Div. of Premark International, Inc.; Chemsurf.

3. Colors, Patterns, and Finishes:

- a. Selections: As selected from manufacturer's standard colors.
- b. Location: Casework in Labs (exposed surfaces only, excludes inside drawers and cabinets), or where indicated on drawings.

F. Edging: Rigid PVC solid high impact with homogeneous color, acid resistant, pre-lamination primed edging, machine applied with hot melt adhesives.

1. 3 mm thick PVC edging at countertop edges, door edges, and drawer front edges.
2. 1 mm thick elsewhere.
3. Color to be selected by Architect from full range of Manufacturer's standard colors.

2.3 PLASTIC LAMINATE FACED CASEWORK

A. Exposed Cabinet Materials: Plastic Laminate, Type VGS. Provide at all exposed surfaces.

1. Chemical-Resistant Plastic Laminate: Provide at all exposed surfaces where indicated on Drawings.

B. Semi-exposed Cabinet Materials:

1. Plastic Laminate-Faced Particleboard, Type VGS. Provide at interior faces of doors and drawer fronts.
2. Melamine-Faced Particleboard: Particleboard with decorative surface of thermally fused, melamine-impregnated web and complying with LMA SAT-1.
 - a. Provide at semi-exposed surfaces other than interior faces of doors and drawer fronts, unless otherwise indicated.

C. Concealed Cabinet Materials:

1. Solid Wood: Any hardwood or softwood species, with no defects affecting strength or utility.
2. Hardwood Plywood: Concealed backs of plywood with exposed or semi-exposed faces shall be same species as faces.
3. Plastic Laminate: Type BKL.

D. Cabinet Construction:

1. Provide balanced construction at doors and other unrestrained panel elements.
2. Bottoms and Ends of Cabinets, Shelves, and Tops of Wall Cabinets and Tall Cabinets: 3/4-inch particleboard, plastic-laminate faced on exposed surfaces, melamine faced on semi-exposed surfaces.
3. Cabinet Bases: 1-1/2 inch pressure-treated lumber, plastic-laminate faced on exposed surfaces.

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4. Backs of Cabinets: 1/2-inch particleboard, plastic-laminate faced on exposed surfaces, melamine faced on semi-exposed surfaces.
 5. Drawer Fronts: 3/4-inch particleboard, plastic-laminate faced on both sides.
 6. Drawer Sides and Backs: 1/2-inch plywood, with glued dovetail or multiple-dowel joints.
 7. Drawer Bottoms: 1/2-inch plywood glued and dadoed into front, back, and sides of drawers.
 8. Doors: 3/4-inch particleboard or medium-density fiberboard, plastic-laminate faced on both sides.
- E. Filler Strips: Provide as needed to close spaces between cabinets and walls, ceilings, and indicated equipment. Fabricate from same material and with same finish as cabinets.

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2.4 CASEWORK HARDWARE

- A. Hardware, General: Provide manufacturer's standard satin-finish, commercial-quality, heavy-duty hardware complying with requirements indicated.
 - 1. Use threaded metal or plastic inserts with machine screws for fastening to particleboard except where hardware is through-bolted from back side.
- B. Butt Hinges: Stainless-steel, heavy-duty, semi-concealed, institutional type 5-knuckle hinges complying with BHMA A156.9, Grade 1, with antifriction bearings and rounded tips. Mill ground hospital tip, tight pin feature with all edges eased. Hinge to be full wrap type of tempered steel 0.095 inch thick. Each hinge to have a minimum of 9 screws, #7, 5/8 inch FHMS to assure positive door attachment. Provide 2 hinges for doors less than 48 inches high and 3 hinges for doors more than 48 inches high. Hinge to accommodate 13/16 inch door and allow 270 degree swing.
 - 1. Hinges in Stainless Steel Casework shall be removable; welding of hinges not acceptable.
- C. Pulls: Solid stainless-steel wire pulls BHMA 630, fastened from back with two screws. Provide 2 pulls for drawers more than 24 inches wide.
- D. Door Catches: Zinc-plated or powder-coated, nylon-roller spring catch or dual, self-aligning, permanent magnet catch. Provide 2 catches on doors more than 48 inches high.
- E. Drawer Slides: Zinc-plated or powder-coated, metal-channel, side-mounted self-closing drawer slides, designed to prevent rebound when drawers are closed, with permanently lubricated nylon-tired, ball-bearing rollers, and complying with BHMA A156.9, Type B05091, and rated for the following loads:
 - 1. Box Drawer Slides: 75 lbf.
 - 2. File Drawer Slides, Full Extension: 150 lbf.
 - 3. Pencil Drawer Slides: 45 lbf.
 - 4. Keyboard Slide: 75 lbf.
- F. Hinged Door and Drawer Locks: Stanley Best 5L7RD (Hand as determined) 626 finish. Provide 2 keys per each lock. Each room cabinet group keyed alike, but different from other room groups. All groups master-keyed.
 - 1. Provide a minimum of six master keys.
 - 2. Provide locks on all doors and drawers.
- G. Adjustable Shelf Supports: Mortise-type, zinc-plated or powder-coated steel standards and shelf rests complying with BHMA A156.9, Types B04071 and B04091. 300 pound load capacity.
- H. Catches: Comply with Americans with Disabilities Act. Top mounted magnetic for fixed cabinets; Roller catch for mobile cabinets. Elbow catches shall be used on inactive doors up to and 72 inches tall.
- I. Chain Bolts: 3 inch long with 18 inch pull chain with angle strike to secure inactive door on cabinets over 72 inches tall.

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2.5 COUNTERTOPS

- A. Countertops, General: Provide smooth, clean exposed tops and edges in uniform plane free of defects. Provide front and end overhang of 1 inch over base cabinets, formed with continuous drip groove on undersurface 1/2-inch from edge.
- B. Plastic Laminate Tops: Plastic-laminate sheet, shop bonded with waterproof glue to both sides of 1-1/8 inch phenolic-resin-bonded particleboard. Use exterior grade plywood as substrate for countertops containing sinks. Sand surfaces to which plastic laminate is to be bonded.
 - 1. Plastic-Laminate Type for Flat Tops: HGS.
 - 2. Plastic-Laminate Type for Formed Tops: HGP.
 - 3. Plastic-Laminate Type for Backing: BKL.
 - 4. Provide 3mm thick PVC edging on front and side edges and on top edges of backsplashes and end splashes.
 - 5. For formed tops where indicated, construct top and backsplash from one piece of plastic laminate with rolled edges and coved intersection. Where indicated, provide separate end splashes fitted to top.
 - 6. Provide 2-inch radius at exposed outside corners of countertops.
- C. Cable Cover Grommets: Hafele #429.93. Color as selected by Architect. Grommets shall be provided wherever power and data outlets are located below countertops in a knee space area.
- D. Simulated Stone Countertops: Refer to Division 12 Section "Simulated Stone Countertops" for solid surfacing, quartz agglomerate, or cultured marble countertops incorporated into work specified in this Section. Simulated stone trim is specified in this Section.

2.6 WALL SHELVING

- A. Plastic-Laminate Shelving: Plastic-laminate sheet, Type HGL or HGP, shop bonded with waterproof glue to both sides of plywood. Sand surfaces to which plastic laminate is to be bonded.
 - 1. Shelf Thickness:
 - a. 3/4 inch for shelves less than 30 inches long.
 - b. 1 inch for shelves 30 inches to 48 inches long.
 - 2. Edge Treatment: Finish both edges with plastic laminate that matches faces.
- B. Adjustable Shelf Supports: Anochrome steel standards and shelf brackets, complying with BHMA A156.9, Heavy-Duty type. Basis of design: Knape & Vogt 83 series oversized standards and 183 series flanged brackets, sizes as required.

2.7 FABRICATION

- A. Fabricate manufactured casework to dimensions and profiles and details indicated. Assemble units in shop in as large components as practicable to minimize field cutting and jointing.

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PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of reinforcements, and other conditions affecting performance of educational casework. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CASEWORK INSTALLATION

- A. Install plumb, level, and true; shim as required, using concealed shims. Where educational casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.
- B. Anchor cabinets securely in place with concealed (when doors and drawers are closed) fasteners, anchored into structural support members of wall construction. Comply with manufacturer's instructions for support of units.
- C. Base Cabinets: Set cabinets straight, level, and plumb. Adjust subtops within 1/16 inch of a single plane. Bolt adjacent cabinets together with joints flush, tight, and uniform. Align similar adjoining doors and drawers to a tolerance of 1/16 inch.
- D. Wall Cabinets: Hang cabinets straight, level, and plumb. Adjust fronts and bottoms within 1/16 inch of a single plane. Fasten to hanging strips, masonry, partition framing, blocking, or reinforcements in partitions. Align similar adjoining doors to a tolerance of 1/16 inch.
- E. Install hardware uniformly and precisely. Set hinges snug and flat in mortises, unless otherwise indicated. Adjust and align hardware so moving parts operate freely and contact points meet accurately. Allow for final adjustment after installation.
- F. Adjust casework and hardware so doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

3.3 INSTALLATION OF TOPS

- A. Field Jointing: Where possible make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.
- B. Attach countertops securely to base units. Glue and mechanically joint countertop seams. Provide cutouts for fixtures and appliances as indicated; drill pilot holes at corners before making cutouts. Smooth cut edges and coat with waterproof coating or adhesive.
- C. Abut top and edge surfaces in one true plane, with internal supports placed to prevent deflection.
- D. Where applied backsplashes are indicated, secure backsplashes to tops with concealed metal brackets at maximum spacing of 16 inches on center.

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- E. Seal junctures of top, splash, and walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.

3.4 INSTALLATION OF SHELVING

- A. Securely fasten adjustable shelving supports to partition framing, wood blocking, or reinforcements in partitions.
- B. Install shelf standards plumb and at heights to align shelf brackets for level shelves. Install shelving level and straight, closely fitted to other work where indicated. Secure shelves to flanged brackets with screws.

3.5 CLEANING AND PROTECTING

- A. Repair or remove and replace defective work as directed on completion of installation.
- B. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.
- C. Protection: Advise Contractor of final protection and maintained conditions necessary to ensure that work will be without damage or deterioration at time of acceptance.

END OF SECTION

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SECTION 13 2613

STORM SHELTER PRODUCTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes furnishing and installing storm shelter products and supplementary items necessary to complete work required for its installation.
- B. This Section includes the following specialties:
 - 1. Roof penetration housings.
 - 2. Louvers.
 - 3. Wind and Impact Resistant Window and Door Assemblies.
- C. Related Sections (the following sections also apply for product standards and installation):
 - 1. Division 07 section "Roof Accessories".
 - 2. Division 08 section "Glazed Aluminum Framing System".
 - 3. Division 08 section "Glazing".
 - 4. Division 08 section "Door Hardware".
 - 5. Division 08 section "Hollow Metal Doors and Frames".

1.2 SUBMITTALS

- A. Product Data:
 - 1. Submit manufacturer's specifications to evidence compliance with these specifications.
 - 2. Submit manufacturer's installation instructions.
- B. [Product Test Reports](#): Written reports based on evaluation of comprehensive tests performed by qualified testing agency indicating that each product complies with requirements.
 - 1. Product Approvals: Submit Product Approval for compliance with ICC 500, ICC/NSSA Standards for the Design and Construction of Storm Shelters. Project is in a 250 mph zone (Product testing to 100 mph).
 - 2. Provide with FEMA 361/320 Tornado Label.
- C. Substitutions: Submit requests for substitutions according to the Conditions of the Contract and Division 1 Specifications Sections.

1.3 DELIVERY, STORAGE AND HANDLING

- A. General: Comply with the Conditions of the Contract and Division 1 Specification Sections.
- B. Deliver, store and handle products in exact accordance with the manufacturer's latest published requirements and specifications.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Engineer products and systems to withstand loads within limits of allowable working stresses of the materials involved under conditions indicated and without permanent deformation or failure of materials.
- B. Windborne-Debris-Impact-Resistance Performance: Products shall meet ICC-500 2014 at 100 mph test speed for ASTM E 1886.

2.2 STORM SHELTER PRODUCTS

- A. Wall Penetration Housings: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to the following:
 - 1. The Wall Vault (Patent #10,700,502 B2) by Roof Penetration Housings, LLC.
 - 2. Construction Standard Unit:
 - a. Wall flange to be Stainless Steel, Cover to Aluminum.
 - b. 88 SRI finish – White.
 - c. Stainless, vandal proof fasteners to attach frame to cover. Note: Fastener from frame to wall by Contractor to be compatible to wall surface.
 - d. Gasket between wall and frame to be Adhesive Butyl gasket. Gasket between cover and frame to be Sil-X-14.
 - e. Sil-X-14 Gasket & Aluminum Exit Seals:
 Series 5000 - .25-1.9" Penetrant O.D.
 Series 6000 – 2.0-3.5" Penetrant O.D.
 Series 7000- 3.5" + Penetrant O.D. Double Flange on Larger Diameter.
 - 3. Size:
 - a. Standard – 17 ½" H x 10" W to accommodate 5-Series 5000 Exit Seals.
- B. Roof Penetration Housings: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Product: Cyclone Roof Housing (Similar to the standard Vault®):
 - a. Model CYCLONE™ ROOF HOUSING for safe room applications to meet ICC 500-2014 250 MPH rating.
 - b. CYCLONE™ Roof Housing Sizing: All sizes are considered custom. Smallest size available: 16" H X 10" X 10" W Largest size available: 36" H X 48" X 48" W Note: ICC-500 2014 requires the smallest and largest sizes are to be third party tested.
 - 2. Exit Seals:
 - a) Design: Weather tight seal for vertical surface/plane penetrations. Seal construction to be manufactured in all aluminum construction and 100% Sil-X-14 silicone gaskets.

 Series 5000 - .25" to 1.90"
 Series 6000 – 2" to 3.125"

Series 7000 – 3.5" Large Diameter Double Gasketed inside and out

3. Vent Through Roof:
 - a. RPH Cyclone Series CVTR2000:
 - b. Rust Resistant steel mounting plate and gasket, nelson studs, and Schedule 40 black steel pipe thru roof.
 - c. Piping extends thru finished roof, secured to the underside of the roof deck with steel plate and gasket for Cast in Place or Precast Concrete panels
 - d. Plumbing contractor to connect with No-Hub coupling inside structure.
 - e. Sizes
 - f. 2-6" piping thru roof,
 - g. Steel plate 3/16" steel mounted to roof deck underside.
 4. Roof and Overflow Drains:
 - a. RPH Cyclone Vault CRD / CRDOF Series:
 - b. Roof drain body and dome 3/16" steel, with industrial coating.
 - c. Designed to meet ANSI STANDARD A112.6.4.2003.
 - d. Combination trash guard/flashing collar
 - e. Energy shock absorbers to absorb 250+ missile testing.
 - f. 100% Made in USA.
 - g. Third Party Tested for ICC-500 2014 Storm Shelter
 - h. Sizes 4-10"
 - i. CWVSO can be used as Down Spout Nozzle
- C. Roof Hatch:
1. Tornado Rated Roof Hatch by Roof Penetration Housings, Model CRH4032.
 2. Performance characteristics:
 - a. Cover shall be reinforced to support a minimum live load with a minimum deflection.
 - b. Operation of the cover shall be smooth and easy with controlled operation throughout the entire arc of opening and closing.
 - c. Operation of the cover shall not be affected by temperature.
 - d. Entire hatch shall be weather tight with fully welded corner joints on cover and curb.
 3. Cover: Shall be 3/16" HRP&O Carbon Steel.
 4. Cover Insulation: no insulation applied in this unit.
 5. Curb body: Shall be 8" in height and 3/16" HRP&O Carbon Steel. The curb shall be formed with 3" flange with 7/16" Dia. Holes provided for securing to the roof deck.
 6. Lifting mechanisms: Manufacturer shall provide gas spring operators to provide assisted lifting of cover, one shall be auto safety locking in open position Construction: bolted to internal framework.
 7. Hardware
 - a. Heavy Duty stainless-steel full-length hinge.
 - b. Cover supplied with welded closing handle.
 - c. Roof hatch latching system equipped with safety system.
 - d. Cover shall automatically lock in the open position with rigid safety.
 - e. All hardware is stainless steel.

STORM SHELTER PRODUCTS

8. Finish: Factory painted Bright White, SRI 88.2 % Powder Coat.
- D. Louvers: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to the following:
1. Product: Greenhech; Model FSG-801.
 2. Construction:
 - a) Severe duty fabricated steel grille designed to protect exterior wall penetrations on FEMA 320 or 361 compliant storm shelters or safe rooms. Design incorporates inverted V style blades which lend high free area and very little airflow resistance while providing maximum protection against extremely high wind loads and wind-borne debris. FSG-801 withstands wind loads up to 248 PSF and complies with FEMA 320 and 361 storm shelter and safe room standards (ICC 500) for debris impact, which simulates a 15 lb. 2 x 4 traveling at 100 MPH. Model FSG-801 is a UL Listed wind-storm rated assembly.
 - b) Size: Per drawings.
 - c) Finish: As selected.
- E. Wind and Impact Resistant Window and Door Assemblies: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to the following:
1. Manufacturer: Insulgard Security Products.
 2. Storefront System: Model TTH600, thermally broken framing system.
 3. Glass Entry Doors; Model TH350 FEMA Doors. Single and double, as indicated on drawings. Wide stile doors.
 - a) Clear Anodic Finish: Architectural Class I, clear coating AA-M10C22A41 Mechanical Finish Chemical Finish: etched, medium matte; 0.70 mils minimum complying with AAMA 611 "Voluntary Specification for Anodized Architectural Aluminum"
 - b) Manufactures Standard Hardware: As required including exit devices. Tested as part of door assembly.
 4. Glass: Model Tor-Gard 40, 1.610 inch glass clad polycarbonate assembly.
 5. Hollow Metal Door: Wind and impact resistant with insulated core. Furnish with hollow metal frames and hardware as tested with assembly. Prime finish for field painting.
 6. Hollow Metal Door Manufacturers and Products:
 - a. Allegion; Steelcraft "Paladin Series", glass light steel tornado doors (Basis of Design).
 - b. ASSA ABLOY; Ceco Door, "StormPro" tornado resistant assemblies.
 - c. Rocky Mountain Metals, Inc.; Tornado resistant openings.
 7. Accessories:
 - a) Anchors: Fully concealed in accordance with requirements of delegated design requirements
 - b) Steel extension anchor plates as required by delegated design.
- F. Overhead Coiling Doors: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to the following:
1. Acceptable Manufactures and Products:

- a) McKeon Rolling Steel Door Company, Inc.; Model Safespace 500 with FES-EP operator.
- b) Cookson; Stormdefender Door, Model PSD361.

2. Construction:

- a) Curtain: Shall be assembled of interlocking galvanized steel slats. Curtain shall be formed of ID slat profile sections of gauge as required to sustain the minimum required design wind pressure. Slat cross section shall not be less than 3" wide by 1-1/2" deep.
- b) Bottom Bar: Shall consist of a double structural steel angle assembly formed to fit and engage the curtain assembly.
- c) Guides: Each guide assembly shall be fabricated of structural steel support angles and guide retaining angles of a sufficient depth to retain curtain in the guides under the design wind pressure and impact forces specified.
- d) Mounting Brackets: Fabricated of hot rolled 3/16" minimum steel plates, brackets shall be provided to house ends of the counterbalance barrel assembly.
- e) Hood: Shall be provided to entirely enclose coiled curtain and counterbalance barrel assembly. Hood shall be fabricated 22 gauge galvanized steel, designed and formed to match brackets. Top and bottom shall be bent and reinforced to provide for proper stiffness.
- f) Counterbalance Assembly: Coiling door shall be counterbalanced by means of adjustable steel helical torsion springs attached to shaft enclosed in pipe with required mounting blocks or rings for attachment of curtain. Grease sealed bearings or self-lubricating graphite bearings shall be attached to the spring barrel which shall be fabricated of hot formed structural quality carbon steel seamless pipe.
- g) Electric Motor Operator: Coiling door shall be provided with a compact power unit designed and built by the coiling door manufacturer. Operator shall be equipped with an adjustable screw-type limit switch to break the circuit at termination of travel. High efficiency gearing running in an oil bath, shall be furnished together with a magnetic operated brake, completely housed to protect against damage, dust and moisture. An efficient overload protection device, which will break the power circuit and protect against damage to the motor windings shall be integral with the unit. Operator is to be housed in a NEMA type 1 enclosure.
- h) Motor: Shall be intermediate duty, thermally protected, ball bearing type with a class A or better insulation. Horsepower of motor is to be 1/3hp minimum or of manufacturer's recommended size, whichever is greater.
- i) Starter: Shall be size "0" magnetic reversing starter, across the line type with mechanical and electrical interlocks, with 10 amp continuous rating and 24 volt control circuit.
- j) Reducer: Spiral gear type, 70% efficiency minimum.
- k) Brake: Magnetically activated, integral within the operator's housing.
- l) Control Station: Provide surface mount push button control station marked open, close and stop.
- m) Obstruction Sensing Device: The coiling door shall be designed with an obstruction sensing safety edge. In the event that the safety edge meets an obstruction during the normal closing operation, the coiling door shall stop, reverse and return to the open position.
- n) Finish: After completion of fabrication, clean all metal surfaces to remove dirt and chemically treat to provide for paint adhesion. Curtain assembly is to receive a prime coat finish of .2 mils of epoxy primer and .8 mils of polyester paint in a McKeon Sterling Gray finish.
- o) Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based

on testing at as close to neutral pressure as possible according to NFPA 252 or UL 10B.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine and verify that receiving substrate surfaces of the structure have no defects or errors which would result in poor or potentially defective application or cause latent defects in workmanship.

3.2 PREPARATION

- A. Prepare structure to ensure proper and adequate structural support for the materials specified.
- B. Prepare substrate surfaces to ensure proper and adequate installation in accordance with manufacturer's requirements.
- C. Field measure and verify dimensions as required.

3.3 INSTALLATION

- A. Install products/materials in exact accordance with manufacturer's latest published requirements, tests, instructions, specifications, and details.
- B. Refer to Details on Drawings for additional requirements.
- C. Protect installed work using adequate and suitable means during and after installation until accepted by owner.
- D. Remove, repair or replace materials which have been damaged in any way.
- E. Clean surfaces of grime and dirt using acceptable and recommended means and methods.
- F. Fire-Rated and Smoke-Rated Doors: Install doors in corresponding fire-rated frames according to NFPA 80.

3.4 STARTUP SERVICE AND DEMONSTRATION

- A. Engage manufacturers qualified technical representative to perform startup service and to train Owner's maintenance personnel as specified below.
 - 1. Perform installation and startup checks according to manufacturer's written instructions.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Fire-Rated and Smoke-Rated Doors:
 - a. Test door opening when activated by detector or fire-alarm system as required. Reset door-opening mechanism after successful test.
 - b. Test automatic self-opening mechanism when activated by smoke detector, emergency push-button station, fire alarm or power failure. Reset self-opening mechanism after successful test.

STORM SHELTER PRODUCTS

- B. Engage manufacturers qualified technical representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors. Include procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance, and procedures for testing and resetting release devices.

END OF SECTION

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SECTION 210100

FIRE PROTECTION OPERATING AND MAINTENANCE MANUALS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Compilation product data and related information appropriate for Owner's operation and maintenance of products furnished under Contract. Prepare operating and maintenance data as specified.
- B. Instruct Owner's personnel in operation and maintenance of equipment and systems.
- C. Submit three copies of complete manual in final form.

1.2 SUBMITTALS

- A. Thirty (30) days after the Contractor has received the final scheduled identified submittals bearing the Architect / Engineer's stamp of acceptance (including resubmittals), submit for review one copy of the first draft of the Operating and Maintenance Manual. This copy shall contain as a minimum:
 - 1. Table of Contents for each element.
 - 2. Contractor information.
 - 3. All submittals, coordination drawings and product data, reviewed by the Architect / Engineer; bearing the Architect / Engineer's stamp of acceptance. (When submittals are returned from Engineer "Correct as Noted", corrected inserts shall be included.)
 - 4. All parts and maintenance manuals for items of equipment.
 - 5. Warranties (without starting dates)
 - 6. Certifications that have been completed. Submit forms and outlines of certifications that have not been completed.
 - 7. Operating and maintenance procedures.
 - 8. Form of Owner's Training Program Syllabus (including times and dates).
 - 9. Control operations/equipment wiring diagrams.
 - 10. Other required operating and maintenance information that are complete.
- B. Copy will be returned to the Contractor within 15 days with comments for corrections.
- C. Submit two (2) completed manuals in final electronic form to the Architect / Engineer one day after substantial completion, and prior to Owner's instructions. Include all specified data, test and balance reports, drawings, dated warranties, certificates, reports, along with other materials and information.
- D. The Architect / Engineer will review the manuals for completeness within fifteen (15) days.
- E. The Contractor shall be notified of any missing or omitted materials. The Manuals shall be reworked by the Contractor, as required, in the office of the Architect / Engineer. The manuals will not be retransmitted.
- F. Two (2) electronic copies of completed Manual shall be delivered to the Owner.

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PART 2 - PRODUCTS

2.1 BINDERS

- A. Commercial quality black three-ring binders with clear overlay plastic covers.
- B. Minimum ring size: 1".
Maximum ring size: 3".
- C. When multiple binders are used, correlate the data into related groupings.
- D. Label contents on spine and face of binder with full size insert. Label under plastic cover.

PART 3 - EXECUTION

3.1 OPERATION AND MAINTENANCE MANUAL

- A. Form for Manuals:
 - 1. Prepare data in form of an instructional manual for use by Owner's personnel.
 - 2. Format:
 - a. Size: 8-1/2" x 11".
 - b. Text: Manufacturer's printed data or neatly typewritten.
 - 3. Drawings:
 - a. Provide reinforced punched binder tab and bind in text.
 - b. Fold larger drawings to size of text pages.
 - 4. Provide flyleaf indexed tabs for each separate product or each piece of operating equipment.
 - 5. Cover: Identify each volume with typed or printed title "Operating and Maintenance Instructions". List:
 - a. Title of Project
 - b. Identity of separate structures as applicable.
 - c. Identity of general subject matter covered in the manual.
 - 6. Binder as specified.
- B. Content of Manual:
 - 1. Neatly typewritten Table of Contents for each volume arranged in systematic order as outlined in the specifications.
 - a. Contractor, name of responsible principal, address and telephone number.
 - b. A list of each product required to be included, indexed to content of the volume.
 - c. List with each product, name, address and telephone number of:
 - 1) Subcontractor or installer
 - 2) Maintenance contractor as appropriate
 - 3) Identify area of responsibility of each
 - 4) Local source of supply for parts and replacement
 - d. Identify each product by product name and other identifying symbols as set forth in Contract Documents.
 - 2. Product Data:
 - a. Include those sheets pertinent to the specific product
 - b. Annotate each sheet to:
 - 1) Identify specific product or part installed
 - 2) Identify data applicable to installation
 - 3) Delete references to inapplicable information. (All options not supplied with equipment shall be marked out indicated in some manner.

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3. Drawings:
 - a. Supplement product data with drawings as necessary to illustrate:
 - 1) Relations of component parts of equipment and systems
 - 2) Control and flow diagrams
 - b. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
 - c. Do not use Project Record Documents as maintenance drawings.
 4. Written text, as required to supplement product data for the particular installation:
 - a. Organize in consistent format under separate headings for different procedures.
 - b. Provide logical sequence of instructions for each procedure.
 5. Copy of each warranty, bond and service contract issued.
 - a. Provide information sheet for Owner's personnel, giving:
 - 1) Proper procedures in event of failure
 - 2) Instances that might affect validity of warranties or bonds
 6. Shop drawings, coordination drawings and product data as specified.
- C. Sections for Equipment and Systems.
1. Content for each unit of equipment and system as appropriate:
 - a. Description of unit and component parts
 - 1) Function, normal operating characteristics, and limiting conditions
 - 2) Performance curves, engineering data and tests
 - 3) Complete nomenclature and commercial number of replaceable parts.
 - b. Operating procedures:
 - 1) Start up, break-in, routine and normal operating instructions.
 - 2) Regulation, control, stopping, shut down and emergency instructions.
 - 3) Summer and winter operating instructions.
 - 4) Special operating instructions.
 - c. Maintenance procedures:
 - 1) Routine operations
 - 2) Guide to trouble-shooting.
 - 3) Disassembly, repair and reassembly.
 - 4) Alignment, adjusting and checking.
 - 5) Routine service based on operating hours.
 - d. Servicing and lubrication schedule. List of lubricants required.
 - e. Manufacturer's printed operating and maintenance instructions.
 - f. Description of sequence of operation by control manufacturer.
 - g. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
 - 1) Predicted life of part subject to wear.
 - 2) Items recommended to be stocked as spare parts.
 - h. As installed control diagrams by controls manufacturer.
 - i. Complete equipment internal wiring diagrams.
 - j. Each Contractor's coordination drawings.
 - k. As installed color coded piping diagrams.
 - l. Charts of valve tag number, with location and function of each valve.
 - m. List of original manufacturer's spare parts and recommended quantities to be maintained in storage.
 - n. Other data as required under pertinent sections of the specifications.
 2. Prepare and include additional data when the need for such data becomes apparent during instruction of Owner's personnel.

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3. Additional requirements for operating and maintenance data as outlined in respective sections of specifications.
4. Provide complete information for products specified in Division 21.
5. Provide certificates of compliance as specified in each related section.
6. Provide start up reports as specified in each related section.
7. Provide signed receipts for spare parts and material.
8. Provide training report and certificates.
9. Provide backflow preventer certified test reports.

END OF SECTION

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SECTION 210500

FIRE PROTECTION GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Except as modified in this Section, General Conditions, Supplementary Conditions, applicable provisions of the General Requirements, and other provisions and requirements of the contract documents apply to work of Division 21 Fire Sprinkler Systems.
- B. Applicable provisions of this section apply to all sections of Division 22, Plumbing.

1.2 CODE REQUIREMENTS AND FEES

- A. Perform work in accordance with applicable statutes, ordinances, codes and regulations of governmental authorities having jurisdiction.
- B. Plumbing work shall comply with applicable inspection services:
 - 1. Underwriters Laboratories
 - 2. National Fire Protection Association
 - 3. State Health Department
 - 4. Local Municipal Building Inspection Department
 - 5. Texas Department of Licensing & Regulations (TDLR)
 - 6. Texas Accessibility Standards (TAS Based on ADA)
- C. Resolve any code violations discovered in contract documents with the Engineer prior to award of the contract. After Contract award, any correction or additions necessary for compliance with applicable codes shall be made at no additional cost to the Owner.
- D. This Contractor shall be responsible for being aware of and complying with asbestos NESHAP regulations, as well as all other applicable codes, laws and regulations.
- E. Obtain all permits required.

1.3 CONTRACTOR'S QUALIFICATIONS

- A. An approved contractor for the work under this division shall be:
 - 1. A licensed specialist in this field and have the personnel, experience, training, skill, and organization to provide a practical working system
 - 2. Able to furnish evidence of having contracted for and installed not less than 3 systems of comparable size and type that has served their Owners satisfactorily for not less than 3 years

1.4 REFERENCE SPECIFICATIONS AND STANDARDS

- A. Materials which are specified by reference to Federal Specifications; ASTM, ASME, ANSI, or AWWA Specifications; Federal Standards; or other standard specifications must comply with latest editions, revisions, amendments or supplements in effect on date bids are received. Requirements in reference specifications and standards are minimum for all equipment, material, and work. In instances where specified capacities, size, or other features of equipment, devices, or materials exceed these minimums, meet specified capacities.

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1.5 CONTRACT DRAWINGS

- A. Contract drawings are diagrammatic only and do not give fully dimensioned locations of various elements of work. Determine exact locations from field measurements.

1.6 PROJECT RECORD DOCUMENTS

- A. Maintain at the job site a separate set of white prints (blue line or black line) of the contract drawings for the sole purpose of recording the "as-built" changes and diagrams of those portions of work in which actual construction is at variance with the contract drawings. Mark the drawings with a colored pencil. Prepare, as the work progresses and upon completion of work, reproducible drawings clearly indicating locations of various lines, valves, ductwork, traps, equipment, and other pertinent items, as installed. Include flow-line elevation of sewer lines. Record existing and new underground and under slab piping with dimensioned locations and elevations of such piping.
- B. At the conclusion of project, obtain without cost to the Owner, erasable mylars of the original drawings and transfer as-built changes to these. Prior to transmittal of corrected drawings, obtain 3 sets of blue-line prints of each drawing, regardless of whether corrections were necessary and include in the transmittal (2 sets are for the Owner's use and one set is for the Architect/Engineer's records). Delivery of these as-built prints and reproducible drawings is a condition of final acceptance. Provide record drawings on one set each (reproducible Dayrex Mylar film positives) and AutoCAD / Revit 2018 files on disk (CD Rom).
- C. As-Built drawings should indicate the following information as a minimum:
 - 1. Indicate all addendum changes to documents.
 - 2. Remove Engineer's seal, name, address and logo from drawings.
 - 3. Mark documents RECORD DRAWINGS.
 - 4. Clearly indicate: DOCUMENT PRODUCED BY
 - 5. Indicate all changes to construction during construction. Indicate actual routing of all piping, etc. that were deviated from construction drawings.
 - 6. Correct schedules to reflect (actual) equipment furnished and manufacturer.
 - 7. During the execution of work, maintain a complete set of drawings and specifications upon which all locations of equipment, ductwork, piping, devices, and all deviations and changes from the construction documents in the work shall be recorded.
 - 8. Location and size of all ductwork and mechanical piping above ceiling including exact location of isolation of domestic and plumbing valves.
 - 9. Exact location of all electrical equipment in and outside of the building.
 - 10. Fire Protection System documents revised to indicate exact location of all sprinkler heads and zone valves.
 - 11. Exact location of all roof mounted equipment, wall, roof and floor penetrations.
 - 12. Cloud all changes.

1.7 SPACE REQUIREMENTS

- A. Consider space limitations imposed by contiguous work in selection and location of equipment and material. Do not provide equipment or material that is not suitable in this respect.

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1.8 RELATION WITH OTHER TRADES

- A. Carefully study all matters and conditions concerning the project. Submit notification of conflict in ample time to prevent unwarranted changes in any work. Review other Divisions of these specifications to determine their requirements.
- B. Because of the complicated relationship of this work to the total project, conscientiously study the relation and cooperate as necessary to accomplish the full intent of the documents.
- C. Provide sleeves and inserts in forms as required for the work. Stub up and protect open ends of pipe before any concrete is placed. Furnish sizes of required equipment pads. Furnish and locate bolts and fittings required to be cast in them.
- D. Locate and size openings required for installation of work specified in this Division in sufficient time to prevent delay in the work.
- E. Refer to other Divisions of the specifications for the scope of required connections to equipment furnished under that Division. Determine from the Contractor for the various trades, the Owner, and by direction from the Architect/Engineer, the exact location of all items.
- F. Contractor shall not hang technology cabling on fire protection pipes. Provide and install separate J-Hooks, cable saddles or ladder trays to carry technology cable plant that is installed.
 - 1. Cables shall not be attached or supported by fire sprinkler heads or delivery systems, or any environmental sensor located in the ceiling air space.

1.9 CONCEALED AND EXPOSED WORK

- A. When the word "concealed" is used in connection with insulating, painting, piping, ducts and the like, the work is understood to mean hidden from sight as in chases, furred spaces or above ceilings. "Exposed" is understood to mean open to view.

1.10 GUARANTEE

- A. Guarantee work for 1 year from the date of substantial completion of the project. During that period make good any faults or imperfections that may arise due to defects or omissions in material, equipment or workmanship. At the Owner's option, replacement of failed parts or equipment shall be provided.

1.11 MATERIAL AND EQUIPMENT

- A. Furnish new and unused materials and equipment meeting the requirements of the paragraph specifying acceptable manufacturers. Where two or more units of the same type or class of equipment are required, provide units of a single manufacturer.

1.12 NOISE AND VIBRATION

- A. Select equipment to operate with minimum noise and vibration. If objectionable noise or vibration is produced or transmitted to or through the building structure by equipment, piping, ducts or other parts of work, rectify such conditions at no additional cost. If the item of equipment is judged to produce objectionable noise or vibration, demonstrate at no additional cost that equipment performs within designated limits on a vibration chart.

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1.13 ACCEPTABLE MANUFACTURERS

- A. Manufacturers names and catalog number specified under sections of Division 21 are used to establish standards of design, performance, quality and serviceability and not to limit competition. Equipment of similar design, equal to that specified, manufactured by a named manufacturer will be acceptable on approval. A request for prior approval of equipment not listed must be submitted ten (10) days before bid due date. Submit complete design and performance data to the Engineer.

1.14 OPERATING TESTS

- A. After all plumbing systems have been completed and put into operation, subject each system to an operating test under design conditions to ensure proper sequencing and operation throughout the range of operation. Tests shall be made in the presence of the Architect/Engineer. Make adjustments as required to ensure proper functioning of all systems. Special tests on individual systems are specified under individual sections. Submit 3 copies of all certifications and test reports adequately in advance of completion of the work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

1.15 WARRANTIES

- A. Submit 3 copies of all warranties and guarantees for systems, equipment, devices and materials. These shall be included in the Operating and Maintenance Manuals.

1.16 BUILDING CONSTRUCTION

- A. It shall be the responsibility of each sub-contractor to consult the Architectural and Engineering drawings, details, and specifications and thoroughly familiarize himself with the project and all job related requirements. Each sub-contractor shall cooperate with the General Contractor to verify that all piping and other items are placed in the walls, furred spaces, chases, etc., so there will be no delays in the job.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 OPENINGS

- A. Framed, cast or masonry openings for ductwork, equipment or piping are specified under other divisions. Drawings and layout work for exact size and location of all openings are included under this division.

3.2 HOUSEKEEPING PADS

- A. Provide equipment housekeeping pads under all floor mounted and ground mounted plumbing equipment, and as shown on the drawings.
- B. Concrete work as specified in Division 3.

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- C. Concrete pads:
 - 1. 4" high, rounded edges, minimum 2500 psi unless otherwise indicated on the drawings
 - 2. Chamfer strips at edges and corner of forms.
 - 3. Smooth steel trowel finish.
 - 4. Doweled to existing slab
- D. Install concrete curbs around multiple pipe penetrations.

3.3 VANDAL RESISTANT DEVICES

- A. Provide a handle for each loose keyed operated valve and hose bibb on the project.
- B. Where vandal resistant screws or bolts are employed on the project, deliver to the Owner 2 suitable tools for use with each type of fastener used.
- C. Proof of delivery of these items to the Owner shall be included in the Operating and Maintenance Manuals.

3.4 INSTRUCTION OF OWNER'S PERSONNEL

- A. Prior to final inspection, conduct an on-site training program to instruct the Owner's operating personnel in the operation and maintenance of the plumbing systems.
 - 1. Provide the training during the Owner's regular working day.
 - 2. The Instructors shall each be experienced in their phase of operation and maintenance of building plumbing systems and with the project.
- B. Time to be allocated for instructions.
 - 1. Minimum of 4 hours dedicated instructor time.
 - 2. 2 hours on each of 2 days.
- C. Before proceeding with the on-site training program, submit the program syllabus; proposed time and dates; and other pertinent information for review and approval.
 - 1. One copy to the Owner.
 - 2. One copy to the Architect/Engineer.
- D. The Owner will provide a list of personnel to receive instructions, and will coordinate their attendance at the agreed upon times.
- E. Use the operation and maintenance manuals as the basis of instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
- F. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shut down of each item of equipment.
- G. Demonstrate equipment functions (both individually and as part of the total integrated system).
- H. Prepare and insert additional data in the operating and maintenance manuals when the need for additional data becomes apparent during instructions.
- I. Submit a report within one week after completion of the training program that instructions have been satisfactorily completed. Give time and date of each demonstration and hours devoted to the demonstration, with a list of people present.

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- J. At the conclusion of the on-site training program, have the person designated by the Owner sign a certificate to certify that he/she has a proper understanding of the system, that the demonstrations and instructions have been satisfactorily completed, and the scope and content of the operating and maintenance manuals used for the training program are satisfactory.
- K. Provide a copy of the report and the certificate in an appropriately tabbed section of each Operating and Maintenance Manual.

3.5 EQUIPMENT IDENTIFICATION

- A. Provide a laminated engraved plastic nameplate on each piece of equipment and starter.
 - 1. Designation approved by Architect/Engineer.
 - 2. Equipment includes, but is not limited to, water heaters, pumps, boilers and utility controllers.
 - 3. Submit schedule of equipment to be included and designations.
- B. Provide nameplates with 1/2" high letters and fastened with epoxy or screws.

3.6 OBSTRUCTIONS

- A. The drawings indicate certain information pertaining to surface and subsurface obstructions which has been taken from available drawings. Such information is not guaranteed, however, as to accuracy of location or complete information.
 - 1. Before any cutting or trenching operations are begun, verify with Owner's representative, utility companies, municipalities, and other interested parties that all available information has been provided.
 - 2. Should obstruction be encountered, whether shown or not, alter routing of new work, reroute existing lines, remove obstruction where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of the new work and leave existing services and structures in a satisfactory and serviceable condition.
- B. Assume total responsibility for and repair any damage to existing utilities or construction, whether or not such existing facilities are shown.

3.7 PROTECTION

- A. Protect work, equipment, fixtures, and materials. At work completion, work must be clean and in original manufacturer's condition.

END OF SECTION

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SECTION 210510

FIRE PROTECTION CONTRACT QUALITY CONTROL

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Contract quality control including workmanship, manufacturer's instructions and demonstrations.

1.2 QUALITY CONTROL PROGRAM

- A. Maintain quality control over supervision, subcontractors, suppliers, manufacturers, products, services, site conditions and workmanship to produce work in accordance with contract documents.

1.3 WORKMANSHIP

- A. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.
- B. Perform work by persons qualified to produce workmanship of specified quality.
- C. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking. Under no conditions shall material or equipment be suspended from structural bridging.
- D. Provide finishes to match approved samples. All exposed finishes shall be approved by the Architect. Submit color samples as required.

1.4 MANUFACTURER'S INSTRUCTIONS

- A. Comply with instructions in full detail, including each step in sequence.
- B. Should instruction conflict with Contract Documents, request clarification from Architect / Engineer before proceeding.

1.5 MANUFACTURER'S CERTIFICATES

- A. When required in individual Specification Sections, submit manufacturer's certificate in duplicate, certifying that products meet or exceed specified requirements.

1.6 MANUFACTURER'S FIELD SERVICES

- A. When required in individual Specification Sections, manufacturer shall provide qualified personnel to observe:
 - 1. Field conditions.
 - 2. Condition of installation.
 - 3. Quality of workmanship.
 - 4. Start-up of equipment.
 - 5. Testing, adjusting, and balancing of equipment.
- B. Representative shall make written report of observations and recommendations to Architect / Engineer.

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PART 2 - PRODUCTS

2.1 REFERENCE APPLICABLE SPECIFICATION SECTIONS.

PART 3 - EXECUTION

3.1 PROTECTION OF EQUIPMENT

- A. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the Contractor is obligated to furnish new equipment of a like kind at no additional cost to the Owner.
- B. Adequately protect equipment from damage after delivery to the project. Cover with heavy tarpaulins, drop cloths or other protective coverings as required to protect from plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion.

END OF SECTION

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SECTION 210512

FIRE PROTECTION SHOP DRAWINGS, COORDINATION DRAWINGS & PRODUCT DATA

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Prepare submittals as required by Division 1.
- B. The term submittal, as used herein, refers to all:
 - 1. Shop Drawings
 - 2. Coordination Drawings
 - 3. Product data
- C. Submittals shall be prepared and produced for:
 - 1. Distribution as specified
 - 2. Inclusion in the Operating and Maintenance Manual, as specified, in the related section

1.2 SHOP DRAWINGS

- A. Present drawings in a clear and thorough manner. Identify details by reference to sheet and detail, schedule, or room numbers shown on Contract Drawings.
- B. Show all dimensions of each item of equipment on a single composite Shop Drawing. Do not submit a series of drawings of components.
- C. Identify field dimensions; show relationship to adjacent features, critical features, work, or products.
- D. Submit shop drawings in plan, elevation and sections, showing equipment in mechanical equipment areas.

1.3 COORDINATION DRAWINGS

- A. Present in a clear and thorough manner. Title each drawing with project name. Identify each element of drawings by reference to sheet number and detail, or room number of contract documents. Minimum drawing scale: $\frac{1}{4}" = 1'-0"$.
- B. Prepare coordination drawings to coordinate installations for efficient use of available space, for proper sequence of installation, and to resolve conflicts. Coordinate with work specified in other sections and other divisions of the specifications.
- C. For each mechanical room and for each outside equipment pad where equipment is located, submit plan and elevation drawings. Show:
 - 1. Actual mechanical equipment and components to be furnished
 - 2. Service clearance
 - 3. Relationship to other equipment and components
 - 4. Roof drains and leader piping
 - 5. Fire protection piping and equipment

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- D. Identify field dimensions. Show relation to adjacent or critical features of work or products.
- E. Related requirements:
 - 1. Ductwork shop drawings
 - 2. Coordination drawing specified in Division 26
- F. Submit shop drawings in plan, elevation and sections, showing equipment in mechanical equipment areas.
- G. Gas piping sketch indicating proposed location of piping prior to proceeding with the installation.

1.4 PRODUCT DATA AND INSTALLATION INSTRUCTION

- A. Submit only pages which are pertinent to the project. All options which are indicated on the product data shall become part of the contract and shall be required whether specified are not.
- B. Mark each copy of standard printed data to identify pertinent products, referenced to specification section and article number.
- C. Show reference standards, performance characteristics and capacities; wiring and piping diagrams and controls; component parts; finishes; dimensions and required clearances.
- D. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete information not applicable.
- E. Mark up a copy of the specifications for the product. Indicate in the margin of each paragraph the following: "Comply, "Do Not Comply", or "Not Applicable". Explain all "Do Not Comply" statements.
- F. Provide a separate transmittal for each submittal item. Transmittals shall indicate product by specification section name and number. Separate all submittals into appropriate specification section number. Do not combine specification sections.

1.5 MANUFACTURERS INSTRUCTIONS

- A. Submit Manufacturer's instructions for storage, preparation, assembly, installation, start-up, adjusting, calibrating, balancing and finishing.

1.6 CONTRACTOR RESPONSIBILITIES

- A. Review submittals prior to transmittal.
- B. Determine and verify:
 - 1. Field measurements
 - 2. Field construction criteria
 - 3. Manufacturer's catalog numbers
 - 4. Conformance with requirements of Contract Documents
- C. Coordinate submittals with requirements of the work and of the Contract Documents.

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- D. Notify the Architect / Engineer in writing at time of submission of any deviations in the submittals from requirements of the Contract Documents.
- E. Do not fabricate products, or begin work for which submittals are specified, until such submittals have been produced and bear contractor's stamp. Do not fabricate products or begin work scheduled to have submittals reviewed until return of reviewed submittals with Architect / Engineer's acceptance.
- F. Contractor's responsibility for errors and omissions in submittals is not relieved whether Architect / Engineer reviews submittals or not.
- G. Contractor's responsibility for deviations in submittals from requirements of Contract Documents is not relieved whether Architect / Engineer reviews submittals or not, unless Architect / Engineer gives written acceptance of the specific deviations on reviewed documents.
- H. Submittals shall show sufficient data to indicate complete compliance with Contract Documents:
 - 1. Proper sizes and capacities
 - 2. That the item will fit in the available space in a manner that will allow proper service
 - 3. Construction methods, materials and finishes
- I. Schedule submissions at least 15 days before date reviewed submittals will be needed.

1.7 SUBMISSION REQUIREMENTS

- A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the Project or in the work of any other Contractor.
- B. Number of submittals required:
 - 1. Shop Drawings and Coordination Drawings: Submit one reproducible transparency and three opaque reproductions.
 - 2. Product Data: Submit the number of copies which the contractor requires, plus those which will be retained by the Architect / Engineer.
- C. Accompany submittals with transmittal letter, in duplicate, containing:
 - 1. Date
 - 2. Project title and number
 - 3. Contractor's name and address
 - 4. The number of each Shop Drawing, Project Datum and Sample submitted
 - 5. Other pertinent data
- D. Submittals shall include:
 - 1. The date of submission
 - 2. The project title and number
 - 3. Contract Identification
 - 4. The names of:
 - a. Contractor
 - b. Subcontractor
 - c. Supplier
 - d. Manufacturer

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5. Identification of the product
 6. Field dimensions, clearly identified as such
 7. Relation to adjacent or critical features of the work or materials
 8. Applicable standards, such as ASTM or federal specifications numbers
 9. Identification of deviations from contract documents
 10. Suitable blank space for General Contractor and Architect / Engineer stamps
 11. Contractor's signed and dated Stamp of Approval
- E. Coordinate submittals into logical groupings to facilitate interrelation of the several items:
1. Finishes which involve Architect / Engineer selection of colors, textures or patterns
 2. Associated items which require correlation for efficient function or for installation

1.8 SUBMITTAL SPECIFICATION INFORMATION

- A. Every submittal document shall bear the following information as used in the project manual:
1. The related specification section number
 2. The exact specification section title
- B. Submittals delivered to the Architect / Engineer without the specified information will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.9 RESUBMISSION REQUIREMENTS

- A. Make re-submittals under procedures specified for initial submittals.
1. Indicate that the document or sample is a re-submittal
 2. Identify changes made since previous submittals
- B. Indicate any changes which have been made, other than those requested by the Architect / Engineer.

1.10 CONTRACTOR'S STAMP OF APPROVAL

- A. Contractor shall stamp and sign each document certifying to the review of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the work and of Contract Documents.
- B. Contractor's stamp of approval on any submittal shall constitute a representation to Owner and Architect / Engineer that Contractor has either determined and verified all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data or assumes full responsibility for doing so, and that Contractor has reviewed or coordinated each submittal with the requirements of the work and the Contract Documents.
- C. Do not deliver any submittals to the Architect / Engineer that do not bear the Contractor's stamp of approval and signature.
- D. Submittals delivered to the Architect / Engineer without Contractor's stamp of approval and signature will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

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1.11 ARCHITECT / ENGINEER REVIEW OF IDENTIFIED SUBMITTALS

- A. The Architect / Engineer will:
 - 1. Review identified submittals with reasonable promptness and in accordance with schedule
 - 2. Affix stamp and initials or signature, and indicate requirements for re-submittal or approval of submittal
 - 3. Return submittals to Contractor for distribution or for resubmission
- B. Review and approval of submittals will not extend to design data reflected in submittals which is peculiarly within the special expertise of the Contractor or any party dealing directly with the Contractor.
- C. Architect / Engineer's review and approval is only for conformance with the design concept of the project and for compliance with the information given in the contract.
 - 1. The review shall not extend to means, methods, sequences, techniques or procedures of construction or to safety precautions or programs incident thereto.
 - 2. The review shall not extend to review of quantities, dimensions, weights or gauges, fabrication processes or coordination with the work of other trades.
- D. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

1.12 SUBSTITUTIONS

- A. Do not make requests for substitution employing the procedures of this Section.
- B. The procedure for making a formal request for substitution is specified in Div. 1.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

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SECTION 210513

ELECTRICAL PROVISIONS OF FIRE PROTECTION WORK

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Electrical provisions to be provided as fire protection work are indicated in other Division 21 sections, on drawings, and as specified.
- B. Types of work, normally recognized as electrical but provided as fire protection, specified or partially specified in this Section, include but are not necessarily limited to the following:
 - 1. Motors for fire protection equipment.
 - 2. Starters for motors of fire protection equipment, but only where specifically indicated to be furnished integrally with equipment.
 - 3. Wiring from motors to disconnect switches or junction boxes for motors of fire protection equipment, but only where specifically indicated to be furnished integrally with equipment.
 - 4. Wiring of field-mounted float control switches, flow control switches, and similar fire protection-electrical devices provided for fire protection systems, to equipment control panels.
 - 5. Pipe heat tracing.
- C. Refer to Division 21 sections for specific individual fire protection equipment electrical requirements.
- D. Refer to Division 26 sections for motor starters and controls not furnished integrally with fire protection equipment.
- E. Refer to Division 26 sections for junction boxes and disconnect switches required for motors and other electrical units of fire protection equipment.

1.2 RELATED WORK

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to work of this Section.

1.3 QUALITY ASSURANCE

- A. Wherever possible, match elements of electrical provisions of fire protection work with similar elements of electrical work specified in Division 26 sections for electrical work not otherwise specified.
- B. For electrical equipment and products, comply with applicable NEMA standards, and refer to NEMA standards for definitions of terminology. Comply with National Electrical Code (NFPA 70) for workmanship and installation requirements.

1.4 SUBMITTALS

- A. Include in listing of motors, voltage, notation of whether motor starter is furnished or installed integrally with motor or equipment containing motors.

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PART 2 - PRODUCTS

2.1 MOTORS

- A. Provide motors for fire protection equipment manufactured by one of the following:
 - 1. Baldor Electric Company
 - 2. Century Electric Div., Inc.
 - 3. General Electric Co.
 - 4. Louis Allis Div.; Litton Industrial Products, Inc.
 - 5. Lincoln Electric
 - 6. Marathon Electric Mfg. Corp.
 - 7. Reliance Electric Co.
 - 8. Westinghouse Electric Corp.
- B. Motor Characteristics. Except where more stringent requirements are indicated, and except where required items of fire protection equipment cannot be obtained with fully complying motors, comply with the following requirements for motors of fire protection work:
- C. Temperature Rating. Rated for 40°C environment with maximum 50°C temperature rise for continuous duty at full load (Class A Insulation).
- D. Provide each motor capable of making starts as frequently as indicated by automatic control system, and not less than 5 starts per hour for manually controlled motors.
- E. Phases and Current Characteristics. Provide squirrel-cage induction polyphase motors for 3/4hp and larger, and provide capacitor-start single-phase motors for 1/2hp and smaller, except 1/6hp and smaller may, at equipment manufacturer's option, be split-phase type. Coordinate current characteristics with power specified in Division 26 sections, and with individual equipment requirements specified in other Division 21 requirements. For 2-speed motors provide 2 separate windings on polyphase motors. Do not purchase motors until power characteristics available at locations of motors have been confirmed, and until rotation directions have been confirmed.
- F. Service Factor. 1.15 for polyphase motors and 1.35 for single-phase motors.
- G. Motor Construction. Provide general purpose, continuous duty motors, Design "B" except "C" where required for high starting torque.
 - 1. Frames. NEMA #56.
 - 2. Bearings are to be ball or roller bearings with inner and outer shaft seals, regreasable except permanently sealed where motor is inaccessible for regular maintenance. Where belt drives and other drives produce lateral or axial thrust in motor, provide bearings designed to resist thrust loading. Refer to individual section of Division 21 for fractional-hp light-duty motors where sleeve-type bearings are permitted.
 - 3. Except as indicated, provide open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation, and provide guarded drip-proof motors where exposed to contact by employees or building occupants. Provide weather-protected Type I for outdoor use, Type II where not housed. Refer to individual sections of Division 21 for other enclosure requirements.
 - 4. Provide built-in thermal overload protection and, where indicated, provide internal sensing device suitable for signaling and stopping motor at starter.
 - 5. Noise Rating: Provide "Quiet" rating on motors.
- H. All motors shall be premium efficiency.

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2.2 EQUIPMENT FABRICATION

- A. Fabricate fire protection equipment for secure mounting of motors and other electrical items included in work. Provide either permanent alignment of motors with equipment, or adjustable mountings as applicable for belt drives, gear drives, special couplings and similar indirect coupling of equipment. Provide safe, secure, durable, and removable guards for motor drives. Arrange for lubrication and similar running-maintenance without removal of guards.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install motors on motor mounting systems in accordance with motor manufacturer's instructions, anchored to resist torque, drive thrusts, and other external forces inherent in fire protection work. Secure sheaves and other drive units to motor shafts with keys and Allen set screws on flat surface of shaft. Unless otherwise indicated, set motor shafts parallel with machine shafts.
- B. Verify voltage with Electrical Plans.

END OF SECTION

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SECTION 210514

FIRE PROTECTION ALTERATIONS PROJECT PROCEDURES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Inspect and service existing equipment and materials that are to remain or to be reused.
- B. Disposal of equipment, materials, or housekeeping pads to be abandoned. Prior to disposal, the Contractor shall verify with the Owner what is to be salvaged by the Owner and what is to become the property of the Contractor.
- C. Handling of equipment and materials to be removed.

1.2 QUALITY ASSURANCE

- A. Coordination with the Owner prior to the disconnection or shutdown of existing equipment, or to the modification of existing operational systems.

1.3 CONTRACT DRAWINGS

- A. There is the possibility that existing conditions and devices are affected by the work indicated on the drawings and called for in the specifications (project manual) that do not appear on the drawings. It is the Contractor's responsibility to visit the site and determine all of the existing conditions and to consider these existing conditions when making and presenting a proposal, to have a complete proposal.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Material used to upgrade and repair existing equipment shall conform to that specified.
- B. Material used to upgrade and repair existing equipment shall not void existing warranties or listings of the equipment to be upgraded or repaired.
- C. Material used to upgrade and repair existing equipment shall be new and shall be of the same manufacturer of the existing equipment, shall be acquired through the existing original equipment manufacturer's approved distribution channels, shall have manufacturer's warranties for the new material being used, and shall be listed for the use intended.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Existing materials and equipment indicated on the drawings or in the specifications to be reused shall be inspected for damaged or missing parts. Contractor shall notify the Architect/Engineer, in writing, accordingly.
- B. If using materials specified or shown on the drawing voids or diminishes the warranty or operation of remaining equipment or systems, the Contractor shall notify the Architect/Engineer, in writing.

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- C. Verify field measurements, above and underground piping connections and flows.
- D. Demolition Drawings are based on casual field observation, and when available, existing record documents. Report discrepancies to Architect before disturbing existing installation, and immediately after such discrepancies are discovered.
- E. Field verify existing conditions and actual utility uses prior to final connections. Existing drawings may not have been available for all required information.

3.2 APPLICATION

- A. Existing materials and equipment indicated on the drawings or in the specifications to be reused shall be cleaned and reconditioned, including cleaning of piping systems prior to installation and reuse, or abandon.
- B. Material and equipment removed that is not to be salvaged for Owner's use or for reuse on the project shall become the property of the Contractor and be removed from the site.
- C. Material or equipment salvaged for Owner's use shall be carefully handled and stored where directed by the Owner or the Architect / Engineer. Relocate material and / or equipment as directed by Owner.
- D. Materials and equipment not indicated to be removed or abandoned shall be reconnected to the new system.
- E. Materials, equipment and housekeeping pads not to be reused or reconnected shall be removed for Owner's review and salvaged by Contractor.
- F. Prior to start of construction, Contractor shall walk areas to be renovated with Owner to identify and document items to be salvaged for Owner's use.
- G. Clean and repair existing materials and equipment that remain or are to be reused.
- H. Contractor shall utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

3.3 SEQUENCE AND SCHEDULE

- A. Coordinate utility service outages with Utility Company, Architect and Owner.
- B. Provide additional or temporary valves, piping and connections to maintain existing systems in service during construction.
- C. Existing Fire Protection Service: Refer to drawings for work in remodeled areas. Where facilities in these areas are to remain in service, any related work to keep the facilities in operation is specified in this Division. Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Obtain permission from Owner at least 48 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area. Maintain acceptable temperature and humidity control within existing building during renovation activities.

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- D. Remove and replace existing fire protection systems and appurtenances as occasioned by new or remodeled construction. Re-establish service that may be interrupted by remodeled construction.
- E. Refer to other drawings series for work in remodeled areas. Where facilities in these areas are required to remain in service, any related work required to keep these facilities in operation is specified in this Division.
- F. Remove and replace existing piping coincident with the construction.

3.4 DEMOLITION AND EXTENSION OF EXISTING FIRE PROTECTION WORK

- A. The Contractor shall modify, remove, and/or relocate all materials and items so indicated on the drawings or required by the installation of new facilities. All removals and/or dismantling shall be conducted in a manner as to produce maximum salvage. Salvage materials shall remain the property of the Owner, and shall be delivered to such destination as directed by the Owner's representative unless they are not wanted, then it will be the responsibility of this Contractor to remove such items and properly dispose of them. Materials and/or items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to good operative condition. The Contractor may, at his discretion, and upon approval of the Owner's representative substitute new materials and/or items of like design and quality in lieu of materials and/or items to be relocated.
- B. All items to be relocated shall be carefully removed in reverse to original assembly or placement and protected until relocated. The Contractor shall clean, repair, and provide all new materials, fittings, and appurtenances required to complete the relocations and to restore them to good operative order. All relocations shall be performed by workmen skilled in the work and in accordance with standard practice of the trades involved.
- C. When items scheduled for relocation and/or reuse are found to be in damaged condition before work has been started on dismantling, the Contractor shall call the attention of the Owner's representative to such items and receive further instructions before removal. Items damaged in repositioning operations are the contractor's responsibility and shall be repaired or replaced by the contractor as approved by the owner's representative, at no additional cost to the Owner.
- D. Fire protection piping and appurtenances to be removed, salvaged, or relocated shall be removed to points indicated on the drawings, specified, or acceptable to the Owner's representative. Piping not scheduled for reuse shall be removed to the points at which reuse is to be continued or service is to remain. Such services shall be sealed, capped, or otherwise tied-off or disconnected in a safe manner acceptable to the Construction Inspector. All disconnections or connections into the existing facilities shall be done in such a manner as to result in minimum interruption of services to adjacent occupied areas. Services to existing areas or facilities that must remain in operation during the construction period shall not be interrupted without prior specific approval of the Owner's representative hereinbefore specified.
- E. Repair adjacent construction and finishes damaged during demolition and extension work.
- F. Maintain access to mechanical installations that remain active. Modify installation or provide access panel as appropriate.

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- G. Extend existing installations using materials and methods compatible with existing fire protection installation, or as specified.
- H. Existing fire protection piping and devices found to need additional hangers installed should be added at no additional cost to the Owner.

3.5 PROTECTION OF THE WORK

- A. Provide adequate temporary support and auxiliary structure as necessary to ensure structural value or integrity of affected portion of work.
- B. Provide devices and methods to protect other portions of work from damage.
- C. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances and finishes.

3.6 IDENTIFICATION OF EQUIPMENT IN RENOVATED AREAS

- A. Identification of Equipment: Provide new identification of all existing equipment to be reused and located within the renovated areas. Do not include the description "existing". Provide new nameplates for all existing equipment in renovated areas as specified in Section 21 05 00 Fire Protection General Provisions.

END OF SECTION

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SECTION 211000

FIRE SPRINKLER SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Design coordination of sprinkler work with the installations of other trades as shown on their drawings; all mechanical, electrical, plumbing and sprinkler work must fit the space requirements. The sprinkler work shall comply with other Sections of this specification; and fit the structure finishes. The Sprinkler Contractor will comply with all the codes and underwriter authorities, and the requirements for the installation of inside and outside piping; including sprinkler heads, valves, tamper switches, flow switches, hangers and supports, sleeves, fire department connections, inspector test connections, main drain and accessories, signs and any other component parts reasonably incidental to providing a complete protection system. Provide 100 percent coverage for the entire building.
- B. A wet system shall be installed in heated areas and dry pipe systems in areas subject to freezing. When heated areas are not available and dry pipe system not used, provide heat tracing and / or insulation installed per NFPA and per local Fire Marshall Requirements, or as indicated on drawings.
- C. Furnish all articles of a completed sprinkler system including all materials, labor, tools, equipment, transportation services and supervision fees.
- D. The plans provide a riser assembly location at water entry into building for flow switch locations, valve locations (with tamper switches), fire department test assemblies and fire department Siamese connections. These are a guide for subsequent preparation of the Contractor's detailed installation drawings of the complete fire protection sprinkler system which shall be submitted to the Architect / Engineer for review. Submit only drawings and calculations bearing the approval of the authority having jurisdiction.
- E. Do not exceed 52,000 square feet of building for each individual sprinkler system.
- F. Install fire protective system identification signs in accordance with NFPA-13, NFPA-14, and NFPA-20
- G. It shall be the fire protection installer's responsibility to verify pressure at the project site by performing a flow test. Determine if the available static pressure, residual pressure and flow rate will adequately provide the fire extinguishing system with the necessary operating requirements or if a fire pump, storage tank and necessary appurtenances are required. Notify Architect and Engineer if low water flow / pressure condition exist and inform them of all options prior to proceeding.
- H. The installation of the entire Sprinkler Systems shall comply with all rules and regulations of the National Board of Fire Underwriters, the Local Building Code, Local Fire Marshall, and Requirements of NFPA Pamphlet 13, and other local authorities exercising jurisdiction.

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- I. Study the general, structural, electrical and mechanical drawings and specifications, in order to become familiar with the building and details as they apply to the work of this Section. Cooperate with all Trades so that there will be no conflict of space. Plumbing flow lines, large ductwork HVAC piping and electrical service feeders shall take precedence over Fire Protection work, except where it is absolutely necessary to maintain coverage protection.
- J. Provide a water curtain sprinkler system along glazing to create a 1-hour rating, as outlined in NFPA 13. Refer to Architecture plans for locations. Water demand for water curtain shall be added to the ceiling sprinkler water demand at the point of connection, per NFPA 13. Sprinkler heads shall be spaced at 6'-0" o.c., minimum 6 inches and maximum 12 inches from glazing.

1.2 BASIS OF DESIGN

- A. National Fire Protection Association (NFPA), latest edition of NFPA 13, Standard for the Installation of Sprinkler Systems.
- B. Vertical zone valves installed in horizontal position are not acceptable. All zone valves are to be located at water entry into building and mounted in the vertical riser.

1.3 QUALITY ASSURANCE

- A. Sprinkler equipment and installation to be in accordance with recommendations of and approved by local, state and federal fire authorities.
- B. Equipment and installation to meet requirements of NFPA No. 13, 14, 20, 24, 25, 70 and 72.
- C. Use materials and equipment that are new and of unused, approved by NFPA and as listed in the UL list of "Inspected Fire Protection Equipment and Materials."

1.4 SHOP DRAWINGS

- A. Make complete shop drawings and working drawings of equipment furnished, including detailed drawings of piping and sprinkler head locations. Drawings shall show construction details and dimensions of each piece of equipment and work to be installed. The location of all heads shall be as approved. Where additional heads are required to meet NFPA 13, provide at no additional cost.
- B. Before the shop drawings are submitted to Architect / Engineer, submit drawings to the jurisdictions for approval. All approvals shall be noted on the drawings or by letter from the departments.
- C. The Architect's approval of shop drawings shall not relieve the responsibility of correctly figured dimensions or any errors that may be contained in these drawings. The omission of any material shown on the contract drawings, or specified from the shop drawings, even though approved, shall not relieve the responsibility to furnish and erect them.
- D. Provide ¼ scale drawings to show the location of the water entry into building with all zone valves, and shut-off valves, with alarms and drains at this location. Prepare the sprinkler drawings under the work of this Section.
- E. Submit samples of all sprinkler types for approval.

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PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Johnson Controls (Tyco Fire Products)
 - 1. Gem/Grinnell
 - 2. Central
 - 3. Star Sprinkler
- B. Automatic Sprinkler Company of America
- C. Potter Roemer, Inc.
- D. The Reliable Automatic Sprinkler Company
- E. Viking Corporation
- F. Victaulic Company of America
- G. Globe Fire Sprinkler Corporation

2.2 PIPING AND FITTINGS

- A. Above Slab Inside Building
 - 1. Pipe 2" and Smaller: Schedule 40, black steel pipe conforming to ASTM A 795 or ASTM A135 joined with threaded fittings.
 - 2. Pipe 2-1/2" and larger, provide ASTM A795 or ASTM A135 UL and FM listed.
 - a. Light wall having a minimum corrosion resistance ratio (CRR) or 1.00 or greater.
- B. Underground within five feet of building. Provide ductile iron pipe, Class 200 conforming to ASTM, and ring-tite fittings. Provide concrete thrust blocks at changes in direction, according to the pipe manufacturer's recommendations.
- C. All piping shall be black carbon steel, except in dry systems where pipe shall be galvanized per ASTM A53.
- D. Fittings used to join pipe shall be listed fabricated fittings or manufactured in accordance to the material and dimension standards listed in table 6.4.1 NFPA 13 and 2.2.1 NFPA 14.

2.3 SPRINKLER HEAD

- A. All sprinklers shall comply with the latest requirements of NFPA 13 with respect to orifice size.
- B. All heads shall be UL listed and/or FM approved, and comply with the latest requirements of NFPA 13 with respect to orifice size unless otherwise noted. Sprinkler heads with "O" ring design shall not be acceptable.
- C. Exposed areas:
 - 1. Standard upright type with brass finish and escutcheon. Provide temperature rating per NFPA 13 and UL/FM approvals.
 - 2. Tyco Model B, FRB, Globe Model GL-QR, GL-SR, or approved equal

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- D. Sidewall applications:
 - 1. Horizontal sidewall type with brass finishes and chrome escutcheon.
 - 2. Unfinished areas and recessed with chrome plated escutcheon. Provide temperature rating per NFPA 13 and UL/FM approvals.
 - 3. Tyco Model B, FRB, Globe Model GL-QR/SW, GL-SR/SW, or approved equal.
- E. Suspended ceilings:
 - 1. Adjustable drop down deflector type concealed heads with manufacturer painted white cover plate with glass bulb fusible link. Provide temperature rating per NFPA 13 and UL/FM approvals.
 - 2. Color of plate, selected by Architect
 - 3. Tyco Series RFII; Series ELOC, Globe Concealed Models GL-QR/INCH, GL-SW/INCH and GL-INCH/ECLH or approved equal.
- F. Dry sprinklers heads at freezers and coolers
 - 1. Tyco Model DS-1, DS-2, or approved equal.
- G. Sprinklers subject to mechanical injury shall be protected with fusible solder type sprinklers and listed heavy duty bolt on guards. Bulb type sprinklers will not be acceptable for these locations.
 - 1. Storage rooms with exposed structure.
 - 2. Gymnasiums.
 - 3. Mechanical and Electrical rooms.
 - 4. Below exposed stairs.
 - 5. Exposed structure areas.
- H. Systems serving walk-in freezers shall utilize Tyco Model DS-1 or DS-C dry pendent sprinklers. A Model DSB-1 dry sprinkler boot shall be utilized in conjunction with the dry sprinkler to eliminate the requirement for insulation and to stop potential air interchange. Length of dry pendent shall be determined by manufacturer's recommendation with respect to freezer ambient temperatures expected.

2.4 INSPECTOR'S TEST CONNECTION

- A. Provide inspector's test connection as required by NFPA 13.
 - 1. Ductile iron module housing with combination sight glass, orifice and bonnet assembly
 - 2. UL listed
 - 3. Victaulic No. 718
 - 4. Globe Model UTD
 - 5. Tyco, or approved equal

2.5 TAMPER SWITCH / SUPERVISORY SWITCH

- A. Tamper switch on each valve
 - 1. Controlling or shutting off sprinkler system or any portion thereof.
 - 2. Tamper switch with either one single pole, double throw switch or two single pole, double throw switches as required.
 - 3. Switch shall be compatible with installed valve for standard mounting.
 - 4. Potter-Roemer Fig. 6220, 6221, 6222, 6223 or approved equal.

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2.6 FLOW SWITCH

- A. Vane type flow switch.
 - 1. Self-contained pneumatic, adjustable retard.
 - 2. Two, single pole, double throw switches.
 - 3. Red enamel tamper proof switch housing with flow paddle.
 - 4. Potter Roemer Model No. 6200, or approved equal.

2.7 FLOORS AND CEILING PLATES

- A. Provide chrome-plated floor and ceiling plates around pipes exposed to view when passing through walls, floors, partitions, or ceilings in finished areas; size plates to fit pipe or insulation and lock in place.

2.8 DOMESTIC MANUFACTURE

- A. All piping material, pipe and pipe fittings shall be manufactured in the United States of America.

2.9 DRY PIPE SYSTEM

- A. General: Provide a UL listed and FM approved dry pipe system as required. System shall consist of a dry pipe valve, air compressor, fusible link type sprinkler heads and all associated trim and piping for a complete operating system.
- B. Dry Pipe Valve: Rated for a working pressure of 175 psi, factory hydrostatic tested at 350 psi, supplied with all gauges, valves, strainer, electrical alarm switch, ball drip valve, and drip cup assembly, manufactured by Victaulic Model 756, Globe Model RCW.
- C. Air Compressor: Oilless, permanently lubricated, pipe mounted, direct drive, complete with safety relief valve manufactured by Reliable Model A or approved equal. Size of air compressor is determined by volume of dry pipe system. Coordinate power requirement with electrical contractor. Coordinate all wiring required with Fire Alarm System.
- D. If the dry pipe system is not used in conjunction with a wet pipe system containing the necessary check valves or backflow preventer, a check valve shall be installed in the dry pipe system at the connection to the water supply.
- E. If the dry pipe system is not used in conjunction with a wet pipe system containing a control valve such as a post indicator (PIV) or outside screw & yoke valve (OS&Y), a PIV or OS&Y shall be installed in the system.
- F. The dry pipe valve and pipe to the wet supply shall be protected from freezing.
- G. Provide an automatic or manual compressed air system capable of restoring normal air pressure to a system in 30 minutes or less.
- H. Provide an accelerator when system capacity exceeds 500 gallons.
- I. Provide a water motor alarm or electric pressure switch.
- J. Provide dry pipe valve trim and pressure gauges.

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- K. Dry pipe system shall be hydraulically calculated for the hazard being protected.
- L. Provide dry pendent type sprinkler heads only when the piping and sprinklers are not in a heated area.
- M. Provide a test drain valve sized per NFPA. An inspector's test shall be provided at each system.
- N. Slope all piping toward a drain per NFPA 13. A drain shall be provided at all low points.
- O. The following accessories shall be provided where required:
 - 1. Victaulic Series 756.
 - 2. Viking Model E dry pipe valve with conventional trim.
 - 3. Viking Model D-1 accelerators.
 - 4. Globe Model RCW dry pipe valve with conventional trim package, and Model C Accelerator.

2.10 GASKETS

- A. Use 1/16-inch thick preformed synthetic rubber bonded.

2.11 COUPLINGS

- A. Use listed rolled grooved mechanical couplings to engage and lock grooved or shouldered pipe ends and to allow for some angular deflection, contraction and expansion. Coupling consists of ductile iron housing, c-shaped composition sealing gasket and steel bolts. Gasket Material for dry pipe systems shall be silicone and listed for dry pipe service.

2.12 VALVES

- A. Use valves suitable for 175 psig WOG.
- B. Valves to be UL listed and FM approved.
- C. Valve Connections:
 - 1. Provide valves suitable to connect adjoining piping as specified for pipe joints. Use full line size valves unless noted otherwise.
 - 2. Screwed ends for pipe sizes 2 inches and smaller.
 - 3. Flanged ends for pipe sizes 2-1/2 inches and larger.
 - 4. Solder or screw to solder adapters for copper tubing.
 - 5. Use grooved body valves with mechanical grooved jointed piping.
- D. Gate Valves:
 - 1. Up to 2 inches, bronze, outside screw and yoke, rising stem, solid wedge, screwed ends, manufactured by: Mueller, or approved equal.
 - 2. Over 2 inches, iron body, bronze trim, outside screw and yoke, rising stem, solid wedge, flanged ends; manufactured by Mueller, or approved equal.
- E. Check Valves:
 - 1. Up to 2 inch, bronze, regrind bronze swing disk, solder or screwed ends; 200 WOG, manufactured by Mueller, or approved equal.

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- 2. Over 2 inch, iron body bronze trim, swing disk, regrind – renew bronze disk and seat, flanged ends; 200 WOG, manufactured by Mueller, Globe Model RCV, or approved equal.
- F. Butterfly Valve: Lug body style, bubble-tight shutoff, cast iron body, ASTM B 148 bronze disk, with integral tamper switch, manufactured by Anvil Model No. 8000 FP, or approved equal.
- G. Freestanding Indicating Post: Install adjustable indicating post and valve outside building where shown on Civil drawings, consisting of UL/FM, non-rising stem gate valve and indicating post. Gate valve shall be iron body, non-rising stem, bronze mounted. Indicator flange, 175-psi non-shock rating, flanged end. Indicator shall be UL/FM approved cast iron body, Plexiglas window and 18-inch adjustment span with handle and tamper switch wired to main fire alarm control panel, manufactured by Mueller, Valve No. A-2052, Indicating Post No. A20800, or approved equal.
- H. Wall post-adjustable indicating valve: Outside building at water entry location into building, consisting of UL/FM, non-rising stem gate valve and indicator. Gate valve shall be iron body, non-rising stem, bronze mounted. Indicator flange, 175-psi non-shock rating, flanged end. Indicator shall be UL/FM approved cast iron body, Plexiglas window and 18-inch adjustment span with handle and tamper switch wired to main fire alarm control panel, manufactured by Mueller, Valve No. A-2052, Indicating Post No. A20800, or approved equal.

2.13 ELECTRIC ALARM BELL

- A. 10-inch round red enamel steel bell with electrically operated vibrating outdoor alarm bell, UL listed, red enamel steel, manufactured by Simplex, or approved equal.

2.14 GAUGES

- A. Gauges shall be bourdon tube type with minimum 4-1/2 inch dial and die cast aluminum case with screwed ring and black enamel finish. The movement shall be all stainless steel with Grade A phosphor bronze bourdon tube, brazed at socket and tip. The accuracy of the gauge shall be within one-half of one percent of the scale range. The pointer shall be the micrometer adjustment type recalibrated from the front. Pressure and compound gauges shall have suitable scale ranges and graduations. Suitable for temperatures up to 120 degrees F.
- B. Gauges shall have 1/4 inch connections and be mounted with combination stop / snubber needle valve with suitable pressure rating. Scale ranges: 0-200 psi.
- C. Gauge range shall be such that system normal operating pressure falls with 25 percent and 75 percent of the full-scale range.
- D. Pressure scale graduations shall read in psig. Figure intervals shall be in – 20 psig increments, with minor divisions in 2 psig increments.
- E. The accuracy of the gauge shall be at least 0.5 percent of the scale range. Gauge shall be made in accordance with ASME B40.1 accuracy grade 2A.

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- F. Manufactured by:
 - 1. Trerice Model No. 4500 Series
 - 2. Ashcroft
 - 3. Marsh
 - 4. Weksler

2.15 SPARE SPRINKLER HEAD BOX

- A. Provide baked enamel steel box to store 36 sprinkler heads (Minimum of 3 of each type used) for emergency replacement. Provide sprinkler wrench.

2.16 ALARM CHECK VALVE

- A. Provide UL listed check valve.
 - 1. Variable for City Supplied systems pressure trim set.
 - 2. Constant for Fire Pump Systems pressure trim set.
 - 3. Tyco AV-1, Globe Model H, or approved equal.

2.17 WATER MOTOR ALARM

- A. Provide a red enamel motor alarm for installation on exterior wall.
 - 1. Tyco Model WMA-1, Globe Model WM, or approved equal.

2.18 SIAMESE FIRE DEPARTMENT CONNECTION

- A. Siamese Wall mounted chrome-plated Siamese. Include caps, sillcock, chain, and a plate lettered AUTO-SPKR.
 - 1. Provide a 4" X 2-1/2" x2-1/2".
 - 2. Potter-Roemer #5751

PART 3 - EXECUTION

3.1 DESIGN

- A. Design, spacing of sprinkler heads and selection sizes shall conform to the requirements of NFPA 13 for the indicated occupancy.
- B. Uniform discharge density design shall be based on hydraulic calculations using the method outlined in NFPA 13. Density of discharge from sprinkler heads shall conform to NFPA 13.
- C. Friction losses in pipe will be based on a value of "C" = 120 in the Hazen and Williams formula.
- D. Design and install the system so that no part will interfere with doors, windows, heating, mechanical, lighting or electrical equipment. Do not locate sprinkler heads closer than 3 feet to lighting fixtures or other obstructions.

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3.2 LOCATION

- A. Heads shown, if indicated on reflected ceiling plans, are an integral part of the ceiling design. Where heads are not shown or indicated, locate them in the exact center of acoustical ceiling tile unless noted otherwise. In rooms with monolithic plaster or gypsum drywall ceilings, locate the sprinkler heads symmetrically arranged with respect to both axes of the room. Locate sprinkler heads in relation to specialty ceiling elements such as slats, ribs, panels, grids, etc., if not shown on the drawings. Generally, locate heads in the exact center of, or spaced between, such elements. Center heads in corridors.
- B. Locate heads as may be required for coordinated ceiling pattern, even though number of heads exceed minimum code requirements.
- C. Sprinkler heads located in utility or mechanical rooms, penthouses, service corridors, or other such spaces not subject to public view need not be centered in ceiling patterns and may use a straight drop from branch line.
- D. Install a water curtain sprinkler system along glazing to create a 1-hour rating, as outlined in NFPA 13. Refer to plans for locations. Water demand for water curtain shall be added to the ceiling sprinkler water demand at the point of connection, per NFPA 13. Sprinkler heads shall be spaced at 6'-0" on center, minimum 6 inches and maximum 12 inches from glazing.
- E. Where glazing shall be installed in 2-hour fire rated assemblies, the Tyco Window sprinkler shall be utilized as outlined in the ICC Legacy report equivalency requirements. Any glazing requiring fire exposure protection shall also utilize the Tyco window sprinklers.

3.3 PREPARATION

- A. Ream pipes and tubes, clean off scale, rust, oxide and dirt, inside and outside, before assembly. Remove welding slag or other foreign material from piping.
- B. Pipe beveled each end, per approved procedures.
- C. Hammer clean and flush out piping after welding to remove scale, welding slag and other debris.

3.4 CONNECTION

- A. Make screwed joints with square, clean full cut standard taper pipe threads. Ream after cutting and threading. Red lead and linseed oil or other approved non-toxic joint compound applied to male threads only.
- B. Nipples: Shoulder type; extra heavy where less than 1-1/2 inch is unthreaded.
- C. Clamp cast iron water pipe at fittings with 3/4 inch rods and properly anchor and support.
- D. Use grooved mechanical couplings and mechanical fasteners only in accessible locations.

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3.5 COORDINATION

- A. Coordinate the installation schedule for this work with the construction schedule for the Work to ensure orderly progress with minimum delay.
- B. Coordinate interface of fire sprinkler system with the work of other trades to ensure proper and adequate provision for the installation and connection of this system.
- C. Coordinate location and quantity of Siamese connections required for fire department connection with Architect and local fire officials.

3.6 SURFACE CONDITIONS

- A. Before starting each stage of the fire sprinkler systems installation, inspect the installed work of other trades and determine that work is complete enough to allow installation to begin. Ensure that work of other trades has been installed in a manner to permit work of this Section in accordance with approved design.

3.7 INSTALLATION

- A. Run piping concealed above furred ceilings and in joists to minimize obstructions. Expose only heads.
- B. Protect sprinkler heads against mechanical injury with heavy duty bolt-on guards.
- C. Locate system drains and inspector's test connections in utility rooms, mechanical rooms or other readily accessible areas not requiring access through ceiling. Coordinate sprinkler system drain flow rates with plumbing system drainage capacities.
- D. Where low points or drains occur above ceilings or in otherwise finished spaces, furnish drain valve with brass cap and chain.
- E. Locate outside alarms on wall of building and coordinate with Architect.
- F. Fire pump and all accessories shall be tested in accordance with NFPA 20 and the local Fire Marshall and/or all other authorities having jurisdiction.
- G. Provide on interior wall near sprinkler valve, cabinet containing extra sprinkler heads of each type and wrench suitable for each head type.
- H. Provide a minimum 18-inch radius swing joint for each drop to sprinkler heads located in ceilings.
- I. Provide Easy-Flex or Flexhead Industries sprinkler hose fittings for each sprinkler head installation for hydraulically designed wet, pre-action, deluge or dry pipe sprinkler connections per NFPA 13. Allow a 3" minimum bend radius per UL.
- J. Install pipe markers to identify fire protection.
- K. Provide shield or deflector for sprinklers or equipment where electrical switchgear, switchboards and motor control centers are in sprinkler protected spaces.

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- L. Install fire 2-1/2 inch department valve, maximum 5 feet above floor, complying with NFPA 14.
- M. During construction, make one standpipe outlet available on each floor without delay, for fire department use.
- N. Provide 3-way standpipe outlets above roof.
- O. Provide pressure gauges at the top of each standpipe as detailed on the drawings.
- P. Provide drain for each standpipe.
- Q. Install valves with stems upright or horizontal, not inverted.
- R. Sprinkler heads shall be installed above and below ductwork over 48 inches wide, in exposed areas, per NFPA 13.
- S. Install the complete fire sprinkler system in accordance with the approved shop drawings.
- T. Perform piping installation in accordance with the provisions of the specifications, including furnishing of required sleeves for fire sprinkler system pipes passing through rated walls, floors, and other parts of the building. Provide scheduled 40 galvanized pipe sleeve for concrete or CMU penetrations. Furnish size required for fireproofing and or insulation. Furnish and install split wall plates and chrome plated escutcheons for exposed fire sprinkler system pipes. Where pipes pass through concrete floors, furnish and install wrought iron or steel pipe sleeves made flush with the ceiling below and extending 2" above the finished floor.
- U. Do not cut or make holes in any part of the building except where shown on the approved shop drawings.
- V. Furnish and install, next to the sprinkler riser main, a print sheet protected by glass or a transparent plastic cover, giving brief instructions regarding control, emergency procedure, and other data required by NFPA #13. For hydraulically designed sprinkler systems, a placard is to be permanently attached to the riser indicating the location, and the basis of design (discharge density and system demand).
- W. Do not install exposed piping below structure in public area.
- X. Provide heat tracing and insulation on wet piping systems exposed to freezing when not installed in a heated space or installed by other acceptable methods of maintaining the piping from freezing. Installation of heat tracing and insulation shall be in accordance with the latest edition of NFPA 13 and the local code authorities. Coordinate electrical requirements with Division 26.

3.8 SECURING AND SUPPORTING

- A. Support piping to maintain line and grade, with provision for expansion and contraction. Use approved adjustable ring type or trapeze-type hangers connected to structural members of the building. Single pipe runs to be supported by approved adjustable ring type hangers. Multiple pipe runs to be supported by approved trapeze type hangers. Do not support piping from other piping or structural joist bridging.

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- B. Provide supports both sides of elbows for pipe 6" and larger.
- C. Support vertical risers with steel strap pipe clamps of approved design and size, supported at each floor. Support piping assemblies in chases so they are rigid and self-supported before the chase is closed.
- D. Support spacing: As recommended by the project structural engineer and support manufacturer, but not more than listed below. Not to exceed spacing requirements of smallest pipe.

Pipe Size	Steel Max. Support Spacing, Feet	Minimum Rod Diameter, Inches
1" & smaller	6	3/8
1-1/4" & 1-1/2"	8	3/8
2"	10	3/8
3"	10	1/2
4" & 5"	10	5/8
6" and above	10	3/4

3.9 PIPE SUPPORTS

- A. Provide P1001 or P 5000 Unistrut metal framing members and appurtenances for pipe support. Hot-dip galvanize members and appurtenances when located outside. Sagging of pipes or supports is not acceptable.
- B. Adjustable ring type hangers shall be used for single pipe supports; Erico Model 115 NFPA UL/FM. When oversized clevis is used, a nipple shall be placed over the clevis bolt as a spacer to assure that the lower U-strap will not move in on the bolt. All parts shall be zinc plated carbon steel, or galvanized.

3.10 PIPE SLEEVES

- A. Sleeves through masonry and concrete construction:
 - 1. Fabricate sleeves of Schedule 40 galvanized steel pipe.
 - 2. Size sleeve large enough to allow for movement due to expansion and to provide continuous insulation.
- B. Sleeves through gypsum wall construction.
 - 1. Fabricate sleeves of 16 gauge galvanized sheet metal.
- C. Sleeves through elevated slab construction.
 - 1. Fabricate sleeves of Schedule 40 galvanized steel pipe with welded center flange in floor.
- D. Extend each sleeve through the floor or wall. Cut the sleeve flush with each wall surface. Sleeves through floors shall extend 2" above floor lines for waterproofing purposes. Slab on grade floors shall not be sleeved except where penetrating waterproofing membrane or insect control is required.
- E. Caulk sleeves water and airtight. Seal annular space between pipes and sleeves with mastic compound to make the space water and air tight.

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- F. For sleeves below grades in outside walls, provide Thunderline Link-Seal or Advance Product and System Interlynx, with 316 stainless steel nuts and bolts, with cast iron pressure plate.
- G. Provide chrome plated escutcheon plates on pipes passing through walls, floors or ceilings exposed to view. At exterior walls, stainless steel sheet metal is to be used.
- H. For sleeves through fire and smoke rated walls, seal with a UL through-penetration firestop, rated to maintain the integrity of the time rated construction. Install in accordance with the manufacturer's installation instructions. Comply with UL and NFPA standards for the installation of firestops. Refer to Architectural drawings for all fire and smoke rated partitions, walls, floors, etc.

3.11 CLEANING OF PIPING SYSTEMS

- A. General cleaning of piping systems. Purge pipe of construction debris and contamination before placing the systems in service. Provide and install temporary connections as required to clean, purge and circulate.

3.12 FLUSHING AND TESTING

- A. Testing and flushing of installation of sprinkler system shall be in accordance with NFPA 13, and NFPA 25.
- B. Flush sprinkler piping in accordance with NFPA 13. Additionally, flush all alarm valves, and all main piping up to valve.
- C. In addition to NFPA 13 required tests, provide flow switch test and tamper switch test for each device, and verify alarm valve operation.
- D. All tests shall be witnessed by Architect / Engineer. Contractor shall notify Architect / Engineer 7 working days in advance.

3.13 EXCAVATING, TRENCHING, AND BACKFILLING

- A. Perform excavation, trenching, and backfilling for this portion of the work in accordance with the specifications.

3.14 PIPE MARKERS

- A. Identify interior exposed piping and piping in accessible chases or plenums with Opti-Code Brady Pressure Sensitive Adhesive Pipe Markers, consisting of pipe marker and direction of flow arrow tape. Clean pipe prior to installation. Background colors of markers, arrows and tape for each type of system shall be the same. Meet ANSI/OSHA standards and clearly identify each system. Provide minimum 2-1/4-inch letters through 4-inch pipe and 4-inch letters for 5-inch pipe and larger.
- B. Identify exterior and mechanical room piping with Snap Around pipe markers through 4-inch pipe and Strap Around markers 5-inch pipe and larger. Pipe markers consisting of pipe marker and direction of flow arrow tape; background colors of markers, arrows and type for each type of system shall be the same. Meet ANSI / OSHA standards and clearly identify each system. Provide minimum 2-1/4-inch letters through 4-inch pipe and 4-inch letters for 5-inch pipe and larger.

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- C. Install identification in the following locations:
 - 1. Both sides of penetrations through walls, floors and ceilings.
 - 2. Close to valves or flanges.
 - 3. Intervals on straight pipe runs not to exceed 50 feet
 - 4. Apply marker where view is obstructed.
- D. Pipe markers shall meet or exceed the specifications of the ASME A13.1 "Scheme for Identification of Piping Systems".

3.15 TESTING AND ACCEPTANCE

- A. Prior to connecting to the overhead sprinkler piping, flush the underground main. Secure required approvals of the flushing operations.
- B. Upon completion of the fire sprinkler system installation, test and retest the complete installation and make corrections as necessary to obtain acceptance by the Fire Marshall and/or any other authority having jurisdiction. Furnish test equipment and personnel required.

3.16 TRAINING

- A. At a time mutually agreed upon, provide 4 hours of instruction to the Owner's designated personnel on the operation and maintenance of the automatic sprinkler system and associated equipment. Owner's Operation and Maintenance Manual prepared for this project shall be used during the instruction.

END OF SECTION

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SECTION 213113

FIRE PUMP SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide and install one packaged fire pump system, including a horizontal split case, centrifugal fire pump complete with motor, controller, and accessories as outlined.

1.2 RELATED WORK

- A. Division 23, Mechanical.

1.3 STANDARDS

- A. Make the installation in accordance with applicable requirements of National Fire Protection Association (NFPA) pamphlets, Factory Mutual, and any requirements of state or local authorities.
- B. Furnish equipment and materials approved by NFPA and UL.

1.4 REQUIREMENTS

- A. The Contractor shall provide and install a packaged fire pump system, designed in accordance with the requirements of NFPA Pamphlet #20. The system manufacturer will assume unit responsibility for the proper operation of the entire packaged system as specified herein.
- B. The Fire Pump manufacturer shall have a quality management system in place and shall be ISO 9001 Certified.

1.5 SHOP DRAWINGS

- A. Make complete shop drawings and working drawings of equipment furnished, including detailed drawings. Submittal data for the pumping system shall include, but is not limited to: pump curves, individual computer data sheets, system drawings, and complete description of control panel with wiring diagram, sequencing data, instrumentation, alarms, and a copy of certification of \$1,000,000.00 minimum liability insurance.
- B. Before the shop drawings are submitted for approval, submit drawings to the jurisdictions for approval. All approvals shall be noted on the drawings or by letter from the departments.
- C. The Architect's approval of shop drawings shall not relieve the responsibility of correctly figured dimensions or any errors that may be contained in these drawings. The omission of any material shown on the contract drawings, or specified from the shop drawings, even though approved, shall not relieve the responsibility to furnish and erect them.

1.6 FACTORY TEST

- A. All equipment will be factory tested in accordance with the requirements of NFPA, UL and FM. Additionally the entire packaged system will be hydrostatically tested by the system manufacturer prior to shipment.

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PART 2 - PRODUCTS

2.1 PUMP

- A. The pump shall be horizontal, split case, class 40, cast iron, bronze fitted, centrifugal fire pump listed by Underwriters Laboratories and/or approved by Factory Mutual (UL/FM).
1. The unit shall be a Patterson 5x3 VIP Inline pump with impellar pattern D-5675.
 2. The unit shall be mounted on a fabricated steel base, complete with coupling, OSHA approved, coupling guard, and directly connected to the motor.
 3. The pump shall be clockwise rotation as viewed from the driver end.
 4. The pump discharge flange shall be rated for 125 lbs
 5. The pump casting shall be smooth, free of scale, lumps, cracks, sand holes and defects of any nature which may make it unfit for the use for which it is intended.
 6. The bolting of pressure-holding castings shall be such that the maximum stress on any bolt will not exceed $\frac{1}{4}$ the elastic limit of the material as computed by using the stress area and on the basis of the water pressure equivalent to the shutoff pressure effective over the area out of the center line of the bolts.
 7. The pump bearings shall have an L-10 rating of not less than 5000 hours based on load ratings and fatigue life.
 8. The shaft shall be sealed with a stuffing box and packing with external water-seal piping. The stuffing box glands shall exert uniform pressure on the packing.
 9. Bearing housing supports, and suction and discharge flanges shall be integrally case with the lower half of the casing. Removal of the upper half of the casing must allow the rotating element to be removed without disconnecting the suction and discharge flanges. Replaceable shaft sleeves shall be furnished and are to be of bronze ASTM-A148 material. The shaft sleeves shall be held in position by the impeller key and locked in position by a separate threaded sleeve nut.
 10. Water slingers of corrosion-resistant material shall be provided to seal the bearings at their inner ends.
 11. The pump casing shall be hydrostatic strength-tested to a minimum of 250 psi, or not less than twice the maximum shut-off pressure.

2.2 DRIVER

- A. The motor shall be 20 HP, 3525 rpm, 3 phase, 60 cycle, 230 volt, horizontal open Dripproof motor with a 1.15 service factor.

2.3 PUMP ACCESSORIES

- A. $\frac{3}{4}$ " Casing Relief Valve
- B. 6" x 5" Eccentric Suction Reducer (125 lb)
- C. 3" x 6" Concentric Discharge Increaser (125 lb)
- D. 4" Ductile Iron Test Header, Grooved
- E. (2) sets of 2-1/2" hose valves with caps and chains

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2.4 JOCKEY PUMP

- A. The jockey pump controller shall complete with fusible disconnect, Hand-Off-Automatic selector switch and a pressure switch. The controller shall be rated for 5 GPM, 0.75 HP, 3 Phase, 60 Cycle, 230 Volt operation.
- B. The minimum enclosure rating shall be NEMA Type 2, driptight.

PART 3 - EXECUTION

3.1 FACTORY FABRICATION

- A. All of the above equipment will be mounted on an open structural steel I-beam skid. All piping, pressure sensing lines, pump by-pass, shut-off valves, stuffing box and casing relief valve drains will be firmly anchored to the steel base by means of structural steel supports. All electrical wiring between controllers and drivers will be completed and tested at the factory. The entire package will require one power connection by the electrical contractor.

3.2 INSTALLATION

- A. Installation shall be in accordance with manufacturer's instructions.

3.3 FIELD ACCEPTANCE AND START-UP SERVICE

- A. The service of a factory-trained representative shall be made available on the job site to check installation, field acceptance testing, start-up and instruct operating personnel.
- B. In order to ensure the fire pump unit is properly coordinated and will function in accordance with the intent of these specifications, all the equipment required to comprise the fire pump unit will be supplied by the fire pump manufacturer in whom shall be vested unit responsibility for the proper function of the complete fire pump unit including the fire pump, motor or engine, base plate, control equipment and other required accessories.
- C. To verify compliance with this requirement, the fire pump manufacturer will be required to submit a notarized Certificate of Compliance certifying that all components of the fire pump unit were in fact supplied by the fire pump manufacturer and acknowledging its responsibility for the proper function of the unit.

3.4 GUARANTEE

- A. The packaged fire pumping system shall be guaranteed in writing, by the manufacturer for a period of one year from date of shipment against defect in design, material or construction.

END OF SECTION

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SECTION 220100

PLUMBING OPERATING AND MAINTENANCE MANUALS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Compilation product data and related information appropriate for Owner's operation and maintenance of products furnished under Contract. Prepare operating and maintenance data as specified.
- B. Instruct Owner's personnel in operation and maintenance of equipment and systems.
- C. Submit three copies of complete manual in final form.

1.2 SUBMITTALS

- A. Thirty (30) days after the Contractor has received the final scheduled identified submittals bearing the Architect/Engineer's stamp of acceptance (including resubmittals), submit for review one copy of the first draft of the Operating and Maintenance Manual. This copy shall contain as a minimum:
 - 1. Table of Contents for each element.
 - 2. Contractor information.
 - 3. All submittals, coordination drawings and product data, reviewed by the Architect / Engineer; bearing the Architect / Engineer's stamp of acceptance. (When submittals are returned from Engineer "Correct as Noted", corrected inserts shall be included.)
 - 4. All parts and maintenance manuals for items of equipment.
 - 5. Warranties (without starting dates)
 - 6. Certifications that have been completed. Submit forms and outlines of certifications that have not been completed.
 - 7. Operating and maintenance procedures.
 - 8. Form of Owner's Training Program Syllabus (including times and dates).
 - 9. Control operations/equipment wiring diagrams.
 - 10. Other required operating and maintenance information that are complete.
- B. Copy will be returned to the Contractor within 15 days with comments for corrections.
- C. Submit two (2) completed manuals in final electronic form to the Architect / Engineer one day after substantial completion, and prior to Owner's instructions. Include all specified data, test and balance reports, drawings, dated warranties, certificates, reports, along with other materials and information.
- D. The Architect/Engineer will review the manuals for completeness within fifteen (15) days.
- E. The Contractor shall be notified of any missing or omitted materials. The Manuals shall be reworked by the Contractor, as required, in the office of the Architect / Engineer. The manuals will not be retransmitted.
- F. Two (2) electronic copies of completed Manual shall be delivered to the Owner.

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PART 2 - PRODUCTS

2.1 BINDERS

- A. Commercial quality black three-ring binders with clear overlay plastic covers.
- B. Minimum ring size: 1 inch; Maximum ring size: 3 inches.
- C. When multiple binders are used, correlate the data into related groupings.
- D. Label contents on spine and face of binder with full size insert. Label under plastic cover.

PART 3 - EXECUTION

3.1 OPERATION AND MAINTENANCE MANUAL

- A. Form for Manuals:
 - 1. Prepare data in form of an instructional manual for use by Owner's personnel.
 - 2. Format:
 - a. Size: 8-1/2 inch x 11 inch.
 - b. Text: Manufacturer's printed data or neatly typewritten.
 - 3. Drawings:
 - a. Provide reinforced punched binder tab and bind in text.
 - b. Fold larger drawings to size of text pages.
 - 4. Provide flyleaf indexed tabs for each separate product or each piece of operating equipment.
 - 5. Cover: Identify each volume with typed or printed title "Operating and Maintenance Instructions". List:
 - a. Title of Project
 - b. Identity of separate structures as applicable.
 - c. Identity of general subject matter covered in the manual.
 - 6. Binder as specified.
- B. Content of Manual:
 - 1. Neatly typewritten Table of Contents for each volume arranged in systematic order as outlined in the specifications.
 - a. Contractor, name of responsible principal, address and telephone number.
 - b. A list of each product required to be included, indexed to content of the volume.
 - c. List with each product, name, address and telephone number of:
 - 1) Subcontractor or installer.
 - 2) Maintenance contractor as appropriate.
 - 3) Identify area of responsibility of each.
 - 4) Local source of supply for parts and replacement.
 - d. Identify each product by product name and other identifying symbols as set forth in Contract Documents.
 - 2. Product Data:
 - a. Include those sheets pertinent to the specific product.
 - b. Annotate each sheet to:
 - 1) Identify specific product or part installed.
 - 2) Identify data applicable to installation.
 - 3) Delete references to inapplicable information. (All options not supplied with equipment shall be marked out indicated in some manner.

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3. Drawings:
 - a. Supplement product data with drawings as necessary to illustrate:
 - 1) Relations of component parts of equipment and systems.
 - 2) Control and flow diagrams.
 - b. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
 - c. Do not use Project Record Documents as maintenance drawings.
 4. Written text, as required to supplement product data for the particular installation:
 - a. Organize in consistent format under separate headings for different procedures.
 - b. Provide logical sequence of instructions for each procedure.
 5. Copy of each warranty, bond and service contract issued.
 - a. Provide information sheet for Owner's personnel, giving:
 - 1) Proper procedures in event of failure.
 - 2) Instances that might affect validity of warranties or bonds.
 6. Shop drawings, coordination drawings and product data as specified.
- C. Sections for Equipment and Systems.
1. Content for each unit of equipment and system as appropriate:
 - a. Description of unit and component parts.
 - 1) Function, normal operating characteristics, and limiting conditions.
 - 2) Performance curves, engineering data and tests.
 - 3) Complete nomenclature and commercial number of replaceable parts.
 - b. Operating procedures:
 - 1) Start up, break-in, routine and normal operating instructions.
 - 2) Regulation, control, stopping, shut down and emergency instructions.
 - 3) Summer and winter operating instructions.
 - 4) Special operating instructions.
 - c. Maintenance procedures:
 - 1) Routine operations
 - 2) Guide to trouble-shooting.
 - 3) Disassembly, repair and reassembly.
 - 4) Alignment, adjusting and checking.
 - 5) Routine service based on operating hours.
 - d. Servicing and lubrication schedule. List of lubricants required.
 - e. Manufacturer's printed operating and maintenance instructions.
 - f. Description of sequence of operation by control manufacturer.
 - g. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
 - 1) Predicted life of part subject to wear.
 - 2) Items recommended to be stocked as spare parts.
 - h. As installed control diagrams by controls manufacturer.
 - i. Complete equipment internal wiring diagrams.
 - j. Each Contractor's coordination drawings.
 - k. As installed color coded piping diagrams.
 - l. Charts of valve tag number, with location and function of each valve.
 - m. List of original manufacturer's spare parts and recommended quantities to be maintained in storage.
 - n. Other data as required under pertinent sections of the specifications.
 2. Prepare and include additional data when the need for such data becomes apparent during instruction of Owner's personnel.

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3. Additional requirements for operating and maintenance data as outlined in respective sections of specifications.
4. Provide complete information for products specified in Division 22.
5. Provide certificates of compliance as specified in each related section.
6. Provide start up reports as specified in each related section.
7. Provide signed receipts for spare parts and material.
8. Provide training report and certificates.
9. Provide backflow preventer certified test reports.
10. Provide gas piping pressure test reports.

END OF SECTION

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SECTION 220500

PLUMBING GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Except as modified in this Section, General Conditions, Supplementary Conditions, applicable provisions of the General Requirements, and other provisions and requirements of the contract documents apply to work of Division 22 Plumbing.
- B. Applicable provisions of this section apply to all sections of Division 22, Plumbing.

1.2 CODE REQUIREMENTS AND FEES

- A. Perform work in accordance with applicable statutes, ordinances, codes and regulations of governmental authorities having jurisdiction.
- B. Plumbing work shall comply with applicable inspection services:
 - 1. Underwriters Laboratories
 - 2. National Fire Protection Association
 - 3. State Health Department
 - 4. Local Municipal Building Inspection Department
 - 5. Texas Department of Licensing & Regulations (TDLR)
 - 6. Texas Accessibility Standards (TAS Based on ADA)
- C. Resolve any code violations discovered in contract documents with the Engineer prior to award of the contract. After Contract award, any correction or additions necessary for compliance with applicable codes shall be made at no additional cost to the Owner.
- D. This Contractor shall be responsible for being aware of and complying with asbestos NESHAP regulations, as well as all other applicable codes, laws and regulations.
- E. Obtain all permits required.

1.3 CONTRACTOR'S QUALIFICATIONS

- A. An approved contractor for the work under this division shall be:
 - 1. A licensed specialist in this field and have the personnel, experience, training, skill, and organization to provide a practical working system
 - 2. Able to furnish evidence of having contracted for and installed not less than 3 systems of comparable size and type that has served their Owners satisfactorily for not less than 3 years

1.4 REFERENCE SPECIFICATIONS AND STANDARDS

- A. Materials which are specified by reference to Federal Specifications; ASTM, ASME, ANSI, or AWWA Specifications; Federal Standards; or other standard specifications must comply with latest editions, revisions, amendments or supplements in effect on date bids are received. Requirements in reference specifications and standards are minimum for all equipment, material, and work. In instances where specified capacities, size, or other features of equipment, devices, or materials exceed these minimums, meet specified capacities.

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1.5 CONTRACT DRAWINGS

- A. Contract drawings are diagrammatic only and do not give fully dimensioned locations of various elements of work. Determine exact locations from field measurements.

1.6 PROJECT RECORD DOCUMENTS

- A. Maintain at the job site a separate set of white prints (blue line or black line) of the contract drawings for the sole purpose of recording the "as-built" changes and diagrams of those portions of work in which actual construction is at variance with the contract drawings. Mark the drawings with a colored pencil. Prepare, as the work progresses and upon completion of work, reproducible drawings clearly indicating locations of various lines, valves, ductwork, traps, equipment, and other pertinent items, as installed. Include flow-line elevation of sewer lines. Record existing and new underground and under slab piping with dimensioned locations and elevations of such piping.
- B. At the conclusion of project, obtain without cost to the Owner, erasable mylars of the original drawings and transfer as-built changes to these. Prior to transmittal of corrected drawings, obtain 3 sets of blue-line prints of each drawing, regardless of whether corrections were necessary and include in the transmittal (2 sets are for the Owner's use and one set is for the Architect/Engineer's records). Delivery of these as-built prints and reproducible is a condition of final acceptance. Provide record drawings on one set each (reproducible Dayrex mylar film positives) and AutoCAD 2012 / Revit CAD files on disk.
- C. As-Built drawings should indicate the following information as a minimum:
 - 1. Indicate all addendum changes to documents.
 - 2. Remove Engineer's seal, name, address and logo from drawings.
 - 3. Mark documents RECORD DRAWINGS.
 - 4. Clearly indicate: DOCUMENT PRODUCED BY
 - 5. Indicate all changes to construction during construction. Indicate actual routing of all piping, ductwork, etc. that were deviated from construction drawings.
 - 6. Indicate exact location of all underground plumbing and flow line elevation.
 - 7. Indicate exact location of all underground plumbing piping and elevation.
 - 8. Indicate exact location of all underground electrical raceways and elevations.
 - 9. Correct schedules to reflect (actual) equipment furnished and manufacturer.
 - 10. During the execution of work, maintain a complete set of drawings and specifications upon which all locations of equipment, ductwork, piping, devices, and all deviations and changes from the construction documents in the work shall be recorded.
 - 11. Location and size of all ductwork and mechanical piping above ceiling including exact location of isolation of domestic and plumbing valves.
 - 12. Exact location of all electrical equipment in and outside of the building.
 - 13. Fire Protection System documents revised to indicate exact location of all sprinkler heads and zone valves.
 - 14. Exact location of all roof mounted equipment, wall, roof and floor penetrations.
 - 15. Cloud all changes.

1.7 SPACE REQUIREMENTS

- A. Consider space limitations imposed by contiguous work in selection and location of equipment and material. Do not provide equipment or material that is not suitable in this respect.

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1.8 TEMPERATURE REQUIRMENTS

- A. All piping, p-traps, and condensate drainage subject to freezing shall be insulated and heat traced. Coordinate power requirements with electrical engineer/contractor.

1.9 RELATION WITH OTHER TRADES

- A. Carefully study all matters and conditions concerning the project. Submit notification of conflict in ample time to prevent unwarranted changes in any work. Review other Divisions of these specifications to determine their requirements.
- B. Because of the complicated relationship of this work to the total project, conscientiously study the relation and cooperate as necessary to accomplish the full intent of the documents.
- C. Provide sleeves and inserts in forms as required for the work. Stub up and protect open ends of pipe before any concrete is placed. Furnish sizes of required equipment pads. Furnish and locate bolts and fittings required to be cast in them.
- D. Locate and size openings required for installation of work specified in this Division in sufficient time to prevent delay in the work.
- E. Refer to other Divisions of the specifications for the scope of required connections to equipment furnished under that Division. Determine from the Contractor for the various trades, the Owner, and by direction from the Architect/Engineer, the exact location of all items.

1.10 CONCEALED AND EXPOSED WORK

- A. When the word "concealed" is used in connection with insulating, painting, piping, ducts and the like, the work is understood to mean hidden from sight as in chases, furred spaces or above ceilings. "Exposed" is understood to mean open to view.

1.11 GUARANTEE

- A. Guarantee work for 1 year from the date of substantial completion of the project. During that period make good any faults or imperfections that may arise due to defects or omissions in material, equipment or workmanship. At the Owner's option, replacement of failed parts or equipment shall be provided.

1.12 MATERIAL AND EQUIPMENT

- A. Furnish new and unused materials and equipment meeting the requirements of the paragraph specifying acceptable manufacturers. Where two or more units of the same type or class of equipment are required, provide units of a single manufacturer.

1.13 NOISE AND VIBRATION

- A. Select equipment to operate with minimum noise and vibration. If objectionable noise or vibration is produced or transmitted to or through the building structure by equipment, piping, ducts or other parts of work, rectify such conditions at no additional cost. If the item of equipment is judged to produce objectionable noise or vibration, demonstrate at no additional cost that equipment performs within designated limits on a vibration chart.

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1.14 SUBMITTALS

- A. The Contractor shall prepare, submit, and obtain Engineer's review of manufacturers' submittals on the following equipment and systems prior to ordering, purchasing, or installation of any equipment or materials. All required submittals shall be transmitted electronically (e.g. pdfs, etc.) with the associated specification section and the item submitted clearly identified. Partial submittals will be returned without review. Submittals, as a minimum, shall include:
1. Plumbing fixtures, faucets and trim
 2. Water heaters and storage tanks
 3. Expansion tanks
 4. Domestic water pressure booster system
 5. Insulation
 6. Floor drains and drainage accessories
 7. Hydrants and hose bibbs
 8. Mixing valves
 9. Submersible pumps
 10. Hot water return pumps
 11. Backflow preventers
 12. Grease/oil interceptors
 13. Pipe and fittings
 14. Grooved joint couplings
 15. Valves
 16. Pipe supports
 17. Piping accessories
 18. Pipe labels and valve tags
- B. All approvals required by any code or enforcement authority, insurance underwriter, etc. shall be obtained prior to equipment being submitted to the Engineer.
- C. Quality Assurance/Control Submittals: Submit the following:
1. Test Reports: Upon request, submit test reports from recognized testing laboratories.
 2. Certificates: Submit the following:
 - a. Manufacturer's certificate that products comply with specified requirements.
 - b. Certificate indicating that the installer is authorized to install the manufacturer's products
- D. Review of submittals by the Engineer does not relieve the Contractor from the responsibility for complying with all requirements of the Contract Documents. Furthermore, it shall be the responsibility of the Contractor to coordinate the requirements of all approved equipment with other trades and disciplines such as roof openings, wall openings, electrical characteristics, etc.
- E. All submittals shall be identified by the equipment mark or tag identification numbers shown on the Contract Drawings. Each individual submittal item shall be marked to show which specification section pertains to the item.
- F. Submittals shall clearly indicate selection of model numbers, sizes, dimensions, electrical characteristics, etc. of the proposed equipment. Any proposed deviations from specified equipment shall be clearly indicated on the submittal.

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- G. Included with submittals of plumbing equipment requiring electrical connections shall be a written statement confirming coordination of voltage requirements, bearing the names and signatures of the plumbing and electrical contractors. A photocopied reproduction of the below statement is acceptable.

1.15 ACCEPTABLE MANUFACTURERS

- A. Manufacturers names and catalog number specified under sections of Division 22 are used to establish standards of design, performance, quality and serviceability and not to limit competition. Equipment of similar design, equal to that specified, manufactured by a named manufacturer will be acceptable on approval. A request for prior approval of equipment not listed must be submitted ten (10) days before bid due date. Submit complete design and performance data to the Engineer.

1.16 OPERATING TESTS

- A. After all plumbing systems have been completed and put into operation, subject each system to an operating test under design conditions to ensure proper sequencing and operation throughout the range of operation. Tests shall be made in the presence of the Architect/Engineer. Make adjustments as required to ensure proper functioning of all systems. Special tests on individual systems are specified under individual sections. Submit 3 copies of all certifications and test reports adequately in advance of completion of the work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

1.17 WARRANTIES

- A. Submit 3 copies of all warranties and guarantees for systems, equipment, devices and materials. These shall be included in the Operating and Maintenance Manuals.

1.18 BUILDING CONSTRUCTION

- A. It shall be the responsibility of each sub-contractor to consult the Architectural and Engineering drawings, details, and specifications and thoroughly familiarize himself with the project and all job-related requirements. Each sub-contractor shall cooperate with the General Contractor to verify that all piping and other items are placed in the walls, furred spaces, chases, etc., so there will be no delays in the job.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 OPENINGS

- A. Framed, cast or masonry openings for ductwork, equipment or piping are specified under other divisions. Drawings and layout work for exact size and location of all openings are included under this division.

3.2 HOUSEKEEPING PADS

- A. Provide equipment housekeeping pads under all floor mounted and ground mounted plumbing equipment, and as shown on the drawings.

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- B. Concrete work as specified in Division 3.
- C. Concrete pads:
 - 1. 4" high, rounded edges, minimum 2500 psi unless otherwise indicated on the drawings
 - 2. Chamfer strips at edges and corner of forms.
 - 3. Smooth steel trowel finish.
 - 4. Doweled to existing slab
- D. Install concrete curbs around multiple pipe penetrations.

3.3 VANDAL RESISTANT DEVICES

- A. Provide a handle for each loose keyed operated valve and hose bibb on the project.
- B. Where vandal resistant screws or bolts are employed on the project, deliver to the Owner 2 suitable tools for use with each type of fastener used.
- C. Proof of delivery of these items to the Owner shall be included in the Operating and Maintenance Manuals.

3.4 INSTRUCTION OF OWNER'S PERSONNEL

- A. Prior to final inspection, conduct an on-site training program to instruct the Owner's operating personnel in the operation and maintenance of the plumbing systems.
 - 1. Provide the training during the Owner's regular working day.
 - 2. The instructors shall each be experienced in their phase of operation and maintenance of building plumbing systems and with the project.
- B. Time to be allocated for instructions.
 - 1. Minimum of 8 hours dedicated instructor time.
 - 2. 4 hours on each of 2 days.
- C. Before proceeding with the on-site training program, submit the program syllabus; proposed time and dates; and other pertinent information for review and approval.
 - 1. One copy to the Owner.
 - 2. One copy to the Architect/Engineer.
- D. The Owner will provide a list of personnel to receive instructions and will coordinate their attendance at the agreed upon times.
- E. Use the operation and maintenance manuals as the basis of instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
- F. Demonstrate start-up, operation, control, adjustment, troubleshooting, servicing, maintenance, and shut down of each item of equipment.
- G. Demonstrate equipment functions (both individually and as part of the total integrated system).
- H. Prepare and insert additional data in the operating and maintenance manuals when the need for additional data becomes apparent during instructions.

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- I. Submit a report within one week after completion of the training program that instructions have been satisfactorily completed. Give time and date of each demonstration and hours devoted to the demonstration, with a list of people present.
- J. At the conclusion of the on-site training program, have the person designated by the Owner sign a certificate to certify that he/she has a proper understanding of the system, that the demonstrations and instructions have been satisfactorily completed, and the scope and content of the operating and maintenance manuals used for the training program are satisfactory.
- K. Provide a copy of the report and the certificate in an appropriately tabbed section of each Operating and Maintenance Manual.

3.5 EQUIPMENT IDENTIFICATION

- A. Provide a laminated engraved plastic nameplate on each piece of equipment and starter.
 - 1. Designation approved by Architect/Engineer.
 - 2. Equipment includes, but is not limited to, water heaters, pumps, boilers and utility controllers.
 - 3. Submit schedule of equipment to be included and designations.
- B. Provide nameplates with 1/2" high letters and fastened with epoxy or screws.

3.6 OBSTRUCTIONS

- A. The drawings indicate certain information pertaining to surface and subsurface obstructions which has been taken from available drawings. Such information is not guaranteed, however, as to accuracy of location or complete information.
 - 1. Before any cutting or trenching operations are begun, verify with Owner's representative, utility companies, municipalities, and other interested parties that all available information has been provided.
 - 2. Should obstruction be encountered, whether shown or not, alter routing of new work, reroute existing lines, remove obstruction where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of the new work and leave existing services and structures in a satisfactory and serviceable condition.
- B. Assume total responsibility for and repair any damage to existing utilities or construction, whether or not such existing facilities are shown.

3.7 PROTECTION

- A. Protect work, equipment, fixtures, and materials. At work completion, work must be clean and in original manufacturer's condition.

END OF SECTION

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SECTION 220510

PLUMBING CONTRACT QUALITY CONTROL

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Contract quality control including workmanship, manufacturer's instructions and demonstrations.

1.2 QUALITY CONTROL PROGRAM

- A. Maintain quality control over supervision, subcontractors, suppliers, manufacturers, products, services, site conditions and workmanship to produce work in accordance with contract documents.

1.3 WORKMANSHIP

- A. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.
- B. Perform work by persons qualified to produce workmanship of specified quality.
- C. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking. Under no conditions shall material or equipment be suspended from structural bridging.
- D. Provide finishes to match approved samples. All exposed finishes shall be approved by the Architect. Submit color samples as required.

1.4 MANUFACTURER'S INSTRUCTIONS

- A. Comply with instructions in full detail, including each step in sequence.
- B. Should instruction conflict with Contract Documents, request clarification from Architect / Engineer before proceeding.

1.5 MANUFACTURER'S CERTIFICATES

- A. When required in individual Specification Sections, submit manufacturer's certificate in duplicate, certifying that products meet or exceed specified requirements.

1.6 MANUFACTURER'S FIELD SERVICES

- A. When required in individual Specification Sections, manufacturer shall provide qualified personnel to observe:
 - 1. Field conditions.
 - 2. Condition of installation.
 - 3. Quality of workmanship.
 - 4. Start-up of equipment.
 - 5. Testing, adjusting, and balancing of equipment.

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- B. Representative shall make written report of observations and recommendations to Architect / Engineer.

PART 2 - PRODUCTS

2.1 REFERENCE APPLICABLE SPECIFICATION SECTIONS

PART 3 - EXECUTION

3.1 PROTECTION OF EQUIPMENT

- A. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the Contractor is obligated to furnish new equipment of a like kind at no additional cost to the Owner.
- B. Adequately protect equipment from damage after delivery to the project. Cover with heavy tarpaulins, drop cloths or other protective coverings as required to protect from plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion.

END OF SECTION

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SECTION 220512

PLUMBING SHOP DRAWINGS, COORDINATION DRAWINGS & PRODUCT DATA

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Prepare submittals as required by Division 1.
- B. The term submittal, as used herein, refers to all:
 - 1. Shop Drawings
 - 2. Coordination Drawings
 - 3. Product data
- C. Submittals shall be prepared and produced for:
 - 1. Distribution as specified
 - 2. Inclusion in the Operating and Maintenance Manual, as specified, in the related section

1.2 SHOP DRAWINGS

- A. Present drawings in a clear and thorough manner. Identify details by reference to sheet and detail, schedule, or room numbers shown on Contract Drawings.
- B. Show all dimensions of each item of equipment on a single composite Shop Drawing. Do not submit a series of drawings of components.
- C. Identify field dimensions; show relationship to adjacent features, critical features, work, or products.
- D. Submit shop drawings in plan, elevation and sections, showing equipment in mechanical equipment areas.

1.3 COORDINATION DRAWINGS

- A. Present in a clear and thorough manner. Title each drawing with project name. Identify each element of drawings by reference to sheet number and detail, or room number of contract documents. Minimum drawing scale: ¼ inch = 1 foot - 0 inch.
- B. Prepare coordination drawings to coordinate installations for efficient use of available space, for proper sequence of installation, and to resolve conflicts. Coordinate with work specified in other sections and other divisions of the specifications.
- C. For each mechanical room and for each outside equipment pad where equipment is located, submit plan and elevation drawings. Show:
 - 1. Actual mechanical equipment and components to be furnished
 - 2. Service clearance
 - 3. Relationship to other equipment and components
 - 4. Roof drains and leader piping
 - 5. Fire protection piping and equipment

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- D. Identify field dimensions. Show relation to adjacent or critical features of work or products.
- E. Related requirements:
 - 1. Ductwork shop drawings
 - 2. Coordination drawing specified in Division 26
- F. Submit shop drawings in plan, elevation and sections, showing equipment in mechanical equipment areas.
- G. Gas piping sketch indicating proposed location of piping prior to proceeding with the installation.

1.4 PRODUCT DATA AND INSTALLATION INSTRUCTION

- A. Submit only pages which are pertinent to the project. All options which are indicated on the product data shall become part of the contract and shall be required whether specified are not.
- B. Mark each copy of standard printed data to identify pertinent products, referenced to specification section and article number.
- C. Show reference standards, performance characteristics and capacities; wiring and piping diagrams and controls; component parts; finishes; dimensions and required clearances.
- D. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete information not applicable.
- E. Mark up a copy of the specifications for the product. Indicate in the margin of each paragraph the following: "Comply, "Do Not Comply", or "Not Applicable". Explain all "Do Not Comply" statements.
- F. Provide a separate transmittal for each submittal item. Transmittals shall indicate product by specification section name and number. Separate all submittals into appropriate specification section number. Do not combine specification sections.

1.5 MANUFACTURERS INSTRUCTIONS

- A. Submit Manufacturer's instructions for storage, preparation, assembly, installation, start-up, adjusting, calibrating, balancing and finishing.

1.6 CONTRACTOR RESPONSIBILITIES

- A. Review submittals prior to transmittal.
- B. Determine and verify:
 - 1. Field measurements
 - 2. Field construction criteria
 - 3. Manufacturer's catalog numbers
 - 4. Conformance with requirements of Contract Documents
- C. Coordinate submittals with requirements of the work and of the Contract Documents.

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- D. Notify the Architect/Engineer in writing at time of submission of any deviations in the submittals from requirements of the Contract Documents.
- E. Do not fabricate products, or begin work for which submittals are specified, until such submittals have been produced and bear contractor's stamp. Do not fabricate products or begin work scheduled to have submittals reviewed until return of reviewed submittals with Architect/Engineer's acceptance.
- F. Contractor's responsibility for errors and omissions in submittals is not relieved whether Architect/Engineer reviews submittals or not.
- G. Contractor's responsibility for deviations in submittals from requirements of Contract Documents is not relieved whether Architect/Engineer reviews submittals or not, unless Architect/engineer gives written acceptance of the specific deviations on reviewed documents.
- H. Submittals shall show sufficient data to indicate complete compliance with Contract Documents:
 - 1. Proper sizes and capacities
 - 2. That the item will fit in the available space in a manner that will allow proper service
 - 3. Construction methods, materials and finishes
- I. Schedule submissions at least 15 days before date reviewed submittals will be needed.

1.7 SUBMISSION REQUIREMENTS

- A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the Project or in the work of any other Contractor.
- B. Number of submittals required:
 - 1. Shop Drawings and Coordination Drawings: Submit one reproducible transparency and three opaque reproductions.
 - 2. Product Data: Submit the number of copies which the contractor requires, plus those which will be retained by the Architect/Engineer.
- C. Accompany submittals with transmittal letter, in duplicate, containing:
 - 1. Date
 - 2. Project title and number
 - 3. Contractor's name and address
 - 4. The number of each Shop Drawing, Project Datum and Sample submitted
 - 5. Other pertinent data
- D. Submittals shall include:
 - 1. The date of submission
 - 2. The project title and number
 - 3. Contract Identification
 - 4. The names of:
 - a. Contractor
 - b. Subcontractor
 - c. Supplier
 - d. Manufacturer
 - 5. Identification of the product

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6. Field dimensions, clearly identified as such
 7. Relation to adjacent or critical features of the work or materials
 8. Applicable standards, such as ASTM or federal specifications numbers
 9. Identification of deviations from contract documents
 10. Suitable blank space for General Contractor and Architect/Engineer stamps
 11. Contractor's signed and dated Stamp of Approval
- E. Coordinate submittals into logical groupings to facilitate interrelation of the several items:
1. Finishes which involve Architect/Engineer selection of colors, textures or patterns
 2. Associated items which require correlation for efficient function or for installation

1.8 SUBMITTAL SPECIFICATION INFORMATION

- A. Every submittal document shall bear the following information as used in the project manual:
1. The related specification section number
 2. The exact specification section title
- B. Submittals delivered to the Architect/Engineer without the specified information will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.9 RESUBMISSION REQUIREMENTS

- A. Make re-submittals under procedures specified for initial submittals.
1. Indicate that the document or sample is a re-submittal
 2. Identify changes made since previous submittals
- B. Indicate any changes which have been made, other than those requested by the Architect / Engineer.

1.10 CONTRACTOR'S STAMP OF APPROVAL

- A. Contractor shall stamp and sign each document certifying to the review of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the work and of Contract Documents.
- B. Contractor's stamp of approval on any submittal shall constitute a representation to Owner and Architect/Engineer that Contractor has either determined and verified all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data or assumes full responsibility for doing so, and that Contractor has reviewed or coordinated each submittal with the requirements of the work and the Contract Documents.
- C. Do not deliver any submittals to the Architect/Engineer that do not bear the Contractor's stamp of approval and signature.
- D. Submittals delivered to the Architect/Engineer without Contractor's stamp of approval and signature will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

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1.11 ARCHITECT/ENGINEER REVIEW OF IDENTIFIED SUBMITTALS

- A. The Architect/Engineer will:
 - 1. Review identified submittals with reasonable promptness and in accordance with schedule
 - 2. Affix stamp and initials or signature, and indicate requirements for re-submittal or approval of submittal
 - 3. Return submittals to Contractor for distribution or for resubmission
- B. Review and approval of submittals will not extend to design data reflected in submittals which is peculiarly within the special expertise of the Contractor or any party dealing directly with the Contractor.
- C. Architect/Engineer's review and approval is only for conformance with the design concept of the project and for compliance with the information given in the contract.
 - 1. The review shall not extend to means, methods, sequences, techniques or procedures of construction or to safety precautions or programs incident thereto.
 - 2. The review shall not extend to review of quantities, dimensions, weights or gauges, fabrication processes or coordination with the work of other trades.
- D. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

1.12 SUBSTITUTIONS

- A. Do not make requests for substitution employing the procedures of this Section.
- B. The procedure for making a formal request for substitution is specified in Div. 1.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

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SECTION 220513

ELECTRICAL PROVISIONS OF PLUMBING WORK

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Electrical provisions to be provided as plumbing work are indicated in other Division 22 sections, on drawings, and as specified.
- B. Types of work, normally recognized as electrical but provided as plumbing, specified or partially specified in this Section, include but are not necessarily limited to the following:
 - 1. Motors for plumbing equipment.
 - 2. Starters for motors of plumbing equipment, but only where specifically indicated to be furnished integrally with equipment.
 - 3. Wiring from motors to disconnect switches or junction boxes for motors of plumbing equipment, but only where specifically indicated to be furnished integrally with equipment.
 - 4. Wiring of field-mounted float control switches, flow control switches, and similar plumbing-electrical devices provided for plumbing systems, to equipment control panels.
 - 5. Pipe heat tracing.
- C. Refer to Division 22 sections for specific individual plumbing equipment electrical requirements.
- D. Refer to Division 26 sections for motor starters and controls not furnished integrally with plumbing equipment.
- E. Refer to Division 26 sections for junction boxes and disconnect switches required for motors and other electrical units of plumbing equipment.

1.2 RELATED WORK

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to work of this Section.

1.3 QUALITY ASSURANCE

- A. Wherever possible, match elements of electrical provisions of plumbing work with similar elements of electrical work specified in Division 26 sections for electrical work not otherwise specified.
- B. For electrical equipment and products, comply with applicable NEMA standards, and refer to NEMA standards for definitions of terminology. Comply with National Electrical Code (NFPA 70) for workmanship and installation requirements.

1.4 SUBMITTALS

- A. Include in listing of motors, voltage, notation of whether motor starter is furnished or installed integrally with motor or equipment containing motors.

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PART 2 - PRODUCTS

2.1 MOTORS

- A. Provide motors for plumbing equipment manufactured by one of the following:
 - 1. Baldor Electric Company
 - 2. Century Electric Div., Inc.
 - 3. General Electric Co.
 - 4. Louis Allis Div.; Litton Industrial Products, Inc.
 - 5. Lincoln Electric
 - 6. Marathon Electric Mfg. Corp.
 - 7. Reliance Electric Co.
 - 8. Westinghouse Electric Corp.
- B. Motor Characteristics. Except where more stringent requirements are indicated, and except where required items of plumbing equipment cannot be obtained with fully complying motors, comply with the following requirements for motors of plumbing work:
- C. Temperature Rating. Rated for 40 deg. C environment with maximum 50 deg. C temperature rise for continuous duty at full load (Class A Insulation).
- D. Provide each motor capable of making starts as frequently as indicated by automatic control system, and not less than 5 starts per hour for manually controlled motors.
- E. Phases and Current Characteristics. Provide squirrel-cage induction polyphase motors for $\frac{3}{4}$ hp and larger, and provide capacitor-start single-phase motors for $\frac{1}{2}$ hp and smaller, except $\frac{1}{6}$ hp and smaller may, at equipment manufacturer's option, be split-phase type. Coordinate current characteristics with power specified in Division 26 sections, and with individual equipment requirements specified in other Division 22 requirements. For 2-speed motors provide two separate windings on polyphase motors. Do not purchase motors until power characteristics available at locations of motors have been confirmed, and until rotation directions have been confirmed.
- F. Service Factor. 1.15 for polyphase motors and 1.35 for single-phase motors.
- G. Motor Construction. Provide general purpose, continuous duty motors, Design "B" except "C" where required for high starting torque.
 - 1. Frames. NEMA #56.
 - 2. Bearings are to be ball or roller bearings with inner and outer shaft seals, regreasable except permanently sealed where motor is inaccessible for regular maintenance. Where belt drives and other drives produce lateral or axial thrust in motor, provide bearings designed to resist thrust loading. Refer to individual section of Division 22 for fractional-hp light-duty motors where sleeve-type bearings are permitted.
 - 3. Except as indicated, provide open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation, and provide guarded drip-proof motors where exposed to contact by employees or building occupants. Provide weather-protected Type I for outdoor use, Type II where not housed. Refer to individual sections of Division 22 for other enclosure requirements.
 - 4. Provide built-in thermal overload protection and, where indicated, provide internal sensing device suitable for signaling and stopping motor at starter.
 - 5. Noise Rating: Provide "Quiet" rating on motors.
- H. All motors shall be premium efficiency.

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2.2 EQUIPMENT FABRICATION

- A. Fabricate plumbing equipment for secure mounting of motors and other electrical items included in work. Provide either permanent alignment of motors with equipment, or adjustable mountings as applicable for belt drives, gear drives, special couplings and similar indirect coupling of equipment. Provide safe, secure, durable, and removable guards for motor drives. Arrange for lubrication and similar running-maintenance without removal of guards.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install motors on motor mounting systems in accordance with motor manufacturer's instructions, anchored to resist torque, drive thrusts, and other external forces inherent in plumbing work. Secure sheaves and other drive units to motor shafts with keys and Allen set screws on flat surface of shaft. Unless otherwise indicated, set motor shafts parallel with machine shafts.
- B. Verify voltage with Electrical Plans.

END OF SECTION

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SECTION 220514

PLUMBING ALTERATIONS PROJECT PROCEDURES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Inspect and service existing equipment and materials that are to remain or to be reused.
- B. Disposal of equipment, materials, or housekeeping pads to be abandoned. Prior to disposal, the Contractor shall verify with the Owner what is to be salvaged by the Owner and what is to become the property of the Contractor.
- C. Handling of equipment and materials to be removed.

1.2 QUALITY ASSURANCE

- A. Coordination with the Owner prior to the disconnection or shutdown of existing equipment, or to the modification of existing operational systems.

1.3 CONTRACT DRAWINGS

- A. There is the possibility that existing conditions and devices are affected by the work indicated on the drawings and called for in the specifications (project manual) that do not appear on the drawings. It is the Contractor's responsibility to visit the site and determine all of the existing conditions and to consider these existing conditions when making and presenting a proposal, to have a complete proposal.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Material used to upgrade and repair existing equipment shall conform to that specified.
- B. Material used to upgrade and repair existing equipment shall not void existing warranties or listings of the equipment to be upgraded or repaired.
- C. Material used to upgrade and repair existing equipment shall be new and shall be of the same manufacturer of the existing equipment, shall be acquired through the existing original equipment manufacturer's approved distribution channels, shall have manufacturer's warranties for the new material being used, and shall be listed for the use intended.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Existing materials and equipment indicated on the drawings or in the specifications to be reused shall be inspected for damaged or missing parts. Contractor shall notify the Architect/Engineer, in writing, accordingly.
- B. If using materials specified or shown on the drawing voids or diminishes the warranty or operation of remaining equipment or systems, the Contractor shall notify the Architect/Engineer, in writing.

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- C. Verify field measurements, above and underground piping connections and flows.
- D. Demolition Drawings are based on casual field observation, and when available, existing record documents. Report discrepancies to Architect before disturbing existing installation, and immediately after such discrepancies are discovered.
- E. Field verify existing conditions and actual utility uses prior to final connections. Existing drawings may not have been available for all required information. Use pipe inspection camera system to field verify existing sanitary / grease waste connections. Verify flow direction and depth prior to connection to existing plumbing systems.

3.2 APPLICATION

- A. Existing materials and equipment indicated on the drawings or in the specifications to be reused shall be cleaned and reconditioned, including cleaning of piping systems prior to installation and reuse.
- B. Material and equipment removed that is not to be salvaged for Owner's use or for reuse on the project shall become the property of the Contractor and be removed from the site.
- C. Material or equipment salvaged for Owner's use shall be carefully handled and stored where directed by the Owner or the Architect / Engineer. Relocate material and / or equipment as directed by Owner.
- D. Materials and equipment not indicated to be removed or abandoned shall be reconnected to the new system.
- E. Materials, equipment and housekeeping pads not to be reused or reconnected shall be removed for Owner's review and salvaged by Contractor.
- F. Prior to start of construction, Contractor shall walk areas to be renovated with Owner to identify and document items to be salvaged for Owner's use.
- G. Clean and repair existing materials and equipment that remain or are to be reused.
- H. Contractor shall utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

3.3 SEQUENCE AND SCHEDULE

- A. Coordinate utility service outages with Utility Company, Architect and Owner.
- B. Provide additional or temporary valves, piping and connections to maintain existing systems in service during construction.
- C. Existing Plumbing Service: Refer to drawings for work in remodeled areas. Where facilities in these areas are to remain in service, any related work to keep the facilities in operation is specified in this Division. Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Obtain permission from Owner at least 48 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area. Maintain acceptable temperature and humidity control within existing building during renovation activities.

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- D. Remove and replace existing Plumbing systems and appurtenances as occasioned by new or remodeled construction. Re-establish service that may be interrupted by remodeled construction.
- E. Refer to other drawings series for work in remodeled areas. Where facilities in these areas are required to remain in service, any related work required to keep these facilities in operation is specified in this Division.
- F. Remove and replace existing piping coincident with the construction.
- G. Remove or relocate existing piping or housekeeping pads as occasioned by new or remodeled construction. Cap unused domestic piping beyond the new finish line.
- H. Relocate all domestic piping as required to accommodate new work requiring precedence.
- I. Remove concrete housekeeping pad where materials or equipment have been removed.
- J. Remove all known utilities that do not provide service to the buildings that remain.
- K. Remove existing plumbing vent penetrations through roof not to be reused.

3.4 DEMOLITION AND EXTENSION OF EXISTING PLUMBING WORK

- A. The Contractor shall modify, remove, and/or relocate all materials and items so indicated on the drawings or required by the installation of new facilities. All removals and/or dismantling shall be conducted in a manner as to produce maximum salvage. Salvage materials shall remain the property of the Owner, and shall be delivered to such destination as directed by the Owner's representative unless they are not wanted, then it will be the responsibility of this Contractor to remove such items and properly dispose of them. Materials and/or items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to good operative condition. The Contractor may, at his discretion, and upon approval of the Owner's representative substitute new materials and/or items of like design and quality in lieu of materials and/or items to be relocated.
- B. All items to be relocated shall be carefully removed in reverse to original assembly or placement and protected until relocated. The Contractor shall clean, repair, and provide all new materials, fittings, and appurtenances required to complete the relocations and to restore them to good operative order. All relocations shall be performed by workmen skilled in the work and in accordance with standard practice of the trades involved.
- C. When items scheduled for relocation and/or reuse are found to be in damaged condition before work has been started on dismantling, the Contractor shall call the attention of the Owner's representative to such items and receive further instructions before removal. Items damaged in repositioning operations are the contractor's responsibility and shall be repaired or replaced by the contractor as approved by the owner's representative, at no additional cost to the Owner.
- D. Plumbing, piping and appurtenances to be removed, salvaged, or relocated shall be removed to points indicated on the drawings, specified, or acceptable to the Owner's representative. Piping not scheduled for reuse shall be removed to the points at which reuse is to be continued or service is to remain. Such services shall be sealed, capped, or otherwise tied-off or disconnected in a safe manner acceptable to the Construction Inspector. All disconnections or connections into the existing facilities shall be done in such a manner as to result in minimum interruption of services to adjacent occupied areas. Services to

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existing areas or facilities that must remain in operation during the construction period shall not be interrupted without prior specific approval of the Owner's representative hereinbefore specified.

- E. Repair adjacent construction and finishes damaged during demolition and extension work.
- F. Maintain access to mechanical installations that remain active. Modify installation or provide access panel as appropriate.
- G. Extend existing installations using materials and methods compatible with existing plumbing installations, or as specified.
- H. Existing plumbing piping and devices found to need additional hangers installed should be added at no additional cost to the Owner.

3.5 PROTECTION OF THE WORK

- A. Provide adequate temporary support and auxiliary structure as necessary to ensure structural value or integrity of affected portion of work.
- B. Provide devices and methods to protect other portions of work from damage.
- C. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances and finishes.

3.6 IDENTIFICATION OF EQUIPMENT IN RENOVATED AREAS

- A. Identification of Equipment: Provide new identification of all existing equipment to be reused and located within the renovated areas. Do not include the description "existing". Provide new nameplates for all existing plumbing equipment in renovated areas as specified in Section 22 05 00 Plumbing General Provisions.

END OF SECTION

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SECTION 220515

PLUMBING EARTHWORK

PART 1 - GENERAL

- A. Excavate and backfill for pipe trenches for underground piping, and excavate for structures installed as part of plumbing work.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Excavate trenches for underground piping to the required depth to ensure 2 foot minimum coverage over piping.
- B. Cut the bottom of the trench or excavation to uniform grade.
- C. Should rock be encountered, excavate 6 inches below grade, fill with bedding material and tamp well.
- D. Lay out alignment of pipe trenches to avoid obstructions. Assure that proposed route of pipe will not interfere with building foundation before any cutting is begun. Should interference be found, contact the Architect/Engineer before proceeding.

3.2 BACKFILL

- A. Backfill shall not be placed until the work has been inspected, tested and approved. Complete backfill to the surface of natural ground or to the lines and grades shown on drawings. Except where special materials are requested, use suitable friable soils from other excavation as backfill material. Do not use peat, silt, muck, debris or other organic materials. Deposit backfill in uniform layers and compact each layer as specified in Division 2.
- B. Compacting Backfill. Place material in uniform layers of prescribed maximum thickness and wet or dry the material to optimum moisture content. Compact with power-driven tampers to the prescribed density. Place regular backfill in 8 inch maximum layers, loose measure. Compact to not less than 95 percent of maximum soil density as determined by ASTM D-698 Standard Proctor.
- C. Restoration. Compact backfill, where trenching or excavation is required in improved areas such as pavements, walks, and similar areas, to a condition equal to the adjacent undisturbed earth, and restore surface of the area to the condition existing prior to trenching or excavating operation.
- D. Provide 6 inch stabilized sand bed with 4 inch stabilized sand cover around each pipe.

3.3 DISPOSAL OF EXCESS MATERIAL

- A. Remove excess excavation material or material unsuitable for backfill. Excess material can be spread on grade, or shall be removed from site as directed by the Owner/Architect.

END OF SECTION

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SECTION 220517

PLUMBING ACCESS DOORS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install access doors in wall or ceiling locations as required or shown for access to valves, controls, regulating devices, water arresters and other equipment requiring maintenance, adjustment or operation.

PART 2 - PRODUCTS

2.1 NON-FIRE RATED ACCESS DOORS

- A. 16-Gauge frames
- B. 14-gauge steel panels
- C. Continuous fully concealed hinges
- D. Flush screwdriver cam lock & cylinder lock for Owner selection
- E. Prime coat finish
- F. Brushed satin stainless steel finish for restroom, kitchen or cafeteria installation
- G. Material suitable for wall and/or ceiling mounting

2.2 FIRE RATED ACCESS DOORS

- A. UL listed, 1-1/2 hour Label "B", access doors
- B. 16-Gauge stainless steel
- C. 20-Gauge insulated sandwich-type door panel.
- D. Two inch thick with fire rated insulation
- E. Continuous fully concealed hinge
- F. Automatic closing and latching mechanism
- G. Knurled knob and recessed key operation for Owner selection
- H. Interior latch release slide for opening from inside
- I. Prime coat finish
- J. Material suitable for wall and/or ceiling mounting

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2.3 ACCEPTABLE MANUFACTURERS

- A. Milcor
- B. MIFAB
- C. Acudor
- D. Elmdor

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Access doors specified in Division 22 will be installed by other crafts. Not all required access doors are shown. Coordinate with the Contractor to locate access doors for ease of operation and maintenance of concealed equipment.
- B. Installation shall be in accordance with the manufacturer's printed instructions.
- C. Minimum size required:
 - 1. 24 inch x 24 inch for plumbing multiple isolation valves and electrical related items in ceilings
 - 2. 8 inch x 8 inch for plumbing for single isolation valve or shock arrestor

END OF SECTION

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SECTION 220519

PRESSURE AND TEMPERATURE INSTRUMENTS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. This section specifies gauges, thermometers, wells and/or pressure and temperature test stations to be installed as specified.

1.2 RELATED WORK

- A. Division 22, Plumbing
 - 1. Plumbing General Provisions
 - 2. Pipe and Pipe Fittings, General
 - 3. Valves, Strainers and Vents

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - GAUGES AND THERMOMETERS

- A. Terice
- B. Taylor
- C. Marsh
- D. Weksler
- E. Marshalltown
- F. Weiss
- G. Miljoco
- H. Watts

2.2 PRESSURE GAUGES

- A. Case and Ring: 4 inch type 304 stainless steel; liquid filled case with stainless steel bayonet ring.
- B. Dial: White aluminum with black markings
- C. Window: Clear acrylic
- D. Tube: Phosphor bronze and forged brass socket.
- E. Gauge accuracy: +/- 1 percent over operating range.
- F. For pulsating service, provide impulse dampers.

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- G. Without flange for pipe mounting.
- H. With flange for wall mounting.
- I. Weiss Model: Domestic Water 4CTS LF (Lead Free) 0-100 PSI

2.3 THERMOMETER WELLS

- A. Brass or type 300 stainless steel. Machined bar stock, 1-piece construction (Lead Free).
- B. Where installed in insulated piping or vessels, provide with extension neck to match insulation thickness.
- C. Provide metal-to-metal contact with bulb chamber for maximum sensitivity.
- D. Wells shall be sized to extend a minimum of 50 percent into pipe.

2.4 THERMOMETERS IN PIPING SYSTEMS OR VESSELS

- A. Die cast aluminum case with baked epoxy finish.
- B. Adjustable angle 9 inch scale length.
- C. Clear acrylic window.
- D. Brass stem, length to match well.
- E. Red reading organic spirit filled-in magnifying glass column.
- F. White background with black figures and markings.
- G. Brass stems and union connections (Lead Free).
- H. Accuracy: +/- 1 percent of scale range.
- I. Range:
 - 1. Hot water lines: 30 deg. F to 240 deg. F.

2.5 PRESSURE AND TEMPERATURE TEST STATIONS

- A. "Test Station" fitting to receive either a temperature or pressure probe. Fitting shall be solid brass with two valve cores of Nordel (Lead Free).
 - 1. Fitted with a color coded cap strap with gasket.
 - 2. Acceptable Manufacturer: Peterson Equipment Company.
 - 3. Provide with extension neck to match insulation thickness.
- B. Provide to the Owner a fitted case with:
 - 1. Two 0-100 psi pressure gauges as specified and adapters with 1/8 inch OD probe.
 - 2. Four 5 inch stem pocket testing thermometers.
 - a. Two with range 0 deg. F to 220 deg. F for hot water.

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PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with drawing details and manufacturer's recommendations.
- B. Provide a ball valve at each gauge (Lead Free).
- C. Locate gauges and thermometers to be easily readable from the floor at a 5 foot-6 inch eye level. Use adjustable angle or rigid stem as required. Install gauges in upright position.
- D. Install gauges in the following locations: across pumps, storage tanks, heat exchangers.
- E. Install thermometer in the following locations: At storage tanks, across heat exchangers, across boiler, leaving side of water heater, leaving water side of tempered water valves, and hot water supply and return lines.
 - 1. Hot water lines: 30 deg. F to 240 deg. F.
 - 2. Tempered water valves 0 deg. F to 120 deg. F.

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SECTION 220523

VALVES, STRAINERS AND VENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Plumbing Valves
- B. Pipe strainer and suction diffusers

PART 2 - PRODUCTS

2.1 VALVES

- A. Pressure Ratings:
 - 1. Unless otherwise indicated, use valves suitable for 125 minimum psig working steam pressure (WSP) and 450 deg. F.
 - 2. The pressure temperature rating of valves shall be not less than the design criteria applicable to components of the system.
- B. Butterfly Valves
 - 1. Butterfly valves shall conform to MSS-SP67.
 - 2. Liners, inserts and discs shall be suitable for the intended service.
 - 3. Valves shall have a full lug type body designed for installation between ANSI standard flanges, and shall be rated at full working pressure with downstream flange removed.
 - 4. All valves for domestic use must be lead free.
- C. Balancing Valves (Manual)
 - 1. Provide balancing valves with:
 - a. Corrosion resistant plug with resilient seal when required.
 - b. O-ring stem seal.
 - c. Permanently lubricated, corrosion resistant bearings.
 - 2. Connections
 - a. Through 2 inch pipe size use threaded connections.
 - b. For valves 2-1/2 inch pipe size and larger shall be provided with 150 psig flange connections.
 - 3. Provide each valve with:
 - a. Memory stop.
 - b. Plastic drip cap.
 - c. 1/8 inch gauge tap.
 - 4. All valves for domestic use must be lead free.
- D. Thermal Balancing Valves (adjustable Temperature)
 - 1. Adjustable thermal balancing valve used for automatic balancing of circulation circuits in domestic hot water systems. Modulates flow rate in each circuit so hot water temperature at fixtures remains constant.
 - 2. Standards:
 - a. NSF/ANSI/CAN 372 low-lead laws, as certified by ICC-ES
 - b. NSF/ANSI/CAN 61, commercial hot water 180 deg. F. as certified by ICC-ES
 - c. Meets codes IPC and UPC

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3. Maximum Working Pressure: 230 psig
 4. Body Material: DZR low-lead brass.
 5. Connections: NPT female threaded
 6. Hydraulic Seals: Peroxide-cured EPDM.
 7. Adjustable Balancing Cartridge: Stainless steel and copper.
 8. ABS Adjustable Knob: Temperature adjustment scale for manual setting and tamper-proof adjustment locking screw.
 9. Factory Setting: 130 deg. F.
 10. Outlet Temperature gauge: 2-inch diameter with optional dual-scale outlet, 30 to 180 deg. F.
 11. Check Valve.
 12. Isolation Ball Valves: Inlet and outlet low-lead brass.
 13. Manufacturers:
 - a. Caleffi
 - b. ThermOmegaTech
 - c. Viega
- E. Thermal Balancing Valves (Fixed Temperature)
1. Static balancing valve with integral flow meter and site gauge, combined with built in temperature gauge and check valve. Designed for balancing domestic hot water circulation systems.
 2. Standards: NSF/ANSI/CAN 372 low-lead laws, as certified by ICC-ES.
 3. Maximum Working Pressure: 150 psig.
 4. Working Temperature Range: 14 to 230 deg. F.
 5. Valve Body, Flow Meter Body and Headwork: DZR low-lead brass.
 6. Ball and Flow Meter Springs and Bypass Valve Stem: Stainless steel.
 7. Ball Control Stem: Brass, chrome plated.
 8. Ball Seal Seat: PTFE
 9. Control Stem Guide, Flow Meter Float, and Indicator Cover: Polysulfone
 10. Built-In Direct Reading Flow Meter:
 - a. Detachable bypass channel for cleaning or replacement.
 - b. Memory sliding pointer providing flow memory indication.
 11. Seals: Peroxide-cured EPDM
 12. Ball/Magnet Flow Indicator: Sealed, isolated chamber, not in contact with system fluid to provide clear, accurate readings.
 13. Outlet Temperature Gauge: 30 to 210 deg. F., 2-inch diameter dual-scale temperature gauge.
 14. Insulation shell
 15. Isolation Ball Valves: Inlet and outlet low-lead brass
 16. Manufacturers:
 - a. Caleffi
 - b. Legend Valve & Fitting, Inc.
 - c. TACO Comfort Solutions, Inc.
- F. Ball Valves
1. Provide ball valves with:
 - a. Blowout proof stem.
 - b. Full size port, 316 stainless steel ball and stem.
 - c. Cast bronze body.
 - d. Threaded ends.
 2. Seat, seals, thrust washers and packing shall be suitable for the intended service.

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3. Service rating:
 - a. 150 psi saturated steam.
 - b. 600 psi WOG.
 4. Provide with memory stop for balancing valves.
 5. Where Viega ProPress fittings are used, Viega ProPress ball valves may be used.
 6. All valves for domestic use must be lead free.
- I. Valve Connections
1. Provide valves suitable to connect to adjoining piping as specified for pipe joints. Use pipe size valves. Sweated joints are not allowed.
 2. Thread pipe sizes 2 inches and smaller.
 3. Flange pipe sizes 2-1/2 inches and larger.
 4. Use screw to solder adapters for copper tubing.
 5. Use grooved body valves with mechanical grooved jointed piping.
 6. Use press valves when using copper press systems.
- J. Valve Operators
1. Provide suitable hand-wheels for gate, globe, angle or drain valves and inside hose bibbs.
 2. When cocks and valves are furnished with square head stem:
 - a. Provide one wrench for every ten cocks or valves sized 2 inches and smaller, minimum of two.
 - b. Provide each cock or valve size 2-1/2 inches and larger with a wrench with setscrew.
 3. Where butterfly valves are provided:
 - a. Provide gear operators on valves 6 inches and larger.
 - b. Where valves are located 7 feet or more above the finished floor in equipment room areas provide chain-operated sheaves. Extend chains to about 5 feet above floor and hook to clips, arrange to clear walking space.
 - c. Lever lock handle with toothed plate for shut-off service and infinitely adjustable handle with lock and nut and memory stop for throttling service on valves 4 inches and smaller.
- K. Acceptable Manufacturers (All listed must be lead free):
1. Apollo
 2. Crane
 3. Dezurik
 4. Jenkins
 5. Keystone
 6. Kitz
 7. Milwaukee Valve
 8. Nibco
 9. Stockham
- L. Check Valves
1. Bronze body, 2 inches and smaller, bronze disc (Teflon disc for steam service), regrinding swing check, screw-in cap, threaded connection (Lead Free).
 2. Iron body, 2-1/2 inches and larger, bronze trim, non-slam: stainless steel pins and springs, and bronze plate or bronze mounted, regrind-renew check, bronze seat ring and disc. Provide either wafer or threaded lug (Lead Free).

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3. Acceptable Manufacturers (All listed must be lead free):
 - a. Apollo
 - b. Keystone
 - c. Kitz
 - d. Milwaukee
 - e. Mission Duocheck
 - f. Nibco
- M. Backflow Preventer (All valves for domestic use must be lead free):
 1. 2 inches and smaller - bronze body, reduced pressure zone type with two inline independent check valves with an intermediate relief valve, complete with two full port ball valve shut-offs and ball type test cocks. Bronze strainer on inlet. Provide air gap fitting with full size drain piped to nearest floor drain.
 - a. Watts 909-QT-S-LF.
 - b. Zurn-Wilkins 975XL3S
 2. 2-1/2 inches and larger - stainless steel or FDA epoxy coated ductile iron reduced pressure zone type with two inline independent check valves with reverse relief valves, two non-rising stem resilient sealed gate valves, cast iron strainer on inlet. Provide air gap fitting piped full size to nearest floor drain.
 - a. Apollo RP4ALF-YS
 - b. Watts 909-NRS-BB-S-LF
 - c. Zurn-Wilkins 375ASTFSC
- N. Provide valves of same manufacturer throughout where possible.
- O. Provide valves with manufacturer's name and manufacturing location, duty and pressure rating clearly marked on outside of body.
- P. Where valves are installed in insulated piping, provide with extended neck so valve operator and stop plate clears the full thickness insulation.
- Q. Provide valve, seat and trim materials suitable for the intended service.
- R. Provide memory stops for all valves used for throttling service. Valves for throttling service shall be butterfly, plug, globe or ball type.
- S. Float Valve
 1. On – Off non-modulating action
 2. Fully adjustable high and low level settings
 3. Float, float linkage and float rod
 4. Complete stainless steel material
 5. Level differential adjustment minimum to 18 inches maximum
 6. Stilling well
 7. Acceptable Manufacturer: CLA-VAL

2.2 PIPE SYSTEMS STRAINERS

- A. Body:
 1. Bronze "Y" pattern or basket as shown on the drawings.
 2. Line size.
 3. Threaded strainer blow down port.
 4. ASTM A #126 Class B Cast Iron Body.

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- B. Construction:
 - 1. 2 inch size and smaller with screw connections rated 400 psi WOG.
 - 2. Over 2 inch size with flanged connections, rated 125 psi WOG.
- C. Fabricate screens of Monel or type 304 stainless steel:
 - 1. With 20 mesh woven wire in piping systems through 2 inches.
 - 2. With 0.045 perforations in piping systems 2-1/2 inches and 3 inches.
 - 3. With 0.125 perforations in piping systems 4 inches and larger.
- D. Start-up:
 - 1. Provide an additional fine mesh disposable screen for use during start-up operations.
 - 2. Remove after 30 days.
 - 3. Attach to piping for Owner's review.
- E. Acceptable Manufacturers (All listed must be lead free):
 - 1. Apollo
 - 2. Crane
 - 3. Keckley
 - 4. Kitz
 - 5. Mueller
 - 6. McAlear
 - 7. Muesco
 - 8. Nibco
 - 9. Zurn

2.3 VALVE SCHEDULE

- A. Domestic Service
 - 1. Gas shut-off service: UL approved for natural gas service.
 - a. Nibco Ball Valve, full port through 1 inch: T-585-70-UL
 - b. Nibco Ball Valve conventional port 1-1/4 inch through 3 inch: T-580-70-UL
 - c. Conbraco Ball Valve, full port through 4 inch: 64-100 Series
 - d. Milwaukee Full Port 1/4 inch-2 inch
 - e. Milwaukee Standard Port 2-1/2 inch & 3 inch
 - f. Kitz Full Port 2 inch -- #68
 - g. Resun 2-1/2 inch and larger: 143 - 1-UL
 - h. DeZurick 2-1/2 inch and larger: Series 425 or 435
 - i. Locking Type: Rockford 3/4 inch and 1 inch PNP-400
 - j. Mueller 1-1/4 inch through 4 inch: Lub-O-seal
 - 2. Cold and Hot water service (all listed must be Lead Free):
 - a. Nibco Ball Valve full port through 2 inch: T-585-66-LF
 - b. Nibco Ball Valve 2-1/2 inch and 3 inch conventional port: T-580-66-LF
 - c. Nibco Butterfly Valve 4 inch and larger: LD-2000 EDPM Gaskets
 - d. Watts Ball Valve 4 inch and larger: G-4000-FDA
 - e. Viega ProPress Bronze Ball Valves (where Viega ProPress fittings are used)
 - f. Kitz Full Port through 2 inch - #868M Lead Free
 - g. Milwaukee Full Port 1/4 inch-2 inch
 - h. Milwaukee Standard Port 2-1/2 inch & 3 inch
 - i. Apollo Ball Valve Full Port through 2-1/2 inch 77CALF
 - j. Apollo Ball Valve Standard Port 3 inch 70LF
 - k. Apollo Butterfly Valve 4 inch and Larger LD141
 - l. Apollo Press Bronze Ball valves – 77 WLF

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3. Compressed air system
 - a. Nibco Ball Valve full port through 2 inch: T-585-70-66
 - b. Nibco Ball Valve 2-1/2 inch and 3 inch conventional port: T-580-70-66
 - c. Watts Ball Valve 4 inch and larger: G-4000
 - d. Viega ProPress Bronze Ball Valves (where Viega ProPress fittings are used)
 - e. Milwaukee Valve Full Port through 2 inch – BA-400S
 - f. Apollo Ball valve full port through 1-1/2 inch 77CA
 - g. Apollo Ball Valve standard port 3 inch 70
 - h. Apollo Press Bronze Ball valves: 77W
4. Check Valve (All listed must be Lead Free):
 - a. Nibco Check Valve: T - 413 - Y -LF (Teflon Seats)
 - b. Nibco Check Valve 2-1/2 inch and larger: F - 918 – Y -LF (Buna-N disc.)
 - c. Nibco Check Valve 2-1/2 inch and larger: W - 920 -W-LF (Wafer)
 - d. Kitz Y & Check: A-22T
 - e. Kitz 2-1/2 inch and Larger #778 C.I.
 - f. Kitz Wafer Check 2-1/2 inch and Larger #7032
 - g. Milwaukee Valve – 509T
 - h. Apollo Check Valve: 163TLF
 - i. Apollo Check Valve 2-1/2 inch and larger: 910FLF
 - j. Apollo Press Check Valve: 163TPR-LF
 - k. Apollo Check Valve 2 inch and larger 910WE-LF (Wafer)

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install valves with stems upright or horizontal, not inverted.
- B. Install valves for shut-off and isolating service at each piece of equipment, at vertical risers, and where shown on the drawings.
- C. Use butterfly valves and ball valves in domestic hot water and domestic cold water systems interchangeable in place of gate and globe valves.
- D. Use butterfly valves and ball valves in circulating water systems, for balancing duty.
- E. Provide drain valves at main shut-off valves and low points of piping and apparatus so the systems can be entirely drained.
 1. 1 inch valve for pipes 6 inch and larger.
 2. 3/4 inch valve for pipes smaller than 6 inch.
 3. Terminate with pipe plug.
 4. Drain valves shall be ball valves.
- F. Provide isolation valves in domestic water lines to isolate all equipment, restrooms, hose bibbs, and where shown on the drawings.
- G. Where valves are installed in insulated pipe, valve operator shall have an insert so the lever or handle will not damage the insulation. Install handles so the lever or handles will not damage the insulation.
- H. Provide clearance for installation of insulation and access to valves.
- I. Provide access where valves are not exposed.

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3.2 VALVE TAGS

- A. Furnish valves with 1-1/2 inch diameter brass valve tags with stamped, black or red-filled numbers. Service designations shall be 1/4 inch letters, and valve numbers shall be 1/2 inch letters. Engineer shall approve Service designations. Secure tags to valves by use of brass "S" hooks or brass chain. Secure chain to valve by use of copper or Monel meter seals. Valve tags are not required if the valve is located within 3 feet of the equipment being served and the service is obvious.
- B. Mount charts and drawings listing functions of each valve and its location in a metal and glass frame. Place charts and drawings as directed; in addition, on the record drawings mark the symbols and furnish a valve schedule properly identifying the valve number, service, exact location, the material being piped, and the room number of area that the valve services. This schedule shall be furnished on reproducible drafting paper or film suitable for reproduction on an Ozalid machine. The Owner shall approve the size of drafting paper. Provide a copy of the valve chart in the Operating and Maintenance Manuals.

3.3 PIPE SYSTEMS STRAINERS

- A. Provide strainers in supply piping to circulating pumps, thermostatic mixing valves, before solenoid valves and trap primer valves.

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SECTION 220533

PIPE HEAT TRACING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install a complete industrial, constant wattage, UL listed system of electric pipe heat tracing and controls on all make-up water piping outdoors above grade to prevent freezing. The heat tracing system shall conform to ANSI/IEEE Standard 515-1989.
- B. Protect the pipe, valves, fittings, meters and appurtenances. Apply sufficient cable and overheat thermostat to protect the entire system.

1.2 SUBMITTALS

- A. Submit shop drawings and product data as specified in Section 22 05 12.
- B. Submit detailed calculations for length of heat tracing cable per foot of pipe, based on actual length of piping installed.
- C. Submit manufacturer's certified capacity charts with selections plotted thereon.
- D. Submit manufacturer's installation instructions.
- E. Submit full load ampere requirement and voltage for branch circuit.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Raychem Corporation
- B. Thermon Manufacturing Company

2.2 COMPONENTS

- A. Self-regulating heater.
 - 1. The self-regulating heater shall consist of two 16 AWG tinned-copper bus wires embedded in parallel in a self-regulating polymer core that varies its power output to respond to temperature all along its length, allowing the heater to be crossed itself without overheating and to be cut in the field. The heater shall be covered by a radiation cross-linked modified polyolefin dielectric jacket.
 - 2. In order to provide energy conservation, and to prevent overheating, the heater shall have a self-regulating factor of at least 90%.
 - 3. The heater shall operate on a line voltage of 120 VAC without the use of transformers.
 - 4. The heater shall be sized according to the following. The required heater output rating is in watts per foot at 50°F (heater selection based on 1-1/2 inch fiberglass insulation on metal piping).

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5. The heater shall be XL-Trace as manufactured by Raychem Corporation or XL-Econotrace as manufactured by Thermon Manufacturing Company.
6. Power connection, end seal, splice and tee kits components shall be applied in the field.
7. The system shall be controlled by an ambient sensing thermostat set at 40°F either directly or through an appropriate contactor.
8. Provide an end-of-circuit voltage indicating light

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install and start up the pipe heat tracing system in accordance with the manufacturer's Installation, Start-up and Service Instructions.
- B. Install the pipe heat tracing cable under the pipe insulation.
- C. Apply "Electrically Traced" signs to the outside of the thermal insulation.
- D. Ground fault protection of the equipment shall be provided per the 1996 National Electrical Code, Article 427-22.
- E. Provide a cast aluminum weatherproof NEMA-4 rated junction box for installation of the cable, with pilot light to indicate operation of the cable.
- F. Use only electrical components as recommended by the manufacturer.

3.2 ELECTRICAL WORK

- A. Furnish and install the wire, conduit and raceway systems required for the automatic operation of the pipe heat tracing system. Conform to the National Electrical Code.
- B. The specified wiring work includes:
 1. Wiring of control instruments between thermostat and junction boxes
 2. Installation of thermostat and junction boxes
 3. Wiring from the heat tracing cable to the junction boxes
- C. Related branch circuit power wiring from the junction box to ground fault type circuit is specified to be provided in Division 26.
- D. Provide devices and appurtenances as specified in Division 26.
- E. Identify each circuit at each terminal with a separate tag.
- F. Color code wires in accordance with IPCEA Standards.
- G. Make all joints and connections with approved mechanical connectors.

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3.3 TESTING OF THE PIPE HEAT TRACING SYSTEM

- A. Test the pipe heat tracing system:
 - 1. Simulate freezing outside air conditions
 - 2. Measure the amperage draw of the heat tracing system
 - 3. Compare to the manufacturer's capacity rating of the actual system
 - 4. After installation and before and after installing the thermal insulation, subject heat to testing using a 1000 VDC megger. Minimum insulation resistance should be between 20 to 1000 megohms regardless of the length.
- B. Submit records of test for approval prior to substantial completion; insert in the Owner's Manual.

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SECTION 220719

PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install piping insulation, jackets, accessories and covering of specified materials. The insulation shall be used for high and low temperature piping applications including domestic hot and cold water, roof and overflow drain sump bodies and rain leaders, horizontal sanitary drain piping which receives condensate, make-up water and pool heating water.

1.2 QUALITY ASSURANCE

- A. The intent of insulation specifications is to obtain superior quality workmanship resulting in an installation that is absolutely satisfactory in both function and appearance. Provide insulation in accordance with the specifications for each type of service and apply as recommended by the manufacturer and as specified.
- B. An approved contractor for this work under this Division shall be:
 - 1. A specialist in this field and have the personnel, experience, training, skill, and the organization to provide a practical working system.
 - 2. Able to furnish evidence of having contracted for and installed not less than 3 systems of comparable size and type that have served their owners satisfactorily for not less than 3 years.
- C. All piping insulation used on the project inside the building must have a flame spread rating not exceeding 25 and a smoke developed rating not exceeding 50, as determined by test procedures ASTM E 84, NFPA 255 and UL 723. These ratings must be as tested on the composite of insulation, jacket or facing, and adhesive. Components such as adhesives, mastics and cements must meet the same individual ratings as the minimum requirements and bear the UL label.
- D. Condensation on any insulated piping system is not acceptable.
- E. Replace insulation damaged by either moisture or other means. Insulation that has been wet, whether dried or not, is considered damaged. Make repairs where condensation is caused by improper installation of insulation. Also repair any damage caused by the condensation.
- F. Where existing insulated piping, or other surfaces are tapped, remove existing insulation back to undamaged sections for hot surfaces or to nearest insulation stop for cold surfaces, and replace with new insulation of the same type and thickness as existing insulation. Apply as specified for insulation of the same service.

1.3 APPROVALS

- A. Submit product data on each insulation type, adhesive, and finish to be used in the work. Make the submittal as specified in Division 1 General Requirements and obtain approval before beginning installation. Include product description, list of materials and thickness for each service and location and the manufacturer's installation instructions for each product.

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- B. Make a field application of each type of insulation to display the material, quality and application method. Obtain approval of the sample application before proceeding with installation of the work.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Glass fiber pipe insulation:
1. Johns-Manville Micro-Lok AP-T
 2. Owens-Corning ASJ/SSL
 3. Knauf ASJ/SSL
- B. Cellular Glass Insulation (Foamglass):
1. Pittsburg Corning
 2. Cell-U-Foam
- C. Aluminum Jacketing:
1. Childers
 2. Pabco
 3. RPR
- D. Fiberglass reinforcing cloth mesh:
1. Perma Glass Mesh
 2. Alpha Glass Mesh
 3. Childers Chil-Glas
 4. Vimasco
- E. Mastics and Adhesives
1. Childers
 2. Foster
 3. Vimasco
 4. Armstrong 520 Adhesive
- F. Elastomeric Insulation
1. Armacell
- G. Weather Resistant Coating
1. WB Armaflex Finish
- H. Glass fiber blanket insulation
1. Manville R-series Microlite FSKL
 2. Owens-Corning eD75 or ED100 RKF
 3. Knauf 0.75 PCF FSK

2.2 FIBERGLASS PIPE INSULATION

- A. Heavy density, dual temperature fiberglass insulation with factory applied, all service, reinforced vapor barrier jacket having integral laminated vapor barrier. Provide with a factory applied pressure sensitive tape closure system and matching butt strips. Supply in thickness as shown.
1. Thermal conductivity 0.23 @ 75°F mean (ASTM 335).

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2.3 ELASTOMERIC INSULATION

- A. Insulation material shall be flexible, closed-cell elastomeric insulation in tubular or sheet form. Material shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less when tested in accordance with ASTM E84, latest revision. Sheet material with a thickness greater than $\frac{3}{4}$ " shall have a flame spread rating of 25 or less and a smoke developed rating of 100 or less when tested in accordance with ASTM E84, latest revision. In addition, the product, when tested, shall not melt or drip flaming particles, and the flame shall not be progressive. In addition, all materials shall pass simulated end-use fire test. Minimum $\frac{3}{4}$ " thick.
1. Thermal conductivity 0.27 at 75°F mean (ASTM C177 or C518)

2.4 CELLULAR GLASS INSULATION

- A. ASTM C552:
1. "k" value of 0.35 @ 75°F ("ksi" value of 0.047 @ 24°C);
 2. 8.0 lb./cu.ft. (128 kg/cu.m.) density

2.5 INSULATION/SHIELD AT HANGERS

- A. Field fabricated: Use 360° sections of rigid foamglass insulation that will support the bearing area at hangers and supports. Further support insulation at hangers and supports with a shield of galvanized metal covering at least half of the pipe circumference and conforming to the schedule. Insulation shall extend at least 1" beyond metal shield on each end. When pipe is guided at top and bottom, metal shields shall cover the whole pipe circumference. Adhere metal shield to insulation so that metal will not slide with respect to insulation with $\frac{1}{2}$ " aluminum bands (2) per shield.
1. Sections of foam glass insulation may be used of the same outside diameter of the adjoining pipe insulation.
 2. Minimum thickness of foam glass insulation shall not be less than 1" thick.
- B. Pipe saddles: Formed galvanized sheets at each support point for insulated pipe, shaped to fit pipe, and covering bottom half of pipe. Length at saddle shall be not less than twice the insulation outside diameter or more than 22". Provide 18 gauge through 4" pipe and 16-gauge 5" pipe and above.

2.6 SEALANT, ADHESIVE AND FINISH

- A. Lap Adhesive. Provide Childers CP-82 adhesive.
- B. Vapor Barrier Finish:
1. Indoors: Provide as insulation coating Childers CP-35, white.
 2. Outdoors: Provide as insulation coating Childers Encacel X.
 3. Underground: Provide Childers CP-22/24 for fittings and areas. Pittwrap cannot be used.
- C. Sealant. Provide Childers CP-76 vapor barrier sealant.
- D. Lagging Adhesive. Provide Childers CP-50.
- E. Other products of equal quality will be acceptable only upon approval.

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2.7 ALUMINUM JACKETING

- A. Finish insulated piping outdoors with a smooth prefabricated Z-lock aluminum jacket 0.016" thick with factory applied 1 mil polyethylene/40 lb and Fab strap. Kraft moisture barrier. Childers Lock-On or approved equal.
- B. Valves, Fittings and Flanges. For finishing valves, fittings, flanges and similar installations, provide formed aluminum covers, 0.024" thick.
- C. Straps and Seals. Provide ½" x 0.020 stainless steel strapping and seals for jackets and covers according to manufacturer's recommendations.

2.8 GLASS FIBER BLANKET INSULATION

- A. Minimum density of 1.0 PCF, 2" thick, installed R value to be 6.0 or better at 75°F mean, facing of 0.35 mil foil reinforced with glass yarn mesh and laminated to 40 lbs fire resistant kraft.

PART 3 - EXECUTION

3.1 INTERIOR PIPING

- A. Cover all piping with glass fiber, heavy density, dual temperature pipe insulation with a vapor barrier jacket. Apply insulation to clean, dry pipes. Longitudinal seams shall be joined firmly together and sealed with self-sealing lap joints. Butt insulation joints firmly together and seal with a 3" wide ASJ butt strip seal. Longitudinal seams and butt strip laps shall be coated and sealed with CP-35 vapor barrier coating for chilled water piping applications.
- B. Install hanger with protective shield, on the outside of all insulation.
- C. Where domestic water pipes (1/2" & ¾" pipe sizes) are installed on trapeze type hangers, provide galvanized sheet metal protection shields at these locations. Place insulation jacket directly on hanger. Incompressible, load bearing insulation segments are not required.
- D. Pipe Saddles: Formed galvanized sheets at each support point for insulated pipe, shaped to fit pipe, and covering bottom half of pipe. Length at saddle shall be not less than twice the insulation outside diameter. Provide 18-gauge through 4" pipe and 16-gauge for 5" pipe and above.
- E. Seal ends of pipe for drinking chilled water insulation with vapor barrier mastic at valves, flanges, fittings and every 21' on straight runs of piping. Mastic should extend on top of ASJ jacket, across the glass, down onto the pipe making a complete seal.
- F. Apply a smooth flood coat of white lagging Foster 8142W over all exposed insulation.
- G. Piping to be insulated as specified above:
 - 1. All hot and cold water.
 - 2. Make-up water
 - 3. Horizontal sanitary drain piping that receives condensate
 - 4. Exposed to view storm drainage system including roof and overflow drain bodies, vertical piping from drain body and all horizontal rain leaders to first elbow turning down

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3.2 PIPING OUTDOORS ABOVE GRADE

- A. Insulate all water piping exterior of building above grade with rigid foam insulation and aluminum jacketing.
- B. Adhere the vapor barrier jacket longitudinal seam with vapor barrier adhesive.
- C. Cover all valves, fittings and flanges with factory made molded or field fabricated segments of pipe insulation of a thickness and material equal to the adjoining insulation. Adhere segments together with no voids, using CP-82 adhesive. Secure fitting insulation covers and segments in place with 1/2" wide glass filament tape.
- D. Apply a tack coat of fitting mastic over the insulation and tape.
- E. Neatly embed with 10 x 10 fiberglass cloth into the tack coat.
- F. Apply mastic over the fiberglass cloth to a thickness where the fabric is not visible after completion.
- G. Seal ends of pipe insulation with vapor barrier mastic at valves, flanges, fittings and every 21' on straight runs of piping. Mastic should extend on top of ASJ jacket, across the foam, down onto the pipe, making a complete seal.
- H. Finish with aluminum jacketing as specified.

3.3 FLANGE, VALVE AND FITTING INSULATION

- A. Cover valves and flanges with fabricated segments, fittings with two-piece factory molded fittings, and both of matching pipe insulation type and thickness equal to that of the adjoining pipe. Fittings and fabricated segments shall be securely held in place.
 - 1. Apply a tack coat of insulating mastic to the insulated fitting to produce a smooth surface.
 - 2. After mastic is dry, apply a second coat of vapor barrier mastic. Neatly embed with 10 x 10 fiberglass cloth into the tack coat.
 - 3. Overlap mastic and fiberglass cloth by 2" on adjoining sections of pipe insulation.
 - 4. Apply a second coat of mastic over the fiberglass cloth to present a smooth surface.
 - 5. Apply mastic to a wet film thickness of 3/64".
 - 6. Fabric shall not be visible after completion.
 - 7. Vapor seal flanges, valves and fittings with Childers CP-35.
- B. PVC fitting covers are not acceptable.

3.4 ALUMINUM JACKETING (Insulated Piping Outdoors Above Grade)

- A. Apply smooth aluminum jacket on piping, valves, fittings and flange covers according to manufacturer's recommendations, using stainless steel strapping and seals, to provide weather tight covering and to shed water.
- B. Aluminum jacketing is not considered as contributing to the vapor barrier or the insulation jacket. The vapor barrier must be sufficient in itself for this function. Lap each adjoining jacket section a minimum of 3" to make a weather tight seal.
- C. Install straps on 9" centers and at each circumferential lap joint.

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- D. Cover and seal all exposed surfaces.
- E. The use of screws and rivets is not approved.
- F. Provide isolation (30# felt) between the aluminum jacket and the sheetmetal protection shield at each pipe support point.

3.5 CONCEALED STORM DRAIN PIPING

- A. Provide flexible glass fiber insulation with factory-applied, reinforced UL labeled Foil-Skrum-Kraft (FSK) facing. Install insulation of clean, dry piping.
- B. Insulation shall be wrapped tightly on the piping with all circumferential joints and longitudinal joints overlapped a minimum of 2" with facing to the outside to obtain specified R-value using a maximum of 25% compression.
- C. Provide vapor retarder at penetrations, joints, seams and damage to the facing with staples and FSK foil tape. The facing shall be taped with a minimum 3" wide strip of reinforced foil tape. Pressure-sensitive tape shall be a minimum 3" (76mm) wide and shall be applied with moving pressure using an appropriate sealing tool. Staples shall be outward cinch and placed 6" (152mm) on center.
- D. Mechanical / Electrical rooms and above ceilings are considered concealed spaces.

3.6 MISCELLANEOUS

- A. Install materials after piping has been tested and approved.
- B. Apply insulation on clean, dry surfaces only.
- C. Apply weather protective finish on elastomeric insulation installed in non-conditioned spaces. Provide a minimum of three coats.

3.7 INSULATION THICKNESS

<u>INSULATED UNIT</u>	<u>THICKNESS</u> <u>(Inches)</u>
Exposed Roof Drain Bodies and Horizontal Roof Drain Leaders	1
Exposed Roof Overflow Drain Bodies and Horizontal Drain Leaders	1
Domestic Cold Water/Make-Up Water Piping/Drinking Chilled Water	1
Horizontal Sanitary Drain Piping Which Receives Condensate	1
Domestic Hot Water Piping, 1-1/2" Pipe and Smaller	1
Domestic Hot Water Piping, 2" Pipe and Larger	1-1/2

END OF SECTION

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SECTION 220800

PLUMBING COMMISSIONING COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section outlines commissioning requirements and activities of Contractor, Owner, CxA and Design Professionals as related to the Division 22 Plumbing.
- B. Related Sections:
 - 1. Division 01 – General Requirements and Specification Section 01 91 13, General Commissioning
 - 2. Division 22 – Plumbing
 - 3. Division 23 – Mechanical
 - 4. Division 26 – Electrical

1.2 DEFINITIONS

- A. Refer to Specification Section 01 91 13, General Commissioning for definitions.

1.3 CONTACT INFORMATION

- A. The Owner will contract directly for commissioning services.
 - 1. Commissioning Agent fee will be paid for directly by the owner.
 - 2. Cost of contractor coordination with the CxA is specified in this section.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. Contractor shall provide all standard and specialized testing equipment required to perform Start-up and Functional Performance Testing. Test equipment required for Functional Performance Testing is listed below. Data logging equipment and software required to test equipment shall be provided by the Contractor.
- B. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 1.0°F and a resolution of + or - 0.2°F. Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year. All equipment shall be calibrated according to the manufacturer's recommended intervals and following any repairs to the equipment. Calibration tags shall be affixed or certificates readily available.

2.2 OTHER CONTRACTOR PROVIDED EQUIPMENT:

- A. Ladders and/or lifts and appropriate fall protection as required by Contractor site requirements.

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PART 3 - EXECUTION

3.1 COORDINATION - GENERAL

- A. Except for the activities to be performed by the CxA called for herein, all component and system installation work required by the Division 22, 23 and 26 specifications including specific contractor furnished items indicated by this Section shall be provided by the Contractor.

3.2 SUBMITTALS

- A. Plumbing
 - 1. Plumbing Equipment.

3.3 EQUIPMENT START-UP

- A. Notification
 - 1. Contractor shall provide ten Owner business days' notice to CxA, Owner and Design Team of start-up dates.
- B. Prior to start-up, contractor shall:
 - 1. Verify that equipment and systems are complete, accessible, correctly connected to utilities and ready for operation. Perform all pre-start inspections and tests as called for in Division 22.
 - 2. Comply with pre-start requirements of manufacturer and complete applicable documentation.
 - 3. Complete applicable sections of Pre-functional Checklists.
 - 4. Coordinate start-up attendance by manufacturer or authorized representative as required by specifications or manufacturer.
- C. At start-up, contractor shall:
 - 1. Supervise the activities of the authorized start-up technician or manufacturer's representative.
 - 2. Verify proper voltage, phase, drive rotation and any other conditions that may cause damage if not correct.
 - 3. Execute start-up under supervision of qualified contractor and equipment manufacturer personnel and in accordance with the manufacturer's instruction.
 - 4. Complete manufacturer start-up requirements and documentation. Provide a copy of documentation to the CxA for inclusion in the Cx Manual.
 - 5. Complete PFC's and provide documentation to CxA.
 - 6. Provide documentation of any issues noted during start-up to CxA, Owner and Design Team. Outline recommendations for corrective action.

3.4 PRE-FUNCTIONAL CHECKLISTS

- A. Contractor shall forward completed copies of PFC's to the CxA for inclusion into the Cx documentation. PFC's will be provided by the CxA. As an alternate, contractor shall submit their versions of the PFC's to the CxA for review and comment.
- B. Contractor shall complete PFC for each of the following equipment:
 - 1. Plumbing:
 - a. Domestic Hot Water Heater/Converter
 - b. Recirculation Pump
 - c. Mixing Valve

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3.5 FUNCTIONAL TESTING

- A. General
 - 1. Contractor shall organize and schedule Construction Team members to execute the functional testing, which will be directed by CxA.
- B. Recirculation Pump
 - 1. Graphics
 - 2. Start/Stop/Schedule
 - 3. Pump Operation (On/Off/Hand/Auto)
 - 4. Temperature Sensor Calibration
- C. Domestic Water Heater
 - 1. Graphics
 - 2. Start/Stop Schedule
 - 3. Discharge Temperature

END OF SECTION

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SECTION 221116

DOMESTIC WATER PIPING AND APPURTENANCES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install domestic hot and cold water piping.

1.2 RELATED WORK

- A. Division 22 Plumbing
1. Valves, Strainers and Vents
 2. Pipe and Pipe Fittings - General
 3. Plumbing Piping Insulation
 4. Plumbing Fixtures and Fixture Carriers

PART 2 - PRODUCTS

2.1 PIPING AND FITTINGS

- A. Below Slab on Grade Piping for Water Entries:
1. 2-inch and smaller, provide ASTM B88 Type K (heavy wall) annealed tempered (soft) seamless copper water tube. No joints below slab entries.
 2. 2-1/2-inch and 3-inch, provide ASTM B88 Type K (heavy wall) annealed tempered (soft) seamless copper water tube, 20 ft. straight lengths. One joint allowed below slab entry using wrought copper, solder-joint pressure fittings: ASME B16.22 with an approved brazing filler metal or pipe can be shop bent for no joint installation by using a "bending" temper tubing.
 3. 4-inch and larger, provide ductile iron pipe with mechanical joints, ANSI A21.6.
 4. 3 inch and larger, provide one-piece stainless steel IBR (in building riser), Watts or Ames.
 5. 2 inch to 3 inch, provide one-piece stainless steel IBR2 (in building riser), Watts or Ames.
- B. Below Grade Piping Outside Building (beyond 5'-0" of building): Provide PVC water main pipe 4 inch through 12 inch in diameter in conformance with AWWA C900. When using 3" or smaller provide Schedule 40 PVC ASTM D1785 with ASTM D-2466 socket type fittings. Provide fittings in conformance with ASTM 2466. Furnish pipe with a minimum pressure rating of 150 lbs. per square inch. Provide PVC pipe as manufactured by Johns-Manville, CertainTeed, Clow or approved equal.
- C. Below Slab on Grade Piping. Furnish ASTM B 88 and ANSI/NSF Standard 61 annealed tempered (soft), Type K copper water tube. Run continuous with no joints under the floor slab. Provide copper pipe corrosion protection as specified in this Section.
- D. Above Slab Piping: Provide seamless ASTM B 88 and ANSI/NSF Standard 61 drawn tempered (hard) Type L copper water tube with wrought copper or bronze fittings with solder-joints, ANSI B16.22. Solder material shall be 95-5 (lead free) (Tin-Antimony-Grade 95TA) ASTM B 32.

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- E. Unions. Provide 150 lb. standard unions with ground joint and bronze seat. Flange larger than 2 inches. Provide dielectric isolating unions at junctions or connection between metallic piping of dissimilar metal. Provide pipe threads with standard taper pipe threads ANSI B2.1.

2.2 WATER HAMMER ARRESTORS

- A. Provide piston type hydraulic engineered/manufactured water hammer arrestors in cold and hot water supply lines in chases or walls to each fixture branch or battery of fixtures serving quick closing valves of electrical, pneumatic, spring loaded type, or quick hand closure valves on fixture trim. Provide water hammer arrestors at the end of the branch line between the last two fixtures served. Provide Precision Plumbing Products, Inc., or equal. Size units according to water hammer arrestor's Standard PDI WH-201; refer to schedule on drawings.
- B. Install all water hammer arrestors so as to attain 100% effectiveness according to Plumbing and Drainage Institute PDI-WH201 Table 5, 6 and 6-A for water hammer arrestors.
- C. All water hammer arrestors shall be installed in a vertical position.
- D. All water hammer arrestors shall be accessible and shall have access panels where required. Arrestors located above ceilings in fixture drops will not be acceptable. Refer to sizing and placement data as indicated in PDI Standard PDI-WH-201.

PART 3 - EXECUTION

3.1 DRAINAGE

- A. Install water piping systems with uniform horizontal grade of 1/8 inch per 10 foot, minimum, to low points to provide complete system drainage. Where constant pitch cannot be maintained for long runs, establish intermediate low points and rise to new level. Grade branches to drain to mains or risers. Unless otherwise indicated, terminate low points of risers with drain valve piped to nearest hub or floor drain.

3.2 STERILIZATION

- A. Prior to starting work, verify system is complete, flushed and clean.
- B. Inject chorine disinfectant in liquid, powder, tablet or gas form throughout the system to obtain 50 to 80 Mg/L residual.
- C. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 20% of the outlets.
- D. Retain disinfectant in system for 8 hours (minimum), 24 hours (maximum). During the disinfection process, operate all valves and accessories.
- E. If final disinfectant residual tests less than 25 Mg/L, repeat treatment.
- F. Flush disinfectant from system until chemical and bacteriological tests prove water quality equal to that of the service main.

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- G. Take samples no sooner than 24 hours after flushing from at least 10% of the outlets and from the water entry.
 - 1. Obtain a minimum of one water sample flushing from at least 10% of the outlets and from the water entry.
 - 2. Take samples from faucets located at highest point in the building, and farthest point from the main water supply.
- H. After final flushing, remove aerators, clean and replace.
- I. Chemical and bacteriological tests shall be conducted by a state certified laboratory.
- J. The firm performing the disinfection shall have chemical laboratory experience.
- K. Provide a laboratory report to indicate the following information.
 - 1. Name and address of the approved laboratory testing the samples.
 - 2. Name and location of the project and date the samples were obtained.
 - 3. Mg/L chlorine during retention.
 - 4. Mg/L chlorine after flushing.
 - 5. The coliform organism count. (An acceptable test shall show absence of coliform organisms.)
- L. If analysis does not satisfy the specified minimum requirements, repeat the disinfection procedure.
- M. Submit for approval to the Architect/Engineer a copy of the laboratory report and the certification of performance. An approved copy of each document shall be inserted in the Owner's manual.

3.3 UNDERGROUND WATER PIPING SYSTEM PROCEDURES

- A. Lay sewer and water lines in separate trenches, separated by 10 foot of undisturbed or compacted soil.

3.4 TESTING

- A. Test under a cold water hydrostatic pressure of 1-1/2 times operating pressure (150 psig minimum) and carefully check for leaks. Repair leaks and retest system until proven watertight.
- B. Test the domestic water piping system at 150psig hydrostatic pressure, maintained for 6 hours.
- C. Use only potable water for the test.
- D. Perform the test before fixtures, faucets, trim or final connections are made to equipment.
- E. If the system is tested in sections, the entire domestic water piping system shall be submitted to a final test, employing the specified procedure.
- F. Do not insulate or conceal piping systems until tests are satisfactorily complete.
- G. If any leaks or other defects are observed, suspend the test and correct the condition at once. Repeat testing until leaks are eliminated and the full test period is achieved.

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- H. The satisfactory completion of testing does not relieve the Contractor of responsibility for ultimate proper and satisfactory operation of piping systems and their accessories.

3.5 COPPER PIPE CORROSION PROTECTION

- A. Corrosion protect copper tube piping systems:
1. In the building slab.
 2. Beneath the building slab.
 3. Buried.
 4. Route plasti-sleeve 0.006 thick material entire length of below slab on grade copper tubing.
- B. Cover copper tubing piping system with:
1. "Tapecoat" TC Primer.
 2. "Tapecoat" CT cold applied coating tape.
- C. Install coating system as specified by the manufacturer.
- D. Extend the corrosion protection 2 inches above concrete slab on grade.

3.6 TEST OF PIPE CORROSION PROTECTION SYSTEM

- A. Test the pipe corrosion protection coating with an approved high voltage tester adjusted to provide sufficient voltage to produce a spark through a pinhole in the coating (at least 15 kv AC).
- B. Make repairs to small holes in accordance with the manufacturer's instructions.
- C. Retest the repairs using procedures listed above.
- D. Furnish certificate of compliance with field testing in Owner's manual.

END OF SECTION

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SECTION 221123

DOMESTIC WATER PUMPS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. General characteristics for pumps specified in Division 22 - Plumbing.

1.2 RELATED WORK

Requirements for pumps are specified in other sections of Division 22 - Plumbing, including the following:

- A. Division 22 Plumbing - Electrical Provisions of Plumbing Work.

1.3 PUMP SELECTION

- A. Select pumps conservatively for scheduled conditions. Furnish pumps that have reasonably high efficiencies, with peak efficiency at or near rated conditions. Select pumps that will operate stably at 15' suction lift despite substantial reduction in head or substantial increase in delivery.
- B. If the pumps proposed are not considered suitable, submit manufacturer's data on other pumps, for review.
- C. Scheduled design flow, design head, pump efficiency, and motor horsepower are the minimum acceptable.
- D. The pump curve shall rise continuously from maximum flow to cut-off.
- E. Shut-off head approximately 10 percent greater than design head, unless otherwise indicated in pump schedules.
- F. Pump brake horsepower shall not exceed the motor horsepower rating over the entire operating range from shut-off to run-out.
- G. Select the pump for operation at or near peak efficiency.
- H. Cavitation-free at all points on the curve.
- I. Impeller diameter shall not exceed 90 percent of the maximum published diameter.

1.4 PUMP SIZE AND TYPE

- A. Provide motor-driven pumps of the type and speed scheduled. Select pumps that are not overloaded throughout the entire range of pump operation. Provide pump connection sizes as indicated.
- B. Submit copies of manufacturer's performance curves, as shop drawings on each pump. Clearly mark the curves for each pump to indicate the diameter of the impeller and the selection point.

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1.5 CERTIFIED DATA

- A. Submit factory certified pump curves showing pump performance characteristics with pump and system operating points plotted. Curves shall include as a minimum, flow (gallons per minute), head (feet of water), all available impeller diameters (inches), efficiency (percent), net positive suction head required (feet of water), brake horsepower, pump size and pump model. Show pump curves with system curve plotted.

PART 2 - PRODUCTS

2.1 HORIZONTAL PUMPS

- A. Pump Construction:
1. Cast iron, designed for 175 psi working pressure
 2. Bronze case wear rings
 3. Grease lubricated ball bearings selected for an average life of 200,000 hours; pressure grease fittings
 4. Flexible coupled
 5. Hot Dipped galvanized drip-rim structural steel base extending past the pump flanges allowing all condensation to be accumulated. Galvanized integral drain pan.
 6. Falk all-metal center dropout spacer coupling
 7. Totally enclosed metal or high-impact polyethylene plastic (Orange Peel) coupling guard per ANSI B15.1, Section 8 and OSHA 1910.219
 8. Suction and discharge flange gauge ports
 9. Fully enclosed bronze impeller keyed to the shaft
 10. 304 Stainless steel shaft minimum
- B. End suction pump volute with integrally cast pedestal support foot for back pullout to allow pump to be serviced without disturbing the system piping. Pumps utilizing pedestal mounted bearing frames in lieu of volute will not be accepted.
- C. Bearings:
1. Conform to Anti-Friction Bearing Manufacturers Association (AFBMA) Standards
 2. Ball or roller bearing pillow block type
 3. Self-aligning
 4. AFBMA L50 rating of 200,000 hours
- D. Horizontal or vertical split case pumps: Double row grease lubricated ball bearing each side.
- E. Provide each pump with an internally flushed mechanical seal. If external flush line is required, provide sediment filter for each line.
1. Use seal materials suitable for the pumped liquid
 2. Renewable bronze or stainless shaft sleeve
- F. Provide each pump with a stuffing box with packing:
1. Hardened 440C stainless steel renewable shaft sleeve
 2. Bronze gland and stainless steel gland bolts
 3. Oil graphite packing
- G. Paint entire unit with two coats of machinery enamel after completion of installation.

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H. Pump Motor:

1. Premium efficiency
2. Totally enclosed fan cooled
3. Cast iron frame and end plate
4. Forge steel lifting eye
5. Over sized conduit box with ground lug
6. So sized with relation to the pump impeller that the brake horsepower requirements will not overload the motor at any point on the pump curve
7. Designed for Variable Frequency Drive Application
8. Minimum Efficiency

3 hp	1800 rpm	89.5%
5 hp	1800 rpm	90.2%
7.5 hp	1800 rpm	91.7%
10 hp	1800 rpm	91.7%
15 hp	1800 rpm	92.4%
20 hp	1800 rpm	93%
25 hp	1800 rpm	93.6%
30 hp	1800 rpm	94.1%
40 hp	1800 rpm	94.5%
50 hp	1800 rpm	94.5%
60 hp	1800 rpm	95%
75 hp+	1800 rpm	95.4%

I. Data plates:

1. Provide the pump with a nameplate constructed of 300 series stainless steel securely fastened to pump casing with stainless steel pins.
2. Locate the nameplate for easy visibility.
3. Clearly stamp the rating conditions and other data below, as a minimum, on the nameplate.
 - a. Manufacturer, address, telephone number
 - b. Pump model number
 - c. Pump serial number
 - d. Size (including impeller diameter scheduled in inches)
 - e. Type
 - f. Equipment designation as listed on the pump schedule.
 - g. Flow scheduled (gallons per minute)
 - h. Dynamic head scheduled (feet of water)
 - i. Efficiency (percent)
 - j. Shut-off head (feet of water)
 - k. Speed (rpm)
 - l. Brake horsepower
 - m. Maximum brake horsepower with rated impeller
 - n. Rotation
 - o. Maximum allowable pressure (psig)

J. The schedule on the drawing sets forth the type of pump and GPM required.

1. The head capacities and horsepower are for bidding purposes only.
2. Make pump selection based on actual system calculations.

K. Acceptable manufacturers:

1. Pacific
2. Bell & Gossett
3. Amtrol/Thrush

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4. Armstrong
5. Aurora
6. Weinman

2.2 DOMESTIC HOT WATER CIRCULATOR

- A. Pump construction:
 1. Cast iron, designed for 125 psi working pressure
 2. Bronze fitted
 3. Grease lubricated ball bearings selected for an average life of 150,000 hours
 4. Flexible coupled
 5. Horizontal or vertical in-line
 6. Flanged connections
- B. Provide each pump with a mechanical seal. Use seal materials suitable for the pumped liquid.
- C. Paint entire unit with two coats of machinery enamel after completion of installation.
- D. Pump motor:
 1. NEMA Standard
 2. Open drip proof
 3. So sized with relation to the pump impeller that the brake horsepower requirements will not overload the motor at any point on the pump curve.
 4. Provide insertion thermostat (Aquastat) or (timer) to control operation of the domestic hot water return pumps.
- E. The schedule on the drawing sets forth the type of pump and GPM required.
 1. The head capacities and horsepower are for bidding purposes only.
 2. Make pump selection based on actual system calculations.
- F. Acceptable manufacturers:
 1. Bell & Gossett
 2. Amtrol/Thrush
 3. Armstrong
 4. Aurora
 5. Grundfos

2.3 DOMESTIC HOT WATER CIRCULATING PUMPS (VARIABLE SPEED) FRACTIONAL HORSEPOWER

- A. Pump Construction:
 1. Variable speed with automated ability to adjust and maintain optimum operating conditions stainless steel housing
 2. Check valve
 3. Flange or union connections
 4. Built-in timer
 5. Built-in temperature sensor
 6. Built-in differential pressure sensor
 7. Programmable
- B. Acceptable manufacturers:
 1. Grundfos
 2. Armstrong
 3. Wilo

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2.4 VERTICAL PEDESTAL TYPE PUMPS (Sump Pump & Sewage Pumps)

- A. Pump construction:
 - 1. Cast iron designed for 150-psi working pressure
 - 2. Bronze fitted
 - 3. Cast iron pedestal base and suction elbow fitting
- B. Bearings:
 - 1. Conform to Anti-Friction Bearing Manufacturers Association (AFBMA) Standards
 - 2. Ball or roller bearing pillow block type
 - 3. Self-aligning
 - 4. AFBMA L10 rating of 25,000 hours
- C. Arrange pump for back pull out.
- D. Provide each pump with a mechanical seal.
 - 1. Use seal materials suitable for the pumped liquid.
 - 2. Renewable bronze shaft sleeve.
- E. Paint entire unit with two coats of machinery enamel after completion of installation.
- F. Pump motor:
 - 1. NEMA Standard
 - 2. Open drip-proof
 - 3. TEFC where located outdoors
 - 4. So sized with relation to the pump impeller that the brake horsepower requirements will not overload the motor at any point on the pump curve.
- G. Data plates:
 - 1. Provide the pump with a nameplate constructed of 300 series stainless steel securely fastened to pump casing with stainless steel pins.
 - 2. Locate the nameplate for easy visibility.
 - 3. Clearly stamp the rating conditions and other data below, as a minimum, on the nameplate.
 - a. Manufacturer, address, telephone number
 - b. Pump model number
 - c. Pump serial number
 - d. Size (including impeller diameter scheduled in inches)
 - e. Type
 - f. Equipment designation as listed on the pump schedule.
 - g. Flow scheduled (gallons per minute)
 - h. Dynamic head scheduled (feet of water)
 - i. Efficiency (percent)
 - j. Shut-off head (feet of water)
 - k. Speed (rpm)
 - l. Brake horsepower
 - m. Maximum brake horsepower with rated impeller
 - n. Rotation
 - o. Maximum allowable pressure (psig)
- H. The type of pump and gpm required are scheduled on the drawings.
 - 1. The head capacities and horsepower are for bidding purposes only.
 - 2. Make pump selection based on actual system calculations.

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- I. Acceptable Manufacturers:
 - 1. Pacific
 - 2. Bell & Gossett
 - 3. Amtrol/Thrush
 - 4. Armstrong
 - 5. Aurora

2.5 SUBMERSIBLE SUMP PUMPS AND SEWAGE EJECTORS

- A. Pump Construction:
 - 1. Hermetically sealed motor
 - 2. Positive action air operated diaphragm switch
 - a. High water alarm contact
 - 3. Housing and base cast iron construction
- B. Provide an alarm terminal cabinet.
 - 1. In the event of a high water alarm, energize a pulsing 2" diameter red signal light with graphic "sump pump high water alarm".
- C. Test the sump pump package by operation of the completed system through four cycles of operation.
 - 1. Fill the sump to operational levels
 - 2. Visually check level controls
 - 3. Pump operation
 - 4. Verify absence of piping leaks, sump leaks, excessive noise, and excessive vibration
 - 5. Verify alarms
 - 6. Verify pump capacity
- D. Sump pump package capacity shall be as scheduled.
- E. Acceptable Manufacturers:
 - 1. Hydromatic
 - 2. Little Giant Pump Co.
 - 3. Weil
 - 4. Goulds
 - 5. Grundfos
 - 6. Crane (Barnes) Air Pumps
 - 7. Ebara
 - 8. Zoeller Pumps

2.6 FLOW INDICATOR

- A. Flow Indicator
 - 1. Bronze Construction
 - 2. Rotating wheel
 - 3. Line Size
 - 4. Double Window
 - 5. Ernst Flow Industries Model EFI E-57-3

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PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install the pumps in accordance with Manufacturer's "Installation, Start-up and Service Instructions".
 - 1. Provide access space around pumps for service.
 - 2. Lubricate pumps prior to start-up.
 - 3. Install hot water circulator horizontally, properly supported to wall, in an accessible location for testing and maintenance at a height not to exceed 60" above finished floor. Install line size Ernst bronze rotating wheel, flow indicator with double window, downstream of circulator.
- B. Provide a line size isolation valve and strainer on the pump suction and a line size silent check valve and balancing valve on the pump discharge.
- C. Support piping adjacent to the pump such that no weight is carried on the pump casing. Decrease from pipe size with eccentric reducer on suction side and concentric increaser on discharge side.
- D. Ensure pumps:
 - 1. Operate at specified system fluid temperatures without vapor binding and cavitation.
 - 2. Are non-overloading in parallel and individual operation.
 - 3. Operate within 25 percent of midpoint of published maximum efficiency curve.
- E. Refer to pump detail on the Contract Drawings for piping accessories to be provided.

3.2 ALIGNMENT FOR BASE MOUNTED PUMPS

- A. Set the pump on a concrete inertia base or concrete housekeeping pad as specified. Anchor, level and grout.
- B. Align the pump and driver in accordance with Hydraulic Institute Standards for centrifugal, rotary and reciprocating pumps.
- C. Realign the pump and driver after initial leveling of pump base before placing the grout and again after the grout has set and the foundation bolts are tightened. Recheck the alignment after the piping has been connected.

3.3 MANUFACTURER START-UP SERVICE ALIGNMENT

- A. After installation, the pumps and motors are to be aligned by the manufacturer or their representative utilizing a dial indicator. After completion, a formal report must be submitted by the Manufacturer to the Engineer prior to final acceptance. This report must include pump serial number, location, beginning and final alignment at a minimum.
 - 1. Technicians, as required, shall be trained and experienced in the work they perform (Contractor start-up / alignment is unacceptable).
- B. Before starting pumps, but after connecting piping:
 - 1. Align shafts and coupling with a precision dial indicator alignment instrument to the minimum tolerances .004 (TIR) per inch of coupling radius or as recommended by the manufacturer, whichever is the greater.
 - 2. Tabulate the actual pump alignment reading with manufacturer's minimum tolerances.

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3. Submit readings for approval.
4. Include the approved readings in the Owner's Maintenance Manual.

3.4 FINAL PUMP FLOW CALIBRATION

- A. Based on the results of the final phases of the test and balance sequences, if the flow of the unthrottled pump is more than 10% above the scheduled values:
 1. Request detailed instructions from the pump manufacturer for the correct impeller diameter.
 2. Trim the impeller to the diameter recommended by the manufacturer, employing precision machinery.
- B. Enter the information on the final configuration of the pump in the Owner's Manual.
 1. Modify the pump nameplate to reflect the correct head and flow data and the impeller diameter.

3.5 SPARE PARTS

- A. Provide the following spare parts and material to the Owner for his use after the warranty period.
 1. A mechanical seal for each pump
 2. A set of bearings for each pump

END OF SECTION

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SECTION 221125

DOMESTIC WATER BOOSTER PUMP

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Variable Speed Packaged Pumping System with VFDs.

1.2 REFERENCE STANDARDS

- A. The work in this section is subject to the requirements of applicable portions of the following standards:
 - 1. ANSI – American National Standards institute
 - 2. ASTM – American Society for Testing and Materials
 - 3. IEEE – Institute of Electrical and Electronics Engineers
 - 4. NEMA – National Electrical Manufacturers Association
 - 5. NEC – National Electrical Code
 - 6. ISO – International Standards Organization
 - 7. UL – Underwriters Laboratories

1.3 SUBMITTALS

- A. Submit shop drawing and product as specified.
- B. Submit manufacturer's certified capacity data.
- C. Submit manufacturer's installation, start-up and service instructions.
 - 1. Electrical Interlocks
- D. Submit wiring diagram.

1.4 SHIPPING, HANDLING AND STORAGE

- A. Deliver, store, protect, and handle in accordance with recommended practices listed in manufacturer's Installation and Maintenance Manuals. All equipment and accessories shall be suitably boxed, crated, covered and protected internally and externally to prevent shipping damage and damage from the weather.
- B. Inspect and report concealed damage to carrier within specified time.
- C. Store in a clean, dry space. Maintain factory protection or cover to keep out dirt, water, construction debris, and traffic (heat enclosures to prevent condensation).

PART 2 – PRODUCTS

2.1 VARIABLE SPEED PACKAGED PUMPING SYSTEM WITH INTEGRATED VARIABLE FREQUENCY DRIVE MOTORS

- A. Furnish and install a prefabricated and tested variable speed packaged pumping system to maintain constant water delivery pressure.

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- B. The packaged pump system shall be a standard product of a single pump manufacturer. The entire pump system including pumps and pump logic controller shall be designed and built by the same manufacturer.
- C. The complete packaged water booster pump system shall be certified and listed by UL (Category QCZJ – Packaged Pumping Systems) for conformance to U.S. and Canadian Standards.

2.2 PUMPS

- A. All pumps shall be ANSI/NSF 61 approved for drinking water.
- B. The pumps shall be of the in-line vertical multi-stage design.
- C. The head capacity curve shall have a steady rise in head from maximum to minimum flow within the preferred operating region. The shut-off head shall be a minimum of 20% higher than the head at the best efficiency point.

- D. Small vertical in-line multi-stage pumps (nominal flow from 3 to 125 gallons per minute) shall have the following features:

- 1. The pump impellers shall be secured directly to the pump shaft by means of a splined shaft arrangement.
- 2. The suction / discharge base shall have ANSI Class 250 flange or internal pipe thread (NPT) connections as determined by the pump station manufacturer.
- 3. Pump Construction:

Suction/discharge base, pump head, motor stool	Cast Iron (Class 30)
Impellers, diffuser chambers, outer sleeve	304 Stainless Steel
Shaft	316 or 431 Stainless Steel
Impeller wear rings	304 Stainless Steel
Shaft journals and chamber bearings	Silicon Carbide
O-rings	EPDM
Shaft couplings for motor flange sizes 184TC and smaller shall be made of cast iron or sintered steel. Shaft couplings for motor flange sizes larger than 184TC shall be made of ductile iron (ASTM 60-40-18)	

- 4. The shaft seal shall be a balanced o-ring cartridge type with the following features:

Collar, Drivers, Spring	316 Stainless steel
Shaft Sleeve, Gland Plate	316 Stainless Steel
Stationary Ring	Silicon Carbide
Rotating Ring	Silicon Carbide
O-Rings	EPDM
The Silicon Carbide shall be imbedded with graphite.	

- 5. Shaft seal replacement shall be possible without removal of any pump components other than the coupling guard, shaft coupling and motor. The entire cartridge shaft seal shall be removable as a one-piece component. Pumps with motors equal to or larger than 15 HP (fifteen horsepower) shall have adequate space within the motor stool so that shaft seal replacement is possible without motor removal.

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- E. Large in-line vertical multi-stage pumps (Nominal flows from 130 to 500 gallons per minute) shall have the following features:
1. The pump impellers shall be secured directly to the smooth pump shaft by means of a split cone and nut design.
 2. The suction / discharge base shall have ANSI Class 125 or Class 250 flange connections in a slip ring (rotating flange) design as indicated in the drawings or pump schedule.
 3. Pump Construction:

Suction/discharge base, pump head	Ductile Iron (ASTM 65-45-12)
Shaft couplings, flange rings	Ductile Iron (ASTM 65-45-12)
Shaft	431 Stainless Steel
Motor Stool	Cast Iron (ASTM Class 30)
Impellers, diffuser chambers, outer sleeve:	304 Stainless Steel
Impeller wear rings	304 Stainless Steel
Intermediate Bearing Journals	Tungsten Carbide
Intermediate Chamber Bearings	Leadless Tin Bronze
Chamber Bushings	Graphite Filled PTFE
O-rings	EPDM
 4. The shaft seal shall be a single balanced metal bellows cartridge with the following construction:

Bellows	904L Stainless Steel
Shaft Sleeve, Gland Plate, Drive Collar	316 Stainless Steel
Stationary Ring	Carbon
Rotating Ring	Tungsten Carbide
O-Rings	EPDM
 5. Shaft seal replacement shall be possible without removal of any pump components other than the coupling guard, motor couplings, motor and seal cover. The entire cartridge shaft seal shall be removable as a one-piece component. Pumps with motors equal to or larger than 15 HP (fifteen horsepower) shall have adequate space within the motor stool so that shaft seal replacement is possible without motor removal.

2.3 INTEGRATED VARIABLE FREQUENCY DRIVE MOTORS

- A. Each motor shall be of the integrated Variable Frequency Drive design consisting of a motor and a variable frequency drive (VFD) built and tested as one unit by the same manufacturer.
- B. The VFD shall be of the PWM (Pulse Width Modulation) design using current IGBT (Insulated Gate Bipolar Transistor) technology.
- C. The VFD shall convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of motor. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor magnetization current suitable for centrifugal pump control and to eliminate the need for motor de-rating.
- D. The VFD shall utilize an energy optimization algorithm to minimize energy consumption. The output voltage

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- E. The VFD shall automatically reduce the switching frequency and/or the output voltage and frequency to the motor during period of sustained ambient temperatures that are higher than the normal operating range. The switching frequency shall be reduced before motor speed is reduced.
- F. An integral RFI filter shall be standard in the VFD.
- G. The VFD shall have a minimum of two skip frequency bands which can be field adjustable.
- H. The VFD shall have internal solid-state overload protection designed to trip within the range of 125% - 150% of rated current.
- I. The integrated VFD motor shall include protection against input transients, phase imbalance, loss of AC line phase, over-voltage, under-voltage, VFD over-temperature, and motor over-temperature. Three-phase integrated VFD motors shall be capable of providing full output voltage and frequency with a voltage imbalance of up to 10%.
- J. The integrated VFD motor shall have, as a minimum, the following input/output capabilities:
 - 1. Speed Reference Signal: 0-10 VDC, 4-20mA
 - 2. Digital remote on/off
 - 3. Fault Signal Relay (NC or NO)
 - 4. Fieldbus communication port (RS485)
- K. The motor shall be Totally Enclosed Fan Cooled (TEFC) with a standard NEMA C-Face, Class F insulation with a temperature rise no higher than Class B.
- L. The cooling design of the motor and VFD shall be such that a Class B motor temperature rise is not exceeded at full rated load and speed at a minimum switching frequency of 9.0 kHz.
- M. Motor drive end bearings shall be adequately sized so that the minimum L10 bearing life is 17,000 hours at the minimum allowable continuous flow rate for the pump at full rated speed.

2.4 PUMP SYSTEM PROGRAMMING

- A. Pump system programming (field adjustable) shall include as a minimum the following:
 - 1. Water shortage protection (analog or digital)
 - 2. Transducer Settings (Suction and Discharge Analog supply/range)
 - 3. PI Controller (Proportional gain and integral time) settings.
 - 4. High System pressure indication and shut-down
 - 5. Low system pressure indication and shut-down
 - 6. Low suction pressure/level shutdown (via digital contact)
 - 7. Low suction pressure/level warning (via analog signal)
 - 8. Low suction pressure/level shutdown (via analog signal)
 - 9. Flow meter settings (if used, analog signal)

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PART 3 - EXECUTION

3.1 FACTORY FABRICATION

- A. All of the above equipment will be mounted on an open structural steel I-beam skid. All piping, pressure sensing lines, pump by-pass, shut-off valves, stuffing box and casing relief valve drains will be firmly anchored to the steel base by means of structural steel supports. All electrical wiring between controllers and drivers will be completed and tested at the factory. The entire package will require one power connection by the electrical contractor.

3.2 INSTALLATION

- A. Installation shall be in accordance with manufacturer's instructions.

3.3 FIELD ACCEPTANCE AND START-UP SERVICE

- A. The service of a factory-trained representative shall be made available on the job site to check installation, field acceptance testing, start-up and instruct operating personnel.
- B. In order to ensure the pump unit is properly coordinated and will function in accordance with the intent of these specifications, all the equipment required to comprise the pump unit will be supplied by the pump manufacturer in whom shall be vested unit responsibility for the proper function of the complete pump unit including the pump, motor or engine, base plate, control equipment and other required accessories.
- C. To verify compliance with this requirement, the pump manufacturer will be required to submit a notarized Certificate of Compliance certifying that all components of the pump unit were in fact supplied by the pump manufacturer and acknowledging its responsibility for the proper function of the unit.

3.4 GUARANTEE

- A. The pumping system shall be guaranteed in writing, by the manufacturer for a period of one year from date of shipment against defect in design, material or construction.

END OF SECTION

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SECTION 221316

SOIL, WASTE AND SANITARY DRAIN PIPING, VENT PIPING AND APPURTENANCES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install piping in buildings and underground laterals to 5 foot outside of building.

1.2 RELATED WORK

- A. Site Work:
 - 1. Sanitary Sewers
 - 2. Excavation, Trenching and Backfilling for Utilities
- B. Division 22 Plumbing:
 - 1. Pipe and Pipe Fittings
 - 2. Plumbing Fixtures and Fixture Carriers
 - 3. Drains, Cleanouts and Hydrants
 - 4. Earthwork

1.3 REFERENCES

- A. CISPI - Cast Iron Soil Pipe Institute
- B. ASTM - American Society for Testing and Materials

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. All No-Hub clamps must have 4 bands minimum. Sizes 5" through 10" shall have six bands minimum.
 - 1. No-Hub Clamps – Sanitary Waste:
 - a. Husky SD 4000
 - 2. No-Hub Clamps - Vents
 - a. Husky SD – 2000
 - b. Mission Rubber Co., LLC Heavy Weight Couplings
 - 3. Clamp-All Hi-TorQ 80 or approved equal
- B. Provide Fernco "Pro-flex" shielded couplings Series 3000 with one piece neoprene gasket for all cast iron pipe transitions to Schedule 40 DWV pipe penetrations through slabs. Sizes 1-1/2" through 8" Series 3000.
- C. Cast Iron Soil Pipe and Fittings:
 - 1. AB&I
 - 2. Charlotte Pipe and Foundry Co.
 - 3. Tyler Pipe / Soil Division

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2.2 DRAIN PIPE AND FITTINGS

- A. Above Slab Pipe:
 - 1. Service weight cast iron hub and spigot pipe and fittings.
 - 2. Compression type, with neoprene gaskets shall conform to ASTM C-564.
 - 3. Pipe shall conform to requirements of ASTM A74.
 - 4. All Cast Iron Soil Pipe and Fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute
- B. Below Slab on Grade Pipe:
 - 1. Service weight/cast iron hub and spigot pipe and fittings
 - 2. Compression type, with neoprene gaskets shall conform to ASTM C-564.
 - 3. Pipe shall conform to requirements of ASTM A74.
 - 4. All Cast Iron Soil Pipe and Fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute

2.3 VENT PIPE AND FITTINGS

- A. Above and Below Slab Pipe.
 - 1. Service weight cast iron bell and spigot pipe and fittings
 - 2. Compression type, with neoprene gaskets shall conform to ASTM C-564.
 - 3. Pipe shall conform to requirements of ASTM A 74.
 - 4. All Cast Iron Soil Pipe and Fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute
- B. Above Slab Pipe.
 - 1. Drainage-waste-vent copper pipe and fittings for waste stub-outs for all fixture locations.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All above and below slab soil, waste, sanitary drain and vent piping installation methods shall be in accordance with Cast Iron Soil Pipe Institute Standards.
- B. Above ground installation in the horizontal position shall be supported at every hub (hub & spigot or hubless type). Hangers are to be placed within 18" of hub or coupling. For large diameter fittings, 5 inches and larger shall be braced to prevent horizontal movement. Every branch opening or change of direction, braces, blocks, rodding or other suitable method shall be used to prevent movement. Riser clamps to be used for each floor, not to exceed 15'-0".
- C. All above and below slab PVC sanitary waste and vent piping installation methods shall be in accordance with IAPMO Installation Standard 18-9 for Schedule 40 PVC-DWV, per manufacturer's recommendations and applicable standards.
- D. Tracer wires shall be installed on all underground PVC sanitary sewer lines installed outside the building slab.
- E. All PVC underground shall be installed in accordance with ASTM D2321.

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3.2 GRADE

- A. Give horizontal pipe grade of 1/4-inch per foot where possible, but not less than 1/8 inch per foot unless otherwise shown.

3.3 DRAIN PIPE AND FITTINGS

- A. Offsets and Fittings.
 - 1. Use reduction fittings to connect two pipes of different diameter.
 - 2. Change directions by appropriate use of 45-degree wyes, long-sweep quarter-bends, and sixth-, eighth-, and sixteenth-bends. Sanitary tees can be used on vertical stacks. Use long sweeps at the base of risers.
 - 3. Provide a separate trap at each fixture, unless a trap is built into the fixture. Provide a deep seal trap at each floor drain and hub drain. Place traps so that the discharge from any fixture will pass through only one trap before reaching a building drain.
 - 4. Refer to Sanitary Drainage Code section for acceptable fittings to be used for changes in direction of drainage flow. Double combo sanitary fittings or double wye and 1/8th bend fittings are not allowed for horizontal to horizontal piping systems per Code.
- B. Hub Drains. Install hub drains where indicated, with the top of the hub 1/2 above the finished floor, unless otherwise indicated on the drawings.
- C. Cleanouts. Install cleanouts the same size as the soil waste lines in which the cleanouts are placed; however, no cleanout should be larger than 4 inches in diameter.
 - 1. Where cleanouts occur in pipe chases, bring the cleanouts through the walls and install covers. Where cleanouts occur in floor slabs, set flush. Reference drawing schedule.
 - 2. Provide cleanouts where soil lines change direction, every 50 foot on long runs, or as shown on the drawings, at the end of each horizontal waste line, and at the base of each riser (and at each increase in pipe size).
 - 3. Cleanouts shall occur at the end of each battery of water closets, urinals, lavatories, sinks, and single water closets. Cleanouts shall be installed so as to access the main sanitary or soil line. Extend and offset above flood rim of water closet.
 - 4. Double sanitary tees and double quarter bends do not allow for easy access to main lines, therefore these types of fittings are not allowed.
- D. Floor Drains. Locate floor drains 1/2-inch below finish floor elevation unless otherwise shown.

3.4 VENT PIPING

- A. Make vent connections to vent stacks with inverted wye fittings. Extend full-size vents through the roof to at least 6 inches above the roof.
- B. Flash the roof penetration with 6 lb. lead flashing approximately 24 inches square. Flange the flashing to the lead sleeve. Extend the flashing up and around the vent pipe. Turn the flashing down inside the pipe at least 2 inches to make a watertight joint. Flashing shall comply with the roofing manufacturer's requirements. Reference the Architectural Drawings for exact requirements.
- C. Locate vent piping through roof a minimum horizontal distance of not less than 20 feet from any air intake opening or supply fan.

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3.5 TESTING

- A. Below Slab on Grade and All Floors in Multi-Story Buildings:
 - 1. Test pipe below slab on grade before backfilling and connecting to city sewers.
 - 2. Maintain not less than 10 foot of hydrostatic head for 1 hour without a leak.
 - 3. Before acceptance of the work the contractor must ensure the piping is in working order before and after the slab is poured. To ensure this the contractor must test completed systems in the presence of the Architect, Engineer and authorities having jurisdiction after installation is complete.
 - 4. Maintain the test on the system till after the slab is poured. Provide an accessible connection that may be reviewed by Architect, Engineer and authorities having jurisdiction prior to and after the slab is poured.
 - 5. Test drainage piping systems in accordance with governing codes and the requirements specified. Provide equipment and materials and make test connections required to execute tests.
 - 6. Test drainage and waste piping hydraulically by filling system to its highest point or, whichever is greater, at a static head of 10 feet. Leaks at any joint shall be sufficient cause for rejection.
 - 7. Air tests may be substituted for hydraulic tests by forcing air into the closed system at a uniform pressure sufficient to balance a column of 10 inch hg in height.
 - 8. Under any of the previously described tests, the water height shall remain constant, after stabilization, for not less than 15 minutes without any further addition of water.
- B. System Test. After the various sections of soil, waste and vent piping are installed, but before fixtures are connected, test the system by:
 - 1. Plugging outlets.
 - 2. Filling vertical sections of multiple story buildings of not less than three floors at a time with water. Provide wyes as required to facilitate plugging.
 - 3. Test for 6 hours without any drop in the water level.

3.6 RODDING SEWERS

- A. All sanitary soil and waste lines, both in the building and out, shall be rodded out and flushed out after completion of construction and prior to finish floor being installed. All work must be completed prior to substantial completion. All floor drains and cleanout locations must be included in this work.
- B. All sanitary soil and waste lines below building 3" and larger shall be internally videotaped at time of substantial completion. All videotaping shall include on-screen date and time, and include audio narration. All videotaping shall be provided by experienced individual in videotaping piping systems. An Owner's Representative shall be present during video-taping. Three copies of the videotape shall be delivered to the Owner for future records.
- C. This work shall be done in the presence of the Owner's Representative, as part of the Contract, to ensure all lines are clear, and any obstruction that may be discovered shall be removed immediately. Rodding shall be accomplished by utilizing the proper rotary head to clear sewer. Pipe sizes 8 inches and larger shall be hydro-flushed.

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3.7 SMOKE TESTING

- A. Interior Plumbing Piping:
1. Contractor shall perform smoke testing on all interior sanitary sewer piping and sanitary vent piping above and below floor prior to cover-up.
 2. Artificially created smoke used must be a persistent white tracer smoke and produced by thermogenic chemical reaction. All smoke candles or smoke pencils to be used must be non-toxic and EPA approved. Provided by Superior Signal Smoke Candles.
 3. All plumbing fixtures must be installed including floor drains with wetted trap seals.
 4. Smoke testing shall be performed after completion of any videotaping, rodding or flushing of the sanitary system. Test must be performed prior to ceiling installation in new construction projects. Smoke is usually injected into the building through the two-way cleanout in the main sewer line leaving the building or a plumbing roof vent or fixture. Smoke will travel through the sanitary sewer and vent system and through the air spaces in the sewer lines and emanate from any leaks in the system. The smoke must reach the last roof vent in the system to indicate the entire system has been completely filled with smoke. The smoke must travel the full length of the piping system. Contractor must provide manpower as necessary to visually trace the flow of smoke through the wall cavities, annular floor/ceiling spaces, inject the smoke, observe the roof vents and to identify the integrity problems.
 5. Contractor shall provide a detailed list of findings and a drawing indicating the location, fixture type, type and size of pipe, and or description of type of problems found.
 6. Typical findings from indoor smoke testing may include:
 - a. Dry traps in floor drains
 - b. Improperly capped sewer lines or vents
 - c. Broken sewer lines or vents
 - d. Cross connected sewer vents and drains
 - e. The drawing of air emanating from sewer vents into intakes of air exchange systems
 - f. Poorly glued pipe joints
 - g. Loose no-hub couplings
 7. An Owner's Representative shall be present during smoke testing.

3.8 SMOKE TESTING – LIQUID SMOKE SYSTEM

- A. Interior Plumbing Piping:
1. Contractor shall perform smoke testing for finding leaks in all interior of building sanitary sewer piping and sanitary vent piping above and below building slab prior to cover up.
 2. Contractor must use a laboratory tested safe liquid smoke with a patented liquid smoke generating system. The liquid smoke must be contained in a pressure tank with inline filter and quick disconnect.
 3. Smoke generating system must generate up to 3 hours or more of continuous and constant smoke. Generating system must have a metering valve to precisely control smoke flow and density. Smoke generating system must have a 4" x 6" industrial flexible mining duct for connection to vent stack or cleanout.
 4. Smoke generating system must be power full enough to push smoke through the smallest leaks.
 5. The liquid smoke must not leave any stains or odors.

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6. The liquid smoke shall not contain Zinc Chloride, a listed toxic compound in OSHA 1915,1000 – Air contaminants.
7. Smoke generating system must have a means to atomize the liquid smoke and have an enclosed fan system capable of up to 700 cfm with adjustable inlet damper control to adjust cfm as necessary for the size of system.
8. Provide Hurco “Power smoker “ with Hurco “LiquiSmoke” system or approved equal.
9. All plumbing fixtures must be installed including floor drains with wetted trap seals.
10. Smoke testing shall be performed after completion of any videotaping, rodding or flushing of the sanitary system. Test must be performed prior to ceiling installation in new construction projects. Smoke is usually injected into the building through the two-way cleanout in the main sewer line leaving the building or a plumbing roof vent or fixture. Smoke will travel through the sanitary sewer and vent system and through the air spaces in the sewer lines and emanate from any leaks in the system. The smoke must reach the last roof vent in the system to indicate the entire system has been completely filled with smoke. The smoke must travel the full length of the piping system. Contractor must provide manpower as necessary to visually trace the flow of smoke through the wall cavities, annular floor/ceiling spaces, inject the smoke, observe the roof vents and to identify the integrity problems.
11. Contractor shall provide a detailed list of findings and a drawing indicating the location, fixture type, type and size of pipe, and or description of type of problems found.
12. Typical findings from indoor smoke testing may include:
 - a. Dry traps in floor drains
 - b. Improperly capped sewer lines or vents
 - c. Broken sewer lines or vents
 - d. Cross connected sewer vents and drains
 - e. The drawing of air emanating from sewer vents into intakes of air exchange systems
 - f. Poorly glued pipe joints
 - g. Loose no-hub couplings
13. An Owner’s Representative shall be present during smoke testing.

END OF SECTION

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SECTION 221413

ROOF DRAINAGE PIPING AND APPURTENANCES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install roof drains, drain pipes and accessories.

1.2 RELATED WORK

- A. Division 22 Plumbing
 - 1. Pipe and Pipe Fittings - General; for general piping requirements.
 - 2. Drains and Cleanouts.
 - 3. Plumbing Piping Insulation.
 - 4. Earthwork

1.3 REFERENCES

- A. CISPI – Cast Iron Soil Pipe Institute
- B. ASTM – American Society for Testing and Materials

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Cast Iron Soil Pipe and Fittings
 - 1. AB&I
 - 2. Charlotte Pipe and Foundry Co.
 - 3. Tyler Pipe / Soil Division

2.2 STORM PIPE AND FITTINGS

- A. Above Ground Pipe. Provide service weight cast iron Hub and Spigot soil pipe and fittings with compression type neoprene gaskets that conform to ASTM C-564. Pipe and fittings shall meet the requirements of ASTM A 74. All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute.
- B. Below Slab on Grade: Provide hot-dip coated service weight cast iron Hub and Spigot soil pipe and fittings with compression type neoprene gaskets. Pipe and fittings shall meet the requirements of ASTM A 74, and gaskets shall conform to ASTM C-564. All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute.
- C. Provide Fernco "Pro-Flex" shielded couplings, Series 3000 with one-piece neoprene gasket for cast iron pipe transitions to Schedule 40 DWV pipe penetrations through slabs. Sizes 2" through 8" use Series 3000.

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PART 3 - EXECUTION

3.1 INSTALLATION

- A. All above and below slab storm piping installation methods shall be in accordance with the Cast Iron Soil Pipe Institute Standards.
- B. Above ground installation in the horizontal position shall be supported at every hub (hub & spigot). Hangers to be placed within 18" of hub or coupling. For large diameter fittings, 5 inches and larger shall be braced to prevent horizontal movement. Every branch opening or change of direction, braces, blocks, rodding or other suitable method shall be used to prevent movement. Riser clamps to be used for each floor, not to exceed 15'-0".
- C. All above and below slab PVC storm piping installation methods shall be in accordance with IAPMO Installation Standard 18-9 for Schedule 40 PVC-DWV, per manufacturer's recommendations and applicable standards, and in accordance with ASTM D2321.

3.2 GRADE

- A. Give horizontal lines minimum grade of 1/8 inch per foot.

3.3 TESTING

- A. Below Slab on Grade and All Floors in Multi-Story Buildings:
 - 1. Test pipe below slab on grade before backfilling and connecting to city sewers.
 - 2. Maintain not less than 10 foot of hydrostatic head for 1 hour without a leak.
 - 3. Before acceptance of the work the contractor must ensure the piping is in working order before and after the slab is poured. To ensure this the contractor must test completed systems in the presence of the Architect, Engineer and authorities having jurisdiction after installation is complete.
 - 4. Maintain the test on the system till after the slab is poured. Provide an accessible connection that may be reviewed by Architect, Engineer and authorities having jurisdiction prior to and after the slab is poured.
 - 5. Test drainage piping systems in accordance with governing codes and the requirements specified. Provide equipment and materials and make test connections required to execute tests.
 - 6. Test drainage and waste piping hydraulically by filling system to its highest point or, whichever is greater, at a static head of 10 feet. Leaks at any joint shall be sufficient cause for rejection.
 - 7. Air tests may be substituted for hydraulic tests by forcing air into the closed system at a uniform pressure sufficient to balance a column of 10 inch hg in height.
 - 8. Under any of the previously described tests, the water height shall remain constant, after stabilization, for not less than 15 minutes without any further addition of water.
- B. System Test. After the various sections of soil, waste and vent piping are installed, but before fixtures are connected, test the system by:
 - 1. Plugging outlets.
 - 2. Filling vertical sections of multiple story buildings of not less than three floors at a time with water. Provide wyes as required to facilitate plugging.
 - 3. Test for 6 hours without any drop in the water level.

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3.4 RODDING SEWERS

- A. All storm sewer lines, both in the building and out, shall be rodded out and flushed out after completion of construction and prior to finish floor being installed. All work must be completed prior to substantial completion. All floor drains and cleanout locations must be included in this work.
- B. All storm lines below building 3" and larger shall be internally video-taped at time of substantial completion. An Owner's Representative shall be present during video-taping. Three copies of the video-tape shall be delivered to the Owner for future records.
- C. This work shall be done in the presence of the Owner's Representative, as part of the Contract, to ensure all lines are clear, and any obstruction that may be discovered shall be removed immediately. Rodding shall be accomplished by utilizing a rotary cutter, which shall be full size of pipe being cleaned for pipe sizes up to 6 inches. Pipe sizes 8 inches and larger shall be hydro-flushed.

END OF SECTION

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SECTION 221423

REINFORCED CONCRETE STORM SEWERS AND APPURTENANCES

PART 1 - GENERAL

1.01 SCOPE

- A. The work includes the construction of reinforced concrete pipe storm sewers and other miscellaneous drainage structures and appurtenances.

1.02 SUBMITTALS

- A. Submit to the Architect/Engineer in conformance with the requirements of the CONDITIONS OF THE CONTRACT.

1.03 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 312333 -Trenching and Backfilling

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Reinforced Concrete Pipe: Reinforced concrete pipe shall conform to the current specifications for reinforced concrete pipe, ASTM Designation C76 of the class shown on the plans. If not otherwise shown on the plans, all reinforced concrete pipes shall be Class III. All pipe shall be machine made by a process that will provide for uniform placement of zero slump concrete in the form and compaction by mechanical devices which will assure a dense concrete in the finished product.
- B. Concrete for Inlets and Appurtenances: Reinforced concrete for inlets shall have a minimum compressive strength at twenty-eight (28) days of 4,000 pounds per square inch and a minimum cement content of five (5) sacks of cement per cubic yard of concrete.
- C. Mortar: Mortar for pipe joints and connections to other drainage structures shall be composed of one (1) part by volume of Portland cement and two (2) parts of sand.

PART 3 - EXECUTION

3.01 BEDDING

- A. All pipe shall receive embedment per the detail on the plans.

3.02 EXCAVATION

- A. Excavation for storm sewer pipes shall consist of performing all excavation of every description and of whatever substance is encountered to the depth required. All excavated material which is not required for backfill or fill shall be removed and disposed of by the Contractor. All excavation shall be made by open cut; banks of trenches shall be kept as nearly vertical as possible and, if required, shall be properly sheeted and braced. For pipes having an inside diameter of thirty-three (33") inches or less, the trench shall be excavated a minimum of sixteen (16") inches wider than the outside diameter of the pipe. The trench shall be excavated a minimum of sixteen (16") inches wider than the outside diameter of the pipe so that a clear space of not less than eight (8") inches is provided on each side of the pipe.

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- B. Cold Applied, Preformed Plastic Gaskets. These preformed gaskets may be used for sealing tongue and groove concrete pipe sewers. The gasket shall be produced from blends of refined hydrocarbon resins and plasticizing compounds reinforced with inert mineral filler and shall contain no solvents, irritating fumes, or obnoxious odors. The gasket joint sealer shall not depend on oxidizing, evaporating, or chemical action for its adhesive or cohesive strength and shall be supplied in extruded rope form of suitable cross section. The gasket joint sealer shall be protected by a removable two-piece wrapper designed so that one-half may be removed longitudinally without disturbing the other half to facilitate application. Preformed gaskets shall be Ram-Nek, as manufactured by K T. Snyder Co., Inc. of Houston, Texas, or approved equal.

3.05 BACKFILL

- A. After the bedding has been prepared and the pipes installed as required, backfill shall be placed in accordance with Section 321313. If the material, when tested, fails to meet the density requirements, the backfill shall be required to be removed and replaced to meet the proper density.
- B. Backfill shall not be placed until the Architect/Engineer or his representative has observed the trench and authorized the placing of backfill. All debris shall be removed from the trench prior to beginning the backfilling operations. Sheet, shoring and bracing shall be pulled and removed during the progress of the backfilling in such a manner to protect the trench and the pipe.
- C. Backfilling shall then be brought up to an elevation slightly above the original ground level to allow for subsequent settlement. The top surface of slopes of all backfill shall be neatly graded off in a workmanlike manner, and where select topsoil, sod, or other material is removed and piled separately, such material shall be carefully replaced in a manner satisfactory to the Architect/Engineer. The top one (1') foot of backfill material shall be of as good quality as the original topsoil which was removed.

3.06 DRAINAGE STRUCTURES

- A. Inlets: Inlets shall be constructed as shown on the drawings. Excavation shall be made with appropriate equipment with a minimum of interference with adjacent improvements and existing utilities. After installation of inlets, all excavated areas which are not occupied by the inlet shall be backfilled with selected materials from the excavation. The backfill material shall be compacted to not less than ninety-five (95%) percent to one hundred (100%) percent of standard density, in accordance with AASHTO T-99.

END OF SECTION

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SECTION 222000

PLUMBING PIPE AND PIPE FITTINGS - GENERAL

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install pipe and pipe fittings for piping systems specified in Division 22 - Plumbing.

1.2 RELATED WORK

- A. Division 22 Plumbing
 - 1. Earthwork
 - 2. Valves, Strainers and Vents
 - 3. Insulation
 - 4. Other Piping Sections

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

- A. The particular type of pipe and fittings for each system is specified in the individual sections.

2.2 JOINTS

- A. Make screwed joints using machine cut USASI taper pipe threads. Apply a suitable joint compound to the male threads only. Ream the pipe to full inside diameter after cutting. All-thread nipples are not permitted.
- B. Dissimilar Metals. Make joints between copper and steel pipe and equipment using insulating unions or couplings such as Crane Company #1259; EPCO as manufactured by EPCO Sales, Inc.; or an approved equal.
- C. Solder joints.
 - 1. Prior to making joints, cut pipe square and ream to full inside diameter. Clean exterior of pipe and socket. Apply a thin coat of suitable fluxing compound to both pipe and socket, and fit parts together immediately.
 - 2. Heat assembled joint only as required to cause the solder to flow. Run the joint full, slightly beaded on the outside, and wipe to remove excess solder.
 - 3. Use silver brazing alloy or Sil-Fos on underground water entry piping. Use lead free solder on all other copper piping.
- D. Make welded joints as recommended by the standards of the American Welding Society. Ensure complete penetration of deposited metal with base metal. Provide filler metal suitable for use with base metal. Keep inside of fittings free from globules of weld metal. The use of mitered joints is not approved.
- E. Flanged.
 - 1. Prior to installation of bolts, center and align flanged joints to prevent mechanical pre-stressing of flanges, pipe or equipment. Align bolt holes to straddle the vertical, horizontal or north-south centerline. Do not exceed 3/64" per foot inclination of the flange face from true alignment.

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2. Use flat-face companion flanges only with flat-faced fittings, valves or equipment. Otherwise, use raised-face flanges.
 3. Install gaskets suitable for the intended service and factory cut to proper dimensions. Secure with manufacturers recommended gasket cement.
 4. Use ANSI nuts and bolts, galvanized or black to match flange material. Use ANSI 316 stainless steel nuts and bolts underground. Tighten bolts progressively to prevent unbalanced stress. Draw bolts tight to ensure proper seating of gaskets.
 5. Use carbon steel flanges conforming to ANSI B16.5 with pipe materials conforming to ASTM A 105 Grade II or ASTM A 108, Grade II, ASTM A 53, Grade B. Use slip-on type flanges on pipe only. Use welding neck type flanges on all fittings. Weld slip-on flanges inside and outside.
 6. Keep flange covers on equipment while fabricating piping. Remove when ready to install in system.
- F. No Hub. Hubless joints shall be made with wide body, neoprene sealing sleeve with stainless steel sleeve, coupling joints conforming to ASTM C 1277.
1. 4" pipe size and smaller coupling housing minimum of 3" width; 24-gauge Series 300 stainless steel with hi-torque clamps; neoprene coupling gasket.
 2. 6" through 10" pipe size coupling housing minimum of 4" width.
 3. Tighten clamps to within manufacturer's tolerances using preset torque wrench.
- G. Mechanical Joints. Provide a stuffing box type mechanical joint adapted to use gasket, cast iron gland and bolts. Coat bolts with bitumastic enamel. Use joint parts similar in design to one of the following:
1. Doublex Simplex Joint manufactured by the American Cast Iron Pipe Company, Birmingham, Alabama.
 2. U.S. joints manufactured by the United States Pipe and Foundry Company, Burlington, New Jersey.
 3. Boltite Joint manufactured by the McWane Cast Iron Pipe Company, Birmingham, Alabama.
 4. Flexlamp manufactured by the National Cast Iron Pipe Company, Birmingham, Alabama.
- H. Compression Joints for Cast Iron Water Pipe. Use Beltite, Tyton or Grip-Tite compression joints. Install in accordance with the manufacturer's recommendations for compression joints. Provide adequate concrete thrust blocks at changes of direction, as recommended by the manufacturer.
- I. Compression Gasket System. Bell and spigot cast iron pipe 4" and smaller, use flax-base lubricant, Tyler Ty-Seal Lubricant or Charlotte Regular Lubricant. 6" and larger use a neoprene base lubricant, Charlotte Adhesive Lubricant.
- J. Ring-Tite Joints: Ring-Tite gasketed sewer fittings for sanitary and storm. Furnish joints for installation manufactured per ASTM/CSA, Ipex, and J.M Eagle C900. Provide adequate concrete thrust blocks at changes in direction, as recommended by manufacturer. JM Eagle Pressure Rated PVC Water Pipe. ASTM D2241 Pressure Rating, ASTM D2129 Joints, Gaskets ASTM F477.
- K. Ball Joints. Where shown, provide flexible ball joints, made of carbon steel. Ball joints must have 15 degrees of angular flexibility. Use welded or flanged ends, as required. Furnish with 11N gaskets.

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- L. Press fittings for copper pipe 1/2" to 4": Copper press fittings shall conform to the material and sizing requirements of ASTM B16.18 or ASME B16.22. O-rings for copper press fittings shall be EPDM. Pro-Press System manufactured by VIEGA. The system intended for use shall be approved by submittal. Systems from various manufacturers may vary in technology. The field personnel shall carry training credentials from the approved manufacturer for the project. Mixing of fittings from different manufacturers is strictly prohibited.

2.3 UNIONS

- A. Use 150 lb. standard (300 lb. WOG) malleable iron, ground joint unions with bronze seat. Provide flanged joints on piping 2-1/2" and larger.
 - 1. Where pipe materials of different types join, use a dielectric union. Union shall be threaded, solder or as required for its intended use.

2.4 BRANCH CONNECTIONS

- A. Pipe 2" and Smaller. For threaded piping, use straight size reducing tee. When branch is smaller than header, a nipple and reducing coupling or swagged nipple may be used.
- B. 2-1/2" through 36": For welding piping, when branch size is the same as header size, use welding tee. Use Weld-o-let when branch is smaller than header. For threaded branch connections, use 3000 lb. full coupling or Thread-o-let welded to header.

2.5 GASKETS

- A. High Temperature Piping. Provide 1/16" thick ring gaskets of aramid reinforced SBR such as Garlock #3200 or 3400 or equal by Advanced Products and Systems.
- B. Other Piping. Provide ring rubber gaskets, Garlock #7992 or equal by Advanced Products and Systems. Use 1/8" thick cloth reinforced neoprene gaskets. For smaller than 6", use 1/16" thick gasket.

2.6 FLOORS AND CEILING PLATES

- A. Provide chrome-plated floor and ceiling plates around pipes exposed to view when passing through walls, floors, partitions, or ceilings in finished areas; size plates to fit pipe or insulation and lock in place.

2.7 DOMESTIC MANUFACTURE

- A. All piping material, pipe and pipe fittings shall be manufactured in the United States of America unless specifically named in these specifications.

PART 3 - EXECUTION

3.1 PIPE FABRICATION AND INSTALLATION

- A. Make piping layout and installation in the most advantageous manner possible with respect to headroom, valve access, opening and equipment clearance, and clearance for other work. Give particular attention to piping in the vicinity of equipment. Preserve the required minimum access clearances to various equipment parts, as recommended by the equipment manufacturer, for maintenance.

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- B. Cut all pipes to measurement determined at the site. After cutting pipe, remove burrs by reaming. Bevel plain ends of ferrous pipe.
- C. Install piping neatly, free from unnecessary traps and pockets. Work into place without springing or forcing. Use fittings to make changes in direction. Field bending and mitering is prohibited. Make connections to equipment using flanged joints, unions or couplings. Make reducing connections with reducing fittings only.
- D. Install piping without tapping out of the bottom of pipe.
- E. Press Connections: Copper and steel press fittings ½" through 4" shall be applied in accordance with the manufacturer's installation instructions. The tubing/pipe shall be fully inserted into the fitting and the tubing/pipe marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing/pipe to assure the tubing/pipe is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool approved by the manufacturer. If soldering (thread adapters, etc.) near press fittings, take precautions to not damage the O-ring fittings. Maintain three pipe diameters or use a cooling agent. Viega-"Pro-Press".

3.2 WELD

- A. Weld and fabricate piping in accordance with ANSI Standard B31.1, latest edition, Code for Pressure Piping.
- B. Align piping and equipment so that no part is offset more than 1/16". Set fittings and joints square and true and preserve alignment during welding operation. Use of alignment rods inside pipe is prohibited.
- C. Do not permit any weld to project within the pipe so as to restrict flows. Tack welds, if used, must be of the same material and made by the same procedure as the completed weld. Otherwise, remove tack welds during welding operation.
- D. Do not split, bend, flatten or otherwise damage piping before, during or after installation.
- E. Remove dirt, scale and other foreign matter from inside piping before tying into existing piping sections, fittings, valves or equipment.
- F. Bevel ends of ferrous pipe.

3.3 OFFSETS AND FITTINGS

- A. Due to the small scale of drawings, the indication of offsets and fittings is not possible. Investigate the structural and finish conditions affecting the work and take steps required to meet these conditions.
- B. Install pipe close to walls, ceilings and columns so pipe will occupy minimum space. Provide proper spacing for insulation coverings, removal of pipe, special clearances, and offsets and fittings.

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3.4 SECURING AND SUPPORTING

- A. Support piping to maintain line and grade, with provision for expansion and contraction. Use approved clevis-type or trapeze-type hangers connected to structural members of the building. Single pipe runs to be supported by approved clevis type hangers. Multiple pipe runs to be supported by approved trapeze type hangers. Do not support piping from other piping or structural joist bridging.
- B. Provide supports both sides of elbows for pipe 6" and larger.
- C. Support vertical risers with steel strap pipe clamps of approved design and size, supported at each floor. Support piping assemblies in chases so they are rigid and self-supported before the chase is closed. Provide structural support for piping penetrating chase walls to fixtures. On cold water pipe, supports shall be outside the insulation.
- D. Where insulation occurs, design hangers to protect insulation from damage. Pipe saddles and insulation shields, where required, are specified in the appropriate insulation section and are sized in accordance with the schedule on the drawings.
- E. Install trapeze hangers, properly sized, to support the intended load without distortion.
- F. Use electro-galvanized or zinc plated threaded rods, nuts, washers and hangers.
- G. At outdoor locations, all supports, brackets and structural members shall be hot-dipped galvanized.
- H. Support spacing: As recommended by the project structural engineer and support manufacturer, but not more than listed below. Not to exceed spacing requirements of smallest pipe.

Pipe Size	Copper & Steel Max. Support Spacing, Feet	Cast Iron Max. Support Spacing, Ft.	Minimum Rod Diameter, Inches
1" & smaller	6		3/8
1-1/4" & 1-1/2"	8	5	3/8
2"	10	5	3/8
3"	10	5	1/2
4" & 5"	10	5	5/8
6" and above	10	5	3/4

3.5 PIPE SUPPORTS

- A. Provide P1001 or P 5000 Unistrut metal framing members and appurtenances for pipe support. Hot-dip galvanize members and appurtenances when located outside. Sagging of pipes or supports is not acceptable.
- B. Adjustable clevis hangers shall be used for single pipe supports; Anvil Fig. 260. When oversized clevis is used, a nipple shall be placed over the clevis bolt as a spacer to assure that the lower U-strap will not move in on the bolt. Provide adjustable clevis with a nut / washer above and below the hanger on the support rod. Ring type clevis hangers are not acceptable.
- C. Provide Anvil Figure 45 galvanized or primed and painted channel assembly for trapeze hangers.

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3.6 PIPE SUPPORTS ON ROOF

- A. Support gas pipe on roof with Portable Pipe Hanger Model PP-10 with roller and fully adjustable height throughout pipe run. Base material shall be high density / high impact polypropylene with UV inhibitors and anti-oxidants. Provide with hot dip galvanized rod finish and framing. Nuts and washers shall be hot dip galvanized.

3.7 ANCHORS

- A. Provide anchors as required. Use pipe anchors consisting of heavy steel collars with lugs and bolts for clamping to pipe and attaching anchor braces. Install anchor braces in the most effective manner to secure desired results. Do not install supports, anchors or similar devices where they will damage construction during installation or because of the weight or the expansion of the pipe. When possible, install sleeves in structural concrete prior to pouring of concrete.

3.8 FLOOR PENETRATIONS

- A. At locations where pipe passes through floors, provide watertight concrete curb around penetration.

3.9 PIPE SLEEVES

- A. Sleeves through masonry and concrete construction:
 - 1. Fabricate sleeves of Schedule 40 galvanized steel pipe.
 - 2. Size sleeve large enough to allow for movement due to expansion and to provide continuous insulation.
- B. Sleeves through gypsum wall construction.
 - 1. Fabricate sleeves of 16-gauge galvanized sheet metal.
- C. Sleeves through elevated slab construction.
 - 1. Fabricate sleeves of Schedule 40 galvanized steel pipe with welded center flange in floor.
- D. Extend each sleeve through the floor or wall. Cut the sleeve flush with each wall surface. Sleeves through floors shall extend 2" above floor lines for waterproofing purposes. Slab on grade floors shall not be sleeved except where penetrating waterproofing membrane or insect control is required.
- E. Caulk sleeves water and airtight. Seal annular space between pipes and sleeves with mastic compound to make the space water and airtight.
- F. For sleeves below grades in outside walls, provide Thunderline Link-Seal or Advance Product and System Interlynx, with 316 stainless steel nuts and bolts, with cast iron pressure plate.
- G. Provide chrome plated escutcheon plates on pipes passing through walls, floors or ceilings exposed to view. At exterior walls, stainless steel sheet metal is to be used.
- H. For sleeves through fire and smoke rated walls, seal with a UL through-penetration firestop, rated to maintain the integrity of the time rated construction. Install in accordance with the manufacturer's installation instructions. Comply with UL and NFPA standards for the installation of firestops. Refer to Architectural drawings for all fire and smoke rated partitions, walls, floors, etc.

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3.10 ISOLATION VALVES

- A. Provide piping systems with line size shutoff valves located at the risers, at main branch connections to mains for equipment, to isolate central plant, and at other locations.

3.11 DRAIN VALVES

- A. Install drain valves at low points of water piping systems so that these systems can be entirely drained. Install a line size drain valve for pipes smaller than 2" unless indicated otherwise. For pipes 2-1/2" and larger, provide 2" drain valves unless indicated otherwise. Drain valves shall be plugged when not in use and at completion.

3.12 CLEANING OF PIPING SYSTEMS

- A. General cleaning of piping systems. Purge pipe of construction debris and contamination before placing the systems in service. Provide and install temporary connections as required to clean, purge and circulate.
- B. Install temporary strainers at the inlet of pumps and other equipment as necessary where permanent strainers are not indicated. Keep strainers in service until the equipment has been tested, then remove either entire strainer or straining element only. Fit strainers with a line size blow down ball valve and pipe to nearest drain. Blow down strainers, remove and clean as frequently as necessary.
- C. Phase One: Initial flushing of system. Remove loose dirt, mill scale, weld beads, rust and other deleterious substances without damage to system components. Open valves, drains, vents and strainers at all system levels during flushing procedures. Flush until "potable water clear" and particles larger than 5 microns are removed.
- D. Connect dead-end supply and return headers, even if not shown on the drawings, and provide terminal drains in bottom of pipe end caps or blind flanges.
- E. Dispose of water in approved manner.
- F. Phase Two: Cleaning of Piping Systems. Remove, without chemical or mechanical damage to any system component, adherent dirt (organic soil), oil, grease, (hydrocarbons), soldering flux, mill varnish, piping compounds, rust (iron oxide) and other deleterious substances not removed by initial flushing. Flush system and replace with clean water.
- G. Phase Three: Final flushing and rinsing: Flush and rinse until "potable water clear" and particles larger than 5 microns are removed. Operate valves to dislodge any debris in valve body. Dispose of water in approved manner.
- H. Submit status reports upon completion of each phase of work on each system.

3.13 TESTING

- A. Test piping after installation with water hydrostatic pressure of 1-1/2 times operating pressure (150 psig minimum) and carefully check for leaks. Repair leaks and retest system until proven watertight.
- B. Do not insulate or conceal piping systems until tests are satisfactorily complete.

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- C. If any leaks or other defects are observed, suspend the test and correct the condition at once. Repeat testing until leaks are eliminated and the full test period is achieved.
- D. The satisfactory completion of testing does not relieve the Contractor of responsibility for ultimate proper and satisfactory operation of piping systems and their accessories.

3.14 PIPE MARKERS

- A. Identify interior exposed piping and piping in accessible chases or plenums with Opti-Code Brady Pressure Sensitive Adhesive Pipe Markers, consisting of pipe marker and direction of flow arrow tape. Clean pipe prior to installation. Background colors of markers, arrows and tape for each type of system shall be the same. Meet ANSI/OSHA standards and clearly identify each system. Provide minimum 2-1/4-inch letters through 4-inch pipe and 4-inch letters for 5-inch pipe and larger.
- B. Identify exterior and mechanical room piping with Snap Around pipe markers through 4-inch pipe and Strap Around markers 5-inch pipe and larger. Pipe markers consisting of pipe marker and direction of flow arrow tape; background colors of markers, arrows and type for each type of system shall be the same. Meet ANSI / OSHA standards and clearly identify each system. Provide minimum 2-1/4-inch letters through 4-inch pipe and 4-inch letters for 5-inch pipe and larger.
- C. Install identification in the following locations:
 - 1. Both sides of penetrations through walls, floors and ceilings.
 - 2. Close to valves or flanges.
 - 3. Intervals on straight pipe runs not to exceed 50 feet
 - 4. Apply marker where view is obstructed.
- D. Pipe markers shall meet or exceed the specifications of the ASME A13.1 "Scheme for Identification of Piping Systems".

END OF SECTION

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SECTION 223333

ELECTRIC WATER HEATER (Commercial ASME)

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Electric water heaters for domestic water systems.

1.2 RELATED WORK

- A. Division 22 Plumbing
 - 1. Domestic Water Piping.
 - 2. Plumbing Piping Insulation.
 - 3. Division 26 Electrical.

1.3 WARRANTY

- A. Provide standard manufacturer's 1 year commercial warranty for mechanical and electrical and 5 year warranty for leaks. Warranty shall start the date of the substantial completion certificate.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Lochinvar.
- B. State.
- C. Rheem / Ruud
- D. A. O. Smith

2.2 PRODUCTS

- A. Provide electric water heaters with kilowatt, recovery ratings, and storage capacities as scheduled on drawings.
- B. Provide an ASME code construction tank designed for 150 psig working pressure. Furnish glass-lined tank. Lining shall be corrosion-resistant.
- C. Furnish factory-assembled, integral units equipped as follows:
 - 1. Immersion thermostat.
 - 2. High temperature limit switch (energy cutout).
 - 3. Low-water cutoff.
 - 4. Heavy duty UL rated for 100,000 cycles.
 - 5. Temperature and pressure relief valve.
 - 6. Anode rod.
- D. Provide heavy-duty, medium watt density elements having nicoloy sheathing and prewired leads.

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- E. The entire vessel shall be enclosed in a round steel enclosure with baked enamel finish and shall enclose the tank with R-16 foam insulation.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
- B. All installations shall be in accordance with the manufacturer's published recommendations.
- C. Furnish all supports required by the equipment included in this Contract.
- D. Provide a 4" thick reinforced concrete housekeeping pad beneath heaters.
- E. Furnish and install all necessary valves, traps, gauges, strainers, unions, etc. to facilitate proper functioning and servicing of equipment.
 - 1. Install a line size shutoff valve in cold water inlet and hot water outlet close to each heater.
 - 2. Provide a temperature gauge in the domestic hot water piping within five feet of outlet to each heater, upstream of all shut-off valves. Size and locate gauges to be easily readable from a standing position.
- F. Provide dielectric isolation device where copper lines connect to ferrous lines or equipment, such as dielectric coupling or dielectric flange fitting.
- G. Route condensate to a vented receiver.
- H. Pipe relief valve discharge and all equipment drains indirectly to appropriate floor drain.
- I. Set the operating and safety controls.
- J. Set thermostats on domestic water heaters to delivery maximum water temperature as indicated on Contract Drawings.
- K. Furnish and install an expansion tank on cold water supply to heater. Locate tank as close to water heater as possible between water heater and all check valves or backflow preventers. Expansion tank capacity shall be as scheduled on Contract Drawings. Install expansion tank in accordance with manufacturer's recommendations.
- L. Install water heater in galvanized drain pan piped to floor drain. Elevate water heater tank bottom above drain pan as to not allow standing water inside of drain pan to touch bottom of tank.

3.2 STARTUP

- A. Startup shall be performed by factory trained and authorized personnel. The factory representative shall also provide a technical and practical operation and maintenance training seminar including a hands-on operation and maintenance demonstration, and classroom presentation with handouts and visual aids, for no less than three physical plant personnel.

END OF SECTION

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SECTION 223334

ELECTRIC WATER HEATER

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Electric water heaters for domestic water systems.

1.2 RELATED WORK

- A. Division 22 Plumbing
 - 1. Domestic Water Piping.
 - 2. Plumbing Piping Insulation.
 - 3. Division 26 Electrical.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Bradford White
- B. State
- C. Rheem/Ruud
- D. A. O. Smith

2.2 PRODUCTS

- A. Provide electric water heaters with kilowatt, recovery ratings, and storage capacities as scheduled on drawings.
- B. Provide a tank designed for 150 psig working pressure. Furnish glass-lined tank. Lining shall be corrosion-resistant.
- C. Furnish factory-assembled, integral units equipped as follows:
 - 1. Extruded high density anode rod.
 - 2. Individually mounted thermostat at each element with a high temperature cutoff.
 - 3. High temperature limit switch (energy cutout).
 - 4. UL rated.
 - 5. Temperature and pressure relief valve.
- D. Provide medium watt density elements having zinc-plated copper sheathing and prewired leads.
- E. The outer jacket shall be baked enamel finish and shall be provided with full size control compartment for performance of service and maintenance through hinged front panels and shall enclose the tank with foam insulation.
- F. Electrical junction box with heavy duty terminal block shall be provided.
- G. Heater shall have a three year limited warranty.

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PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
- B. All installations shall be in accordance with the manufacturer's published recommendations.
- C. Furnish all supports required by the equipment included in this Contract.
- D. Provide a 4" thick reinforced concrete housekeeping pad beneath heaters.
- E. Furnish and install all necessary valves, traps, gauges, strainers, unions, etc. to facilitate proper functioning and servicing of equipment.
 - 1. Install a line size shutoff valve in cold water inlet and hot water outlet close to each heater.
 - 2. Provide a temperature gauge in the domestic hot water piping within five feet of outlet to each heater, upstream of all shut-off valves. Size and locate gauges to be easily readable from a standing position.
- F. Provide dielectric isolation device where copper lines connect to ferrous lines or equipment, such as dielectric coupling or dielectric flange fitting.
- G. Route condensate to a vented receiver.
- H. Pipe relief valve discharge and all equipment drains indirectly to appropriate floor drain.
- I. Set the operating and safety controls.
- J. Set thermostats on domestic water heaters to delivery maximum water temperature as indicated on Contract Drawings.
- K. Furnish and install an expansion tank on cold water supply to heater. Locate tank as close to water heater as possible between water heater and all check valves or backflow preventers. Expansion tank capacity shall be as scheduled on Contract Drawings. Install expansion tank in accordance with manufacturer's recommendations.
- L. Install water heater in galvanized drain pan piped to floor drain. Elevate water heater tank bottom above drain pan as to not allow standing water inside of drain pan to touch bottom of tank.

3.2 STARTUP

- A. Startup shall be performed by factory trained and authorized personnel. The factory representative shall also provide a technical and practical operation and maintenance training seminar including a hands-on operation and maintenance demonstration, and classroom presentation with handouts and visual aids, for no less than three physical plant personnel.

3.3 WARRANTY

- A. Provide standard manufacturer's 1 year commercial warranty for mechanical and electrical and 5 year warranty for leaks. Warranty shall start the date of the substantial completion certificate.

END OF SECTION

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SECTION 223432

GAS-FIRED DOMESTIC WATER HEATER

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Gas-fired domestic hot water heating systems, including hot water heaters, storage tanks, control valves, and pressure and temperature relief valves, as required.

1.2 RELATED ITEMS

- A. Division 22 Plumbing:
 - 1. Domestic Water Piping
 - 2. Gas Piping
 - 3. Flue Piping
 - 4. Plumbing Piping Insulation

1.3 CERTIFICATION

- A. Provide water heater listed by UL Laboratories, according to ANSI Z21.10 Standards governing storage-type water heaters. Must meet ASHRAE/IESNA 90.1-1999 and be design-certified by Underwriter's Laboratories for 180°F water. Must meet SCAQMD Rule 1146.2 for low-nox emissions.

1.4 WARRANTY

- A. Provide standard manufacturer's 1 year commercial warranty for mechanical and electrical and 5 year warranty for leaks. Warranty shall start the date of the substantial completion certificate.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. A.O. Smith
- B. State
- C. Lochinvar
- D. Bradford White

2.2 CAPACITY

- A. Water heaters shall have the storage capacity and gallons per hour recovery at 100°F rise as scheduled.

2.3 TANK

- A. Construct the tank with a 125 psi ASME rating in accordance with the ASME Code, Section IV. Tank shall have a seamless glass-lined steel tank construction.
- B. Powered Anodes.

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2.4 BURNER

- A. A spiral-shaped heat exchanger placed entirely inside the tank which shall be glass-lined on the flue gas side to protect against acidic flue gas condensate.
- B. Heater shall have a down-fired power burner designed for precise mixing of air and gas for optimum efficiency, requiring no special calibration on start-up.

2.5 INSULATION

- A. Insulate the water heater with factory applied foam insulation and trim with a heavy-gauge, enameled steel jacket.

2.6 CONTROLS

- A. Furnish 120V controls for heaters of 100,000 BTUH and above. Controls shall be an integrated solid-state temperature and ignition control device with integral diagnostics, LED fault display capability, and a digital display of temperature system.

2.7 FLUE

- A. This water heater(s) shall be suitable for sealed combustion direct-venting with 4" diameter PVC air intake pipe and 4" diameter PVC exhaust pipe for a total of 70 feet of intake and 70 feet of exhaust. Provide a properly sized thermal expansion tank as scheduled on drawings. Refer to manufacturer's installation instructions for material types used in air intake and exhaust pipe use.

2.8 CARBON MONOXIDE MONITORING SYSTEM

- A. Provide and install a manual reset Carbon Monoxide Detector located within the boiler room when combustion air is ducted to boilers. The Carbon Monoxide Detector and the boilers shall be interlocked so that the burners will not operate when the level of CO in the room rises above 50ppm. The Carbon Monoxide detector shall disable the boiler's burner upon loss of power to the detector.
- B. Carbon Monoxide Sensor with two year warranty by U.S. Draft Co. Model CGM-605 with model XB expansion module.
 - 1. Provided with pre-programmed dry contacts to shut down equipment during unsafe operation.
 - 2. NEMA 1 Enclosure
 - 3. Complies with Texas State Boiler Code 65.603-2015
 - 4. Additional features shall include 0-10 VDC control signal out, visual alarm and audible alarm.
 - 5. Provide expansion board for additional equipment interlocks.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install a line size valve in the cold water supply close to each heater and a line size plug cock in the gas supply close to each heater.
- B. Provide approved dielectric couplings at all cold water and hot water connections to storage tank, and at pressure and temperature relief valve connection.

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- C. Install according to manufacturer's specifications and pipe as shown.
- D. Install water heater in galvanized drain pan piped to floor drain. Provide ¾" outlet connection. Elevate water heater tank bottom above drain pan as to not allow standing water inside of drain pan to touch bottom of tank.
- E. Provide and install acid neutralization box for each heater on condensate from exhaust vent.

3.2 STARTUP

- A. Startup shall be performed by factory trained and authorized personnel. The factory representative shall also provide a technical and practical operation and maintenance training seminar including a hands-on operation and maintenance demonstration, and classroom presentation with handouts and visual aids, for no less than three physical plant personnel.
- B. Startup procedure shall include a functional test of Carbon Monoxide Detector. Simulate an alarm condition and demonstrate the functionality of the detector shutting down the appliances. Owner / Engineer shall be present to witness test.

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SECTION 224000

PLUMBING FIXTURES AND FIXTURE CARRIERS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install water closets, urinals, lavatories, electric drinking fountains, fixture carriers and plumbing appurtenances.

1.2 RELATED WORK

- A. Division 22 Plumbing
 - 1. Drains, Hydrants and Cleanouts
 - 2. Domestic Water Piping
 - 3. Soil, Waste and Sanitary Drain Piping and Vent Piping

1.3 JOB REQUIREMENTS

- A. Furnish plumbing fixtures and trim as shown and specified. Provide faucets, fittings, supply stops and similar devices of a single manufacturer. Furnish faucets and supply stops with renewable seats. Porcelain to steel and enameled cast iron fixtures shall be acid resistant. Wall hung fixtures shall be installed with a fixture carrier.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Plumbing Fixtures (Vitreous China):
 - 1. American Standard
 - 2. Kohler
 - 3. Toto
 - 4. Zurn
- B. Plumbing Faucets:
 - 1. American Standard
 - 2. Chicago
 - 3. T&S Brass
 - 4. Zurn
 - 5. Symmons
 - 6. Speakman
 - 7. Moen Commercial
- C. Supports and Carriers:
 - 1. Wade
 - 2. Zurn
 - 3. J.R. Smith
 - 4. Josam
 - 5. Watts
 - 6. MIFAB

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- D. Flush Valves:
 - 1. Sloan
 - 2. Zurn
 - 3. Moen Commercial

- E. Supplies, Stops and Chrome Plated Tubular Brass:
 - 1. McGuire
 - 2. Kohler
 - 3. Chicago
 - 4. Zurn

- F. Water Closet Seats:
 - 1. Beneke
 - 2. Church
 - 3. Olsonite
 - 4. Bemis
 - 5. Centoco

- G. Electric Drinking Fountains:
 - 1. Halsey Taylor
 - 2. Elkay

- H. Floor Drains:
 - 1. Wade
 - 2. J.R. Smith
 - 3. Josam
 - 4. Zurn
 - 5. Watts
 - 6. Sioux Chief
 - 7. MIFAB

- I. Cleanouts:
 - 1. Wade
 - 2. J.R. Smith
 - 3. Josam
 - 4. Zurn
 - 5. Watts
 - 6. MIFAB

- J. Shower Systems:
 - 1. Bradley
 - 2. Acorn
 - 3. Willoughby

- K. Shower Valves
 - 1. Chicago
 - 2. Acorn
 - 3. Symmons
 - 4. Bradley
 - 5. Moen Commercial

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- L. Shower Stall
 - 1. Aquabath
 - 2. Aquatic
 - 3. Aquarius
 - 4. Best Bath Systems (Access)

- M. Stainless Steel Sinks:
 - 1. Elkay
 - 2. Just
 - 3. Griffin
 - 4. Moen Commercial
 - 5. Amtekco Industries

- N. Mop Sinks:
 - 1. Crane Fiat
 - 2. Stern Williams
 - 3. Acorn
 - 4. CECO

- O. Service Sinks:
 - 1. American Standard
 - 2. Kohler
 - 3. Eljer
 - 4. CECO

- P. Roof Drains:
 - 1. Wade
 - 2. J.R. Smith
 - 3. Josam
 - 4. Zurn
 - 5. Watts
 - 6. MIFAB

- Q. Thermostatic Mixing Valves
 - 1. Lawler
 - 2. Symmons
 - 3. Leonard
 - 4. Powers
 - 5. Holby
 - 6. Bradley

- R. Emergency Safety Equipment
 - 1. Speakman
 - 2. Bradley
 - 3. Encon
 - 4. Guardian
 - 5. Haws

- S. Shock Arrestors:
 - 1. Precision Products
 - 2. Sioux Chief

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- T. Backflow Preventors
 - 1. Watts
 - 2. Febco
 - 3. Wilkins
 - 4. Beeco

- U. Hose Bibbs
 - 1. Wade
 - 2. Chicago
 - 3. Josam
 - 4. Woodford
 - 5. Zurn
 - 6. J.R. Smith
 - 7. MIFAB

- V. Wall Hydrants
 - 1. Wade
 - 2. Woodford
 - 3. Zurn
 - 4. J.R. Smith
 - 5. Josam
 - 6. MIFAB

- W. Solids Interceptors
 - 1. Wade
 - 2. J.R. Smith
 - 3. Zurn
 - 4. Josam
 - 5. MIFAB

2.2 REQUIREMENTS

- A. Refer to the drawings for equipment to be supplied.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with the manufacturer's instructions.
- B. Make rough-in and final connection of service to each fixture provided under this Section and other Sections or Architectural or Plumbing Drawings.
- C. Provide necessary stops, valves, traps, unions, vents, cold water, hot water, sanitary, etc. for a complete installation.
- D. Provide isolation valves in domestic water lines to isolate all equipment, restrooms, hose bibbs, and where shown on drawings.
- E. Remove piping and services roughed-in incorrectly and install correctly, without cost.
- F. Exposed piping, fittings and appurtenances shall be chrome-plated brass.

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- G. Coordinate with the Contractor for locations and service required for each plumbing fixture.
- H. All floor drains and floor sinks shall have trap primer connections. Provide trap primer valves and 1/2-inch water line to each floor drain connection. Trap primer supply line shall have ball valve and Y strainer on inlet side of trap primer valve to facilitate cleaning.
- I. All floor drains and floor sink locations are to be coordinated with all equipment. Locate drains in mechanical equipment spaces to conform to drain locations of equipment furnished. Coordinate drain location with food service equipment and Architectural Drawings.
- J. All floor drains, floor sinks and cleanout covers are to be provided with stainless steel vandal resistant screws.
- K. Trap primer valves installed in concealed spaces shall have approved access doors for accessibility.

END OF SECTION

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SECTION 226311

GAS PIPING AND APPURTENANCES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install steel gas pipe inside buildings, including the supply line from the meter, service lines to gas equipment and appliances, termination of the service line with a plug valve, drip leg, and final connection to equipment and appliances with unions.
- B. Coordinate service line from utility main and extend to meter. Coordinate installation of the service line and meter with Gas Company.
- C. Extend steel gas piping from meter to inside the building to all fixtures, appliances and equipment requiring gas.

1.2 RELATED WORK

- A. Division 22 Plumbing
 - 1. Plumbing Pipe and Fittings
 - 2. Valves and Vents

1.3 UTILITY CONNECTIONS

- A. Make arrangements for and pay all fees and connection charges for obtaining service to the building.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS - ABOVE GRADE:

- A. Pipe 2 inch and Smaller:
 - 1. Schedule 40 ASTM A 53 black steel pipe
 - 2. Factory fabricated socket weld fittings.
- B. Pipe Larger than 2 inches:
 - 1. Schedule 40 ASTM A 53 black steel pipe.
 - 2. Factory fabricated butt weld fittings for welded steel pipes shall conform to ASTM A-234 WPB (seamless weld fittings).
- C. Unions:
 - 1. Standard 150 lb. (300 lb. water, oil or gas) malleable iron.
 - 2. Ground joint unions, with bronze seat.
 - 3. Flange joints for pipe larger than 2 inch in diameter.
- D. Flanges:
 - 1. Steel flanges. ANSI B16.5 and ASTM A-105.

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2.2 PIPE AND FITTINGS - BELOW GRADE OUTSIDE BUILDING

- A. Polyethylene pipe shall be ASTM D3350 Grade PE24 cell classification and ASTM D1248 Class B material classification.
- B. Pipe shall be medium density polyethylene PE 2406 and PE 2708 manufactured by Poly Pipe Industries, Inc. or Performance Pipe.
- C. Polyethylene yellow molded butt fittings for use with medium density polyethylene pipe shall meet testing requirements of ASTM D2513 and resin material listing of ASTM D3350 with PPI designation of PE 2406 as manufactured by Central Plastics Co.

2.3 VALVES

- A. See Section 22 05 23.

2.4 GAS PRESSURE REGULATOR

- A. Size the gas pressure regulator in accordance with the manufacturer's recommendations for flow quantities and reduced pressure as required for all equipment. Coordinate final equipment gas pressure requirements prior to ordering regulators. Provide American Meter Company regulators or approved equal, suitable for outdoor installation. Regulators outside exposed to weather shall be installed with vent in vertical down position.
- B. All line pressure regulators shall be listed ANSI (American National Standard) E2.180A-2000 and CSA (Canadian Standards Association Standard) CGA6.22A-M00.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation Standards: Install gas piping in accordance with recommendations of the National Fire Protection Association.
- B. Drip Legs: Install a capped drip leg 6 inches long at the base of each vertical rise.
- C. Coating and Wrapping. Coat and wrap underground piping in accordance with the service utility company standards.
- D. Sleeves.
 - 1. Encase gas piping running in or through solid partitions with thin wall metal conduit. Sleeve piping and fittings shall be two pipe sizes, but not less than 1 inch larger than encased gas piping.
 - 2. Encase gas piping running below slab in Schedule 40 PVC, minimum size two pipe sizes larger than gas pipe. Vent sleeve to atmosphere with a 1-1/2 inch vent with 1-1/2 inch return bend above building roof. Seal ends of sleeve with UL fire rated caulk.
 - 3. Encase gas piping running below sidewalks, parking lots, slab, etc. with thin wall metal conduit. Sleeve piping and fittings shall be two pipe sizes, but not less than 1 inch larger than encased gas piping.
- E. Do not install gas piping exposed to view inside public area, or occupied spaces, without prior written approval.

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- F. Weld all gas piping above grade.
- G. Provide test ports and isolation valves to enable proper testing of system in the future.
- H. Provide isolation valve and unions across regulators for proper removal.
- I. Provide transition risers where below grade polyethylene pipe changes to steel pipe above grade.
- J. Gas Pressure Regulators / Vents:
 - 1. Piping shall be sized in accordance with the regulator manufacturer's instructions. Never use pipe sizes smaller than the vent size; smaller pipe sizes restrict the gas flow. Where there is more than one regulator at a location, each regulator shall have a separate vent to the roof / outdoors.
 - 2. Support the vent pipe to eliminate strain on the regulator diaphragm case.
 - 3. Install vent piping from regulators to location to prevent gas smells from entering building. Do not locate the vent line terminus near windows, fans, or other ventilation equipment. See the installation instructions furnished with the regulator.
 - 4. Install double elbows and insect screen at end of piping to prevent moisture and insects from entering. Always point outdoor vent pipes in the downward position to reduce the possibility of rain, snow, sleet, and other moisture entering the pipe.
 - 5. When installed inside building route vents horizontally and terminate through building sidewall. The vent must be piped to the outside atmosphere using the shortest length of pipe, the fewest possible pipe elbows, and a pipe diameter as large as the vent size or larger. If a long gas run must be used, increase the pipe one nominal size every ten feet to keep the flow restriction as low as possible. Vents terminating through roof must have prior approval from Architect before installation. Through roof penetrations shall be minimized.
 - 6. Regulators installed outside or on roof top: Install regulator vent turned downward with insect screen over vent opening. The vent shall be designed to prevent the entry of water, insects, or other foreign materials that could cause blockage.
 - 7. Ensure the end of the vent line is away from ANY potential ignition sources. It is the installer's responsibility to ensure the vent line is exhausting to a safe environment
 - 8. Where low pressure line regulators have inlet pressure exceeding 2 psi, a downstream over-pressure protection device (OPD) shall be installed in accordance with ANSI Z21.80.
 - 9. Medium pressure regulators shall have a capped tee fittings (sediment trap) upstream from the regulator and a capped tee fitting installed not less than 10 pipe diameters downstream of the regulator.
 - 10. All over pressure protection devices (OPD) shall be vented to the exterior.

3.2 TESTING GAS PIPING

- A. Preliminary gas test as required by Code, but minimum test pressure of 50 PSI held for not less than eight hours without noticeable drop.
- A. Preliminary gas test as required by code and local AHJ.
- B. Test joints with a soap solution while lines are under pressure.
- C. Repair leaks.

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- D. Final gas test shall be with a 24-inch column of mercury or a diaphragm gauge with a minimum dial size of 3-1/2 inches with a set hand and a pressure range not to exceed twenty (20) psig with 2/10-pound increments. The minimum test pressure shall not be less than ten (10) psi and the maximum test pressure shall not exceed twelve (12) psig. This test will be observed for no less than (30) thirty minutes with no drop in pressure.
- E. Provide copy of gas pressure test reports in Operations & Maintenance Manual.
- F. Provide Railroad Commission of Texas Pipeline Safety Form PS-86B.
 - 1. To find form online, go to Texas School Gas Test Form.
- G. School renovations projects shall have all gas piping tested. Report and document gas leaks found to the Architect and Engineer. Repair leaks at no additional cost to the Owner.

3.3 IDENTIFICATION CONDUCTOR

- A. Spiral A #12 AWG insulated copper conductor the full length of the thermoplastic piping system. Fasten to the pipe at 3-foot intervals with plastic tie wraps.
- B. Terminate at each end in a 12-inch x 12-inch x 4 inch FRP junction box.
 - 1. Bolted gasketed cover with stainless steel screws.
 - 2. Screw type terminal strip.
 - 3. Legend on cover "gas pipe identification conductor."
- C. Set in concrete pad.

3.4 PAINT EXPOSED OUTSIDE GAS PIPE

- A. Interior and Exterior Gas piping shall be protected from rust.
- B. Paint pipe with a flat alkyd coating, clean pipe prior to painting by preparing surface by hand tool cleaning per SSPC-SP2-82, applying one coat of Glidden Y-590 Rustmaster Metal Primer White and topcoat of Yellow Alkyd Flat Enamel.

END OF SECTION

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SECTION 230100

HVAC OPERATING AND MAINTENANCE MANUALS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Compilation product data and related information appropriate for Owner's operation and maintenance of products furnished under Contract. Prepare operating and maintenance data as specified.
- B. Instruct Owner's personnel in operation and maintenance of equipment and systems.
- C. Submit three copies of complete manual in final form.

1.2 SUBMITTALS

- A. Thirty (30) days after the Contractor has received the final scheduled identified submittals bearing the Architect/Engineer's stamp of acceptance (including resubmittals), submit for review one copy of the first draft of the Operating and Maintenance Manual. This copy shall contain as a minimum:
 - 1. Table of Contents for each element.
 - 2. Contractor information.
 - 3. All submittals, coordination drawings and product data, reviewed by the Architect/Engineer, bearing the Architect/Engineer's stamp of acceptance. (When submittals are returned from Engineer "Correct as Noted", corrected inserts shall be included.)
 - 4. All parts and maintenance manuals for items of equipment.
 - 5. Warranties (without starting dates)
 - 6. Certifications that have been completed. Submit forms and outlines of certifications that have not been completed.
 - 7. Operating and maintenance procedures.
 - 8. Form of Owner's Training Program Syllabus (including times and dates).
 - 9. Control operations/equipment wiring diagrams.
 - 10. Schedule of filters for each item of equipment.
 - 11. Schedule of belts for each item of equipment.
 - 12. Other required operating and maintenance information that are complete.
- B. Copy will be returned to the Contractor within 15 days with comments for corrections.
- C. Submit three (3) completed manuals in final electronic form to the Architect/Engineer one day after substantial completion, and prior to Owner's instructions. Include all specified data, test and balance reports, drawings, dated warranties, certificates, reports, along with other materials and information.
- D. The Architect/Engineer will review the manuals for completeness within fifteen (15) days.
- E. The Contractor shall be notified of any missing or omitted materials. The Manuals shall be reworked by the Contractor, as required, in the office of the Architect / Engineer. The manuals will not be retransmitted.
- F. Two (2) complete electronic Manuals will be delivered to the Owner.

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PART 2 - PRODUCTS

2.1 BINDERS

- A. Commercial quality black three-ring binders with clear overlay plastic covers.
- B. Minimum ring size: 1".
Maximum ring size: 3".
- C. When multiple binders are used, correlate the data into related groupings.
- D. Label contents on spine and face of binder with full size insert. Label under plastic cover.

PART 3 - EXECUTION

3.1 OPERATION AND MAINTENANCE MANUAL

- A. Form for Manuals:
 - 1. Prepare data in form of an instructional manual for use by Owner's personnel.
 - 2. Format:
 - a. Size: 8-1/2" x 11".
 - b. Text: Manufacturer's printed data or neatly typewritten.
 - 3. Drawings:
 - a. Provide reinforced punched binder tab and bind in text.
 - b. Fold larger drawings to size of text pages.
 - 4. Provide flyleaf indexed tabs for each separate product or each piece of operating equipment.
 - 5. Cover: Identify each volume with typed or printed title "Operating and Maintenance Instructions". List:
 - a. Title of Project
 - b. Identity of separate structures as applicable.
 - c. Identity of general subject matter covered in the manual.
 - 6. Binder as specified.
- B. Content of Manual:
 - 1. Neatly typewritten Table of Contents for each volume arranged in systematic order as outlined in the specifications.
 - a. Contractor, name of responsible principal, address and telephone number.
 - b. A list of each product required to be included, indexed to content of the volume.
 - c. List with each product, name, address and telephone number of:
 - 1) Subcontractor or installer.
 - 2) Maintenance contractor as appropriate.
 - 3) Identify area of responsibility of each.
 - 4) Local source of supply for parts and replacement.
 - d. Identify each product-by-product name and other identifying symbols as set forth in Contract Documents.
 - 2. Product Data:
 - a. Include those sheets pertinent to the specific product.
 - b. Annotate each sheet to:
 - 1) Identify specific product or part installed.
 - 2) Identify data applicable to installation.
 - 3) Delete references to inapplicable information. (All options not supplied with equipment shall be marked out indicated in some manner.

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3. Drawings:
 - a. Supplement product data with drawings as necessary to illustrate:
 - 1) Relations of component parts of equipment and systems.
 - 2) Control and flow diagrams.
 - b. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
 - c. Do not use Project Record Documents as maintenance drawings.
 4. Written text, as required to supplement product data for the particular installation:
 - a. Organize in consistent format under separate headings for different procedures.
 - b. Provide logical sequence of instructions for each procedure.
 5. Copy of each warranty, bond and service contract issued.
 - a. Provide information sheet for Owner's personnel, giving:
 - 1) Proper procedures in event of failure.
 - 2) Instances that might affect validity of warranties or bonds.
 6. Shop drawings, coordination drawings and product data as specified.
- C. Sections for Equipment and Systems.
1. Content for each unit of equipment and system as appropriate:
 - a. Description of unit and component parts.
 - 1) Function, normal operating characteristics, and limiting conditions.
 - 2) Performance curves, engineering data and tests.
 - 3) Complete nomenclature and commercial number of replaceable parts.
 - b. Operating procedures:
 - 1) Start up, break-in, routine and normal operating instructions.
 - 2) Regulation, control, stopping, shut down and emergency instructions.
 - 3) Summer and winter operating instructions.
 - 4) Special operating instructions.
 - c. Maintenance procedures:
 - 1) Routine operations
 - 2) Guide to troubleshooting.
 - 3) Disassembly, repair and reassembly.
 - 4) Alignment, adjusting and checking.
 - 5) Routine service based on operating hours.
 - d. Servicing and lubrication schedule. List of lubricants required.
 - e. Manufacturer's printed operating and maintenance instructions.
 - f. Description of sequence of operation by control manufacturer.
 - g. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
 - 1) Predicted life of part subject to wear.
 - 2) Items recommended to be stocked as spare parts.
 - h. As installed control diagrams by controls manufacturer.
 - i. Complete equipment internal wiring diagrams.
 - j. Schedule of filters for each air handling system.
 - k. Schedule of belts for each item of equipment.
 - l. Each Contractor's coordination drawings.
 - m. As installed color coded piping diagrams.
 - n. Charts of valve tag number, with location and function of each valve.
 - o. List of original manufacturer's spare parts and recommended quantities to be maintained in storage.
 - p. Other data as required under pertinent sections of the specifications.

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2. Prepare and include additional data when the need for such data becomes apparent during instruction of Owner's personnel.
3. Additional requirements for operating and maintenance data as outlined in respective sections of specifications.
4. Provide complete information for products specified in Division 23.
5. Provide certificates of compliance as specified in each related section.
6. Provide start up reports as specified in each related section.
7. Provide signed receipts for spare parts and material.
8. Provide training report and certificates.
9. Provide extended compressor warranty certificates.

END OF SECTION

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SECTION 230500

MECHANICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Except as modified in this Section, General Conditions, Supplementary Conditions, applicable provisions of the General Requirements, and other provisions and requirements of the contract documents apply to work of Division 23 Mechanical.
- B. Applicable provisions of this section apply to all sections of Division 23, Mechanical.

1.2 CODE REQUIREMENTS AND FEES

- A. Perform work in accordance with applicable statutes, ordinances, codes and regulations of governmental authorities having jurisdiction.
- B. Mechanical work shall comply with applicable inspection services:
 - 1. Underwriters Laboratories
 - 2. National Fire Protection Association
 - 3. State Health Department
 - 4. Local Municipal Building Inspection Department
 - 5. Texas Department of Licensing & Regulations (ADA)
- C. Resolve any code violations discovered in contract documents with the Engineer prior to award of the contract. After Contract award, any correction or additions necessary for compliance with applicable codes shall be made at no additional cost to the Owner.
- D. This Contractor shall be responsible for being aware of and complying with asbestos NESHAP regulations, as well as all other applicable codes, laws and regulations.
- E. Obtain all permits required.

1.3 CONTRACTOR'S QUALIFICATIONS

- A. An approved contractor for the work under this division shall be:
 - 1. A specialist in this field and have the personnel, experience, training, skill, and organization to provide a practical working system
 - 2. Able to furnish evidence of having contracted for and installed not less than 3 systems of comparable size and type that has served their Owners satisfactorily for not less than 3 years

1.4 REFERENCE SPECIFICATIONS AND STANDARDS

- A. Materials which are specified by reference to Federal Specifications; ASTM, ASME, ANSI, or AWWA Specifications; Federal Standards; or other standard specifications must comply with latest editions, revisions, amendments or supplements in effect on date bids are received. Requirements in reference specifications and standards are minimum for all equipment, material, and work. In instances where specified capacities, size, or other features of equipment, devices, or materials exceed these minimums, meet specified capacities.

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1.5 CONTRACT DRAWINGS

- A. Contract drawings are diagrammatic only and do not give fully dimensioned locations of various elements of work. Determine exact locations from field measurements.

1.6 PROJECT RECORD DOCUMENTS

- A. Maintain at the job site a separate set of white prints (black line) of the contract drawings for the sole purpose of recording the "as-built" changes and diagrams of those portions of work in which actual construction is at variance with the contract drawings. Mark the drawings with a colored pencil. Prepare, as the work progresses and upon completion of work, reproducible drawings clearly indicating locations of various lines, valves, ductwork, traps, equipment, and other pertinent items, as installed. Include flow-line elevation of sewer lines. Record existing and new underground and under slab piping with dimensioned locations and elevations of such piping.
- B. At the conclusion of project, obtain without cost to the Owner, erasable mylars of the original drawings and transfer as-built changes to these. Prior to transmittal of corrected drawings, obtain 3 sets of blue line prints of each drawing, regardless of whether corrections were necessary and include in the transmittal (2 sets are for the Owner's use and one set is for the Architect/Engineer's records). Delivery of these as-built prints and reproducibles is a condition of final acceptance. Provide record drawings on one set each (reproducible Dayrex mylar film positives) and Revit CAD files on disk (CD Rom).
- C. As-Built drawings should indicate the following information as a minimum:
 - 1. Indicate all addendum changes to documents.
 - 2. Remove Engineer's seal, name, address and logo from drawings.
 - 3. Mark documents RECORD DRAWINGS.
 - 4. Clearly indicate: DOCUMENT PRODUCED BY
 - 5. Indicate all changes to construction during construction. Indicate actual routing of all piping, ductwork, etc. that were deviated from construction drawings.
 - 6. Indicate exact location of all underground mechanical piping and elevation.
 - 7. Indicate exact location of all underground electrical raceways and elevations.
 - 8. Correct schedules to reflect (actual) equipment furnished and manufacturer.
 - 9. Location and size of all ductwork and mechanical piping above ceiling including exact location of isolation of domestic and mechanical valves.
 - 10. Exact location of all electrical equipment in and outside of the building.
 - 11. Exact location of all roof mounted equipment, wall, roof and floor penetrations.
 - 12. Cloud all changes.

1.7 SPACE REQUIREMENTS

- A. Consider space limitations imposed by contiguous work in selection and location of equipment and material. Do not provide equipment or material that is not suitable in this respect.

1.8 RELATION WITH OTHER TRADES

- A. Carefully study all matters and conditions concerning the project. Submit notification of conflict in ample time to prevent unwarranted changes in any work. Review other Divisions of these specifications to determine their requirements.
- B. Because of the complicated relationship of this work to the total project, conscientiously study the relation and cooperate as necessary to accomplish the full intent of the documents.

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- C. Provide sleeves and inserts in forms as required for the work. Stub up and protect open ends of pipe before any concrete is placed. Furnish sizes of required equipment pads. Furnish and locate bolts and fittings required to be cast in them.
- D. Locate and size openings required for installation of work specified in this Division in sufficient time to prevent delay in the work.
- E. Refer to other Divisions of the specifications for the scope of required connections to equipment furnished under that Division. Determine from the Contractor for the various trades, the Owner, and by direction from the Architect/Engineer, the exact location of all items.

1.9 CONCEALED AND EXPOSED WORK

- A. When the word "concealed" is used in connection with insulating, painting, piping, ducts and the like, the work is understood to mean hidden from sight as in chases, furred spaces or above ceilings. "Exposed" is understood to mean open to view.

1.10 GUARANTEE

- A. Guarantee work for 1 year from the date of substantial completion of the project. During that period make good any faults or imperfections that may arise due to defects or omissions in material, equipment or workmanship. At the Owner's option, replacement of failed parts or equipment shall be provided.
- B. The equipment shall be checked out and started by a factory authorized representative from the equipment manufacturer. Visual and mechanical inspection of installation, initial startup and operational training shall be performed. A signed service report shall be submitted after equipment is operational. The manufacturer shall guarantee that all components and systems to be free from defects in material and workmanship during the warranty period.

1.11 MATERIAL AND EQUIPMENT

- A. Furnish new and unused materials and equipment meeting the requirements of the paragraph specifying acceptable manufacturers. Where two or more units of the same type or class of equipment are required, provide units of a single manufacturer.

1.12 NOISE AND VIBRATION

- A. Select equipment to operate with minimum noise and vibration. If objectionable noise or vibration is produced or transmitted to or through the building structure by equipment, piping, ducts or other parts of work, rectify such conditions at no additional cost. If the item of equipment is judged to produce objectionable noise or vibration, demonstrate at no additional cost that equipment performs within designated limits on a vibration chart.

1.13 ACCEPTABLE MANUFACTURERS

- A. Manufacturers names and catalog number specified under sections of Division 23 are used to establish standards of design, performance, quality and serviceability and not to limit competition. Equipment of similar design, equal to that specified, manufactured by a named manufacturer will be acceptable on approval. A request for prior approval of equipment not listed must be submitted ten (10) days before bid due date. Submit complete design and performance data to the Engineer.

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1.14 OPERATING TESTS

- A. After all mechanical systems have been completed and put into operation, subject each system to an operating test under design conditions to ensure proper sequencing and operation throughout the range of operation. Tests shall be made in the presence of the Architect/Engineer. Make adjustments as required to ensure proper functioning of all systems. Special tests on individual systems are specified under individual sections. Submit 3 copies of all certifications and test reports adequately in advance of completion of the work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

1.15 WARRANTIES

- A. Submit 3 copies of all warranties and guarantees for systems, equipment, devices and materials. These shall be included in the Operating and Maintenance Manuals.

1.16 BUILDING CONSTRUCTION

- A. It shall be the responsibility of each sub-contractor to consult the Architectural and Engineering drawings, details, and specifications and thoroughly familiarize himself with the project and all job-related requirements. Each sub-contractor shall cooperate with the General Contractor to verify that all piping and other items are placed in the walls, furred spaces, chases, etc., so there will be no delays in the job.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 OPENINGS

- A. Framed, cast or masonry openings for ductwork, equipment or piping are specified under other divisions. Drawings and layout work for exact size and location of all openings are included under this division.

3.2 AIR FILTERS AND PIPE STRAINERS

- A. Immediately prior to substantial completion of the project, inspect, clean and service air filters and strainers. Replace air filters.

3.3 LUBRICATION, REFRIGERANT AND OIL

- A. Provide a complete charge of correct lubricant for each item of equipment requiring lubrication.
- B. Provide a complete and working charge of proper refrigerant, free of contaminants, into each refrigerant system. After each system has been in operation long enough to ensure completely balanced conditions, check the charge and modify for proper operation as required.
- C. Provide a complete charge of special oil for refrigeration use, suitable for operation with refrigerant, in each system.

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3.4 HOUSEKEEPING PADS

- A. Provide equipment housekeeping pads under all floor mounted and ground mounted HVAC equipment, and as shown on the drawings.
- B. Concrete work as specified in Division 3.
- C. Concrete pads:
 - 1. 4" high, rounded edges, minimum 2500 psi unless otherwise indicated on the drawings
 - 2. Chamfer strips at edges and corner of forms.
 - 3. Smooth steel trowel finish.
 - 4. Doweled to existing slab
- D. Install concrete curbs around duct penetrations or multiple pipe penetrations.

3.5 INSTRUCTION OF OWNER'S PERSONNEL

- A. Prior to final inspection, conduct an on-site training program to instruct the Owner's operating personnel in the operation and maintenance of the mechanical systems.
 - 1. Provide the training during the Owner's regular working day.
 - 2. The instructors shall each be experienced in their phase of operation and maintenance of building mechanical systems and with the project.
- B. Time to be allocated for instructions.
 - 1. Minimum of 8 hours dedicated instructor time.
 - 2. 4 hours on each of 2 days.
- C. Before proceeding with the on-site training program, submit the program syllabus; proposed time and dates; and other pertinent information for review and approval.
 - 1. One copy to the Owner.
 - 2. One copy to the Architect/Engineer.
- D. The Owner will provide a list of personnel to receive instructions and will coordinate their attendance at the agreed upon times.
- E. Use the operation and maintenance manuals as the basis of instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
- F. Demonstrate start-up, operation, control, adjustment, troubleshooting, servicing, maintenance, and shut down of each item of equipment.
- G. Demonstrate equipment functions (both individually and as part of the total integrated system).
- H. Prepare and insert additional data in the operating and maintenance manuals when the need for additional data becomes apparent during instructions.
- I. Submit a report within one week after completion of the training program that instructions have been satisfactorily completed. Give time and date of each demonstration and hours devoted to the demonstration, with a list of people present.

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- J. At the conclusion of the on-site training program, have the person designated by the Owner sign a certificate to certify that he/she has a proper understanding of the system, that the demonstrations and instructions have been satisfactorily completed, and the scope and content of the operating and maintenance manuals used for the training program are satisfactory.
- K. Provide a copy of the report and the certificate in an appropriately tabbed section of each Operating and Maintenance Manual.

3.6 EQUIPMENT IDENTIFICATION

- A. Provide a laminated engraved plastic nameplate on each piece of equipment and starter.
 - 1. Designation approved by Architect/Engineer.
 - 2. Equipment includes, but is not limited to, air handling units, fan coil units, variable volume boxes, fans, pumps, boilers and chillers.
 - 3. Submit schedule of equipment to be included and designations.
- B. Provide nameplates with 1/2" high letters and fastened with epoxy or screws.

3.7 OBSTRUCTIONS

- A. The drawings indicate certain information pertaining to surface and subsurface obstructions which has been taken from available drawings. Such information is not guaranteed, however, as to accuracy of location or complete information.
 - 1. Before any cutting or trenching operations are begun, verify with Owner's representative, utility companies, municipalities, and other interested parties that all available information has been provided.
 - 2. Should obstruction be encountered, whether shown or not, alter routing of new work, reroute existing lines, remove obstruction where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of the new work and leave existing services and structures in a satisfactory and serviceable condition.
- B. Assume total responsibility for and repair any damage to existing utilities or construction, whether or not such existing facilities are shown.

3.8 PROTECTION

- A. Protect work, equipment, fixtures, and materials. At work completion, work must be clean and in original manufacturer's condition.

3.9 INDOOR AIR QUALITY

- A. All equipment and ductwork shall be installed to allow sufficient space for testing, maintenance, and commissioning functions. Access doors or panels shall be installed in ventilation equipment, ductwork, and plenum enclosures for inspection and cleaning of outdoor air intakes, mixing plenums, up and downstream of coils, filters, drain pans and fans.
- B. Practice source control and eliminate potential contaminants in material selection, installation, and maintenance.
- C. Provide installation and disposal instructions for all materials and chemicals that are potential contaminants.

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- D. Obtain and conform to the requirements of the Material Safety Data Sheets (MSDSs) in the use of materials.
- E. Utilize manufacturer's recommendations and provide installation instructions for all chemicals, compounds, and potential contaminants including pre-installation degassing if required.
- F. Ventilate completed building prior to final completion using no less than design outside air for at least 48 hours before occupancy.
- G. Make provisions for controls to prevent the entry of air contaminants into the HVAC air distribution system.
- H. Steps shall be taken to ensure that the HVAC system continues to function effectively and are not damaged or contaminated during construction activities.

END OF SECTION

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SECTION 230510

HVAC CONTRACT QUALITY CONTROL

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Contract quality control including workmanship, manufacturer's instructions, mock-ups and demonstrations.

1.2 QUALITY CONTROL PROGRAM

- A. Maintain quality control over supervision, subcontractors, suppliers, manufacturers, products, services, site conditions and workmanship to produce work in accordance with contract documents.

1.3 WORKMANSHIP

- A. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.
- B. Perform work by persons qualified to produce workmanship of specified quality.
- C. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking. Under no conditions shall material or equipment be suspended from structural bridging.
- D. Provide finishes to match approved samples. All exposed finishes shall be approved by the Architect. Submit color samples as required.

1.4 MANUFACTURER'S INSTRUCTIONS

- A. Comply with instructions in full detail, including each step-in sequence.
- B. Should instruction conflict with Contract Documents, request clarification from Architect / Engineer before proceeding.

1.5 MANUFACTURER'S CERTIFICATES

- A. When required in individual Specification Sections, submit manufacturer's certificate in duplicate, certifying that products meet or exceed specified requirements.

1.6 MANUFACTURER'S FIELD SERVICES

- A. When required in individual Specification Sections, manufacturer shall provide qualified personnel to observe:
 - 1. Field conditions
 - 2. Condition of installation
 - 3. Quality of workmanship
 - 4. Start-up of equipment
 - 5. Testing, adjusting, and balancing of equipment
- B. Representative shall make written report of observations and recommendations to Architect / Engineer.

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1.7 MOCK-UPS

- A. Assemble and erect the specified equipment and products complete, with specified anchorage and support devices, seals and finishes.
- B. Do not proceed with any work involving a mock-up, until the related mock-up has been approved in writing.
- C. Acceptable mock-ups in place shall be retained in the completed work.
- D. Perform tests and submit results as specified.

1.8 SCHEDULING OF MOCK-UPS

- A. Schedule demonstration and observation of mock-ups, in phases, with Architect / Engineer.
 - 1. Rough-in.
 - 2. Finish with all appurtenances in place.
 - 3. Insulation installed.
 - 4. Demonstrations.

PART 2 - PRODUCTS

2.1 REFERENCE APPLICABLE SPECIFICATION SECTIONS.

PART 3 - EXECUTION

3.1 PACKAGED ROOFTOP UNIT

- A. Mock-up a rooftop unit, completely installed, including:
 - 1. Piping connections; including condensate, natural gas and other piping appurtenances.
 - 2. Pipe insulation.
 - 3. Condensate drain piping.
 - 4. Electrical connections.
 - 5. Ductwork beyond the first transition.
 - 6. Cabinet/internal vibration isolation.
 - 7. Duct insulation.
 - 8. Instrumentation.
- B. Tests: Airflow at scheduled static pressure.
- C. Demonstrate:
 - 1. Filter accessibility.
 - 2. Accessibility to drain and components for service.
 - 3. Control sequence.

3.2 PROTECTION OF EQUIPMENT

- A. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the Contractor is obligated to furnish new equipment of a like kind at no additional cost to the Owner.

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- B. Adequately protect equipment from damage after delivery to the project. Cover with heavy tarpaulins, drop cloths or other protective coverings as required to protect from plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion.

END OF SECTION

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SECTION 230511

MECHANICAL ALTERATIONS PROJECT PROCEDURES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Inspect and service existing equipment and materials that are to remain or to be reused.
- B. Disposal of equipment, materials, or housekeeping pads to be abandoned. Prior to disposal, the Contractor shall verify with the Owner what is to be salvaged by the Owner and what is to become the property of the Contractor.
- C. Handling of equipment and materials to be removed.

1.2 QUALITY ASSURANCE

- A. Coordination with the Owner prior to the disconnection or shutdown of existing equipment, or to the modification of existing operational systems.

1.3 CONTRACT DRAWINGS

- A. There is the possibility that existing conditions and devices are affected by the work indicated on the drawings and called for in the specifications (project manual) which do not appear on the drawings. It is the Contractor's responsibility to visit the site and determine all of the existing conditions and to consider these existing conditions when making and presenting a proposal, to have a complete proposal.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Material used to upgrade and repair existing equipment shall conform to that specified.
- B. Material used to upgrade and repair existing equipment shall not void existing warranties or listings of the equipment to be upgraded or repaired.
- C. Material used to upgrade and repair existing equipment shall be new and shall be of the same manufacturer of the existing equipment, shall be acquired through the existing original equipment manufacturer's approved distribution channels, shall have manufacturer's warranties for the new material being used, and shall be listed for the use intended.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Existing materials and equipment indicated on the drawings or in the specifications to be reused shall be inspected for damaged or missing parts. Contractor shall notify the Architect/Engineer, in writing, accordingly.
- B. If using materials specified or shown on the drawing voids or diminishes the warranty or operation of remaining equipment or systems, the Contractor shall notify the Architect/Engineer, in writing.

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- C. Verify field measurements, above and underground piping connections and flows.
- D. Demolition Drawings are based on casual field observation, and when available, existing record documents. Report discrepancies to Architect before disturbing existing installation, and immediately after such discrepancies are discovered.
- E. Field verify existing conditions and actual utility uses prior to final connections. Existing drawings may not have been available for all required information. Use pipe inspection camera system to field verify existing sanitary / grease waste connections. Verify actual HVAC supply and return piping connections. Verify flow direction and depth prior to connection to existing plumbing systems.

3.2 APPLICATION

- A. Existing materials and equipment indicated on the drawings or in the specifications to be reused shall be cleaned and reconditioned, including cleaning of piping systems and HVAC coils prior to installation and reuse.
- B. Material and equipment removed that is not to be salvaged for Owner's use or for reuse on the project shall become the property of the Contractor and be removed from the site.
- C. Material or equipment salvaged for Owner's use shall be carefully handled and stored where directed by the Owner or the Architect / Engineer. Relocate material and / or equipment as directed by Owner.
- D. Materials and equipment not indicated to be removed or abandoned shall be reconnected to the new system.
- E. Materials, equipment and housekeeping pads not to be reused or reconnected shall be removed for Owner's review and salvaged by Contractor.
- F. Prior to start of construction, Contractor shall walk areas to be renovated with Owner to identify and document items to be salvaged for Owner's use.
- G. Clean and repair existing materials and equipment that remain or are to be reused.
- H. Contractor shall utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

3.3 SEQUENCE AND SCHEDULE

- A. Coordinate utility service outages with Utility Company, Architect and Owner.
- B. Provide additional or temporary valves, piping, ductwork and connections to maintain existing systems in service during construction.
- C. Existing HVAC and Plumbing Service: Refer to drawings for work in remodeled areas. Where facilities in these areas are to remain in service, any related work to keep the facilities in operation is specified in this Division. Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Obtain permission from Owner at least 48 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area. Maintain acceptable temperature and humidity control within existing building during renovation activities.

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- D. Remove and replace existing Mechanical systems and appurtenances as occasioned by new or remodeled construction. Re-establish service that may be interrupted by remodeled construction.
- E. Refer to other drawings series for work in remodeled areas. Where facilities in these areas are required to remain in service, any related work required to keep these facilities in operation is specified in this Division.
- F. Remove and replace existing piping, grilles, boxes and ductwork coincident with the construction.
- G. Remove or relocate existing piping, grilles, ductwork or housekeeping pads as occasioned by new or remodeled construction. Cap unused HVAC or domestic piping and duct beyond the new finish line.
- H. Relocate all HVAC and or domestic piping, grilles, boxes and ductwork as required to accommodate new work requiring precedence.
- I. Remove concrete housekeeping pad where materials or equipment have been removed.
- J. Remove all known utilities, which do not provide service to the buildings that remain.
- K. Remove existing plumbing or mechanical vent penetrations through roof not to be reused.

3.4 DEMOLITION AND EXTENSION OF EXISTING MECHANICAL WORK

- A. The Contractor shall modify, remove, and/or relocate all materials and items so indicated on the drawings or required by the installation of new facilities. All removals and/or dismantling shall be conducted in a manner as to produce maximum salvage. Salvage materials shall remain the property of the Owner and shall be delivered to such destination as directed by the Owner's representative unless they are not wanted, then it will be the responsibility of this Contractor to remove such items and properly dispose of them. Materials and/or items scheduled for relocation, and which are damaged during dismantling or reassembly operations shall be repaired and restored to good operative condition. The Contractor may, at his discretion, and upon approval of the Owner's representative substitute new materials and/or items of like design and quality in lieu of materials and/or items to be relocated.
- B. All items to be relocated shall be carefully removed in reverse to original assembly or placement and protected until relocated. The Contractor shall clean, repair, and provide all new materials, fittings, and appurtenances required to complete the relocations and to restore them to good operative order. All relocations shall be performed by workmen skilled in the work and in accordance with standard practice of the trades involved.
- C. When items scheduled for relocation and/or reuse are found to be in damaged condition before work has been started on dismantling, the Contractor shall call the attention of the Owner's representative to such items and receive further instructions before removal. Items damaged in repositioning operations are the contractor's responsibility and shall be repaired or replaced by the contractor as approved by the owner's representative, at no additional cost to the Owner.

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- D. HVAC, Plumbing, piping, ductwork and appurtenances to be removed, salvaged, or relocated shall be removed to points indicated on the drawings, specified, or acceptable to the Owner's representative. Piping and ductwork not scheduled for reuse shall be removed to the points at which reuse is to be continued or service is to remain. Such services shall be sealed, capped, or otherwise tied-off or disconnected in a safe manner acceptable to the Construction Inspector. All disconnections or connections into the existing facilities shall be done in such a manner as to result in minimum interruption of services to adjacent occupied areas. Services to existing areas or facilities that must remain in operation during the construction period shall not be interrupted without prior specific approval of the Owner's representative herein before specified.
- E. Repair adjacent construction and finishes damaged during demolition and extension work.
- F. Maintain access to mechanical installations that remain active. Modify installation or provide access panel as appropriate.
- G. Extend existing installations using materials and methods compatible with existing mechanical installations, or as specified.
- H. Existing mechanical piping and devices found to need additional hangers installed should be added at no additional cost to the Owner.

3.5 PROTECTION OF THE WORK

- A. Provide adequate temporary support and auxiliary structure as necessary to ensure structural value or integrity of affected portion of work.
- B. Provide devices and methods to protect other portions of work from damage.
- C. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances and finishes.

3.6 IDENTIFICATION OF EQUIPMENT IN RENOVATED AREAS

- A. Identification of Equipment: Provide new identification of all existing equipment to be reused and located within the renovated areas. Do not include the description "existing". Provide new nameplates for all existing mechanical equipment in renovated areas as specified in Section 23 05 00 Mechanical General Provisions.

3.7 REFRIGERANT DISPOSAL

- A. Contractor shall dispose of refrigerant from all DX equipment including refrigerant piping per OSHA, EPA, Federal, State and Local Codes.

END OF SECTION

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SECTION 230512

SHOP DRAWINGS, COORDINATION DRAWINGS & PRODUCT DATA

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Prepare submittals as required by these specifications as outlined below.
- B. The term submittal, as used herein, refers to all:
 - 1. Shop Drawings
 - 2. Coordination Drawings
 - 3. Product data
- C. Submittals shall be prepared and produced for:
 - 1. Distribution as specified
 - 2. Inclusion in the Operating and Maintenance Manual, as specified, in the related section

1.2 SHOP DRAWINGS

- A. Present drawings in a clear and thorough manner. Identify details by reference to sheet and detail, schedule, or room numbers shown on Contract Drawings.
- B. Show all dimensions of each item of equipment on a single composite Shop Drawing. Do not submit a series of drawings of components.
- C. Identify field dimensions; show relationship to adjacent features, critical features, work, or products.
- D. Submit shop drawings in plan, elevation and sections, showing equipment in mechanical equipment areas.

1.3 COORDINATION DRAWINGS

- A. Present in a clear and thorough manner. Title each drawing with project name. Identify each element of drawings by reference to sheet number and detail, or room number of contract documents. Minimum drawing scale: $\frac{1}{4}" = 1'-0"$.
- B. Prepare coordination drawings to coordinate installations for efficient use of available space, for proper sequence of installation, and to resolve conflicts. Coordinate with work specified in other sections and other divisions of the specifications.
- C. For each mechanical room and for each outside equipment pad where equipment is located, submit plan and elevation drawings. Show:
 - 1. Actual mechanical equipment and components to be furnished
 - 2. Service clearance
 - 3. Relationship to other equipment and components
 - 4. Roof drains and leader piping
 - 5. Fire protection piping and equipment

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- D. Identify field dimensions. Show relation to adjacent or critical features of work or products.
- E. Related requirements:
 - 1. Ductwork shop drawings
 - 2. Coordination drawing specified in Division 26
- F. Submit shop drawings in plan, elevation and sections, showing equipment in mechanical equipment areas.
- G. Gas piping sketch indicating proposed location of piping prior to proceeding with the installation.

1.4 PRODUCT DATA AND INSTALLATION INSTRUCTION

- A. Submit only pages which are pertinent to the project. All options which are indicated on the product data shall become part of the contract and shall be required whether specified are not.
- B. Mark each copy of standard printed data to identify pertinent products, referenced to specification section and article number.
- C. Show reference standards, performance characteristics and capacities; wiring and piping diagrams and controls; component parts; finishes; dimensions and required clearances.
- D. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete information not applicable.
- E. Mark up a copy of the specifications for the product. Indicate in the margin of each paragraph the following: COMPLY, DO NOT COMPLY, or NOT APPLICABLE. Explain all DO NOT COMPLY statements.
- F. Provide a separate transmittal for each submittal item. Transmittals shall indicate product by specification section name and number. Separate all submittals into appropriate specification section number. Do not combine specification sections.

1.5 MANUFACTURERS INSTRUCTIONS

- A. Submit Manufacturer's instructions for storage, preparation, assembly, installation, start-up, adjusting, calibrating, balancing and finishing.

1.6 CONTRACTOR RESPONSIBILITIES

- A. Review submittals prior to transmittal.
- B. Determine and verify:
 - 1. Field measurements
 - 2. Field construction criteria
 - 3. Manufacturer's catalog numbers
 - 4. Conformance with requirements of Contract Documents
- C. Coordinate submittals with requirements of the work and of the Contract Documents.

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- D. Notify the Architect/Engineer in writing at time of submission of any deviations in the submittals from requirements of the Contract Documents.
- E. Do not fabricate products, or begin work for which submittals are specified, until such submittals have been produced and bear contractor's stamp. Do not fabricate products or begin work scheduled to have submittals reviewed until return of reviewed submittals with Architect / Engineer's acceptance.
- F. Contractor's responsibility for errors and omissions in submittals is not relieved whether Architect / Engineer reviews submittals or not.
- G. Contractor's responsibility for deviations in submittals from requirements of Contract Documents is not relieved whether Architect/Engineer reviews submittals or not, unless Architect / Engineer gives written acceptance of the specific deviations on reviewed documents.
- H. Submittals shall show sufficient data to indicate complete compliance with Contract Documents:
 - 1. Proper sizes and capacities
 - 2. That the item will fit in the available space in a manner that will allow proper service
 - 3. Construction methods, materials and finishes
- I. Schedule submissions at least 15 days before date reviewed submittals will be needed.

1.7 SUBMISSION REQUIREMENTS

- A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the Project or in the work of any other Contractor.
- B. Number of submittals required:
 - 1. Shop Drawings and Coordination Drawings: Submit one reproducible transparency and three opaque reproductions.
 - 2. Product Data: Submit the number of copies which the contractor requires, plus those which will be retained by the Architect/Engineer.
- C. Accompany submittals with transmittal letter, in duplicate, containing:
 - 1. Date
 - 2. Project title and number
 - 3. Contractor's name, address and contact number.
 - 4. The number of each Shop Drawing, Project Datum and Sample submitted
 - 5. Other pertinent data
- D. Submittals shall include:
 - 1. The date of submission
 - 2. The project title and number
 - 3. Contract Identification
 - 4. The names of:
 - a. Contractor
 - b. Subcontractor
 - c. Supplier
 - d. Manufacturer
 - 5. Identification of the product
 - 6. Field dimensions, clearly identified as such

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7. Relation to adjacent or critical features of the work or materials
 8. Applicable standards, such as ASTM or federal specifications numbers
 9. Identification of deviations from contract documents
 10. Suitable blank space for General Contractor and Architect/Engineer stamps
 11. Contractor's signed and dated Stamp of Approval
- E. Coordinate submittals into logical groupings to facilitate interrelation of the several items:
1. Finishes which involve Architect/Engineer selection of colors, textures or patterns
 2. Associated items which require correlation for efficient function or for installation

1.8 SUBMITTAL SPECIFICATION INFORMATION

- A. Every submittal document shall bear the following information as used in the project manual:
1. The related specification section number
 2. The exact specification section title
- B. Submittals delivered to the Architect/Engineer without the specified information will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.9 RESUBMISSION REQUIREMENTS

- A. Make re-submittals under procedures specified for initial submittals.
1. Indicate that the document or sample is a re-submittal
 2. Identify changes made since previous submittals
- B. Indicate any changes which have been made, other than those requested by the Architect / Engineer.

1.10 CONTRACTOR'S STAMP OF APPROVAL

- A. Contractor shall stamp and sign each document certifying to the review of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the work and of Contract Documents.
- B. Contractor's stamp of approval on any submittal shall constitute a representation to Owner and Architect/Engineer that Contractor has either determined and verified all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data or assumes full responsibility for doing so, and that Contractor has reviewed or coordinated each submittal with the requirements of the work and the Contract Documents.
- C. Do not deliver any submittals to the Architect/Engineer that do not bear the Contractor's stamp of approval and signature.
- D. Submittals delivered to the Architect/Engineer without Contractor's stamp of approval and signature will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

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1.11 ARCHITECT / ENGINEER REVIEW OF IDENTIFIED SUBMITTALS

- A. The Architect / Engineer will:
 - 1. Review identified submittals with reasonable promptness and in accordance with schedule
 - 2. Affix stamp and initials or signature, and indicate requirements for re-submittal or approval of submittal
 - 3. Return submittals to Contractor for distribution or for resubmission
- B. Review and approval of submittals will not extend to design data reflected in submittals which is peculiarly within the special expertise of the Contractor or any party dealing directly with the Contractor.
- C. Architect / Engineer's review and approval is only for conformance with the design concept of the project and for compliance with the information given in the contract.
 - 1. The review shall not extend to means, methods, sequences, techniques or procedures of construction or to safety precautions or programs incident thereto.
 - 2. The review shall not extend to review of quantities, dimensions, weights or gauges, fabrication processes or coordination with the work of other trades.
- D. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

1.12 SUBSTITUTIONS

- A. Do not make requests for substitution employing the procedures of this Section.
- B. The procedure for making a formal request for substitution is specified in Div. 1.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

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SECTION 230513

ELECTRICAL PROVISIONS OF HVAC WORK

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Electrical provisions to be provided as mechanical work are indicated in other Division 23 sections, on drawings, and as specified.
- B. Types of work, normally recognized as electrical but provided as mechanical, specified or partially specified in this Section, include but are not necessarily limited to the following:
 - 1. Motors for mechanical equipment.
 - 2. Starters for motors of mechanical equipment, but only where specifically indicated to be furnished integrally with equipment.
 - 3. Wiring from motors to disconnect switches or junction boxes for motors of mechanical equipment, but only where specifically indicated to be furnished integrally with equipment.
 - 4. Wiring of field-mounted float control switches, flow control switches, and similar mechanical-electrical devices provided for mechanical systems, to equipment control panels.
 - 5. Wiring of smoke detectors for shutdown of air handling equipment when a fire alarm system is not included in the project.
 - 6. Low Voltage wiring of thermostats, timer switches, push buttons, and similar control devices.
- C. Refer to Division 23 Controls Sections for related control system wiring.
- D. Refer to Division 23 sections for specific individual mechanical equipment electrical requirements.
- E. Refer to Division 26 sections for motor starters and controls not furnished integrally with mechanical equipment.
- F. Refer to Division 26 sections for junction boxes and disconnect switches required for motors and other electrical units of mechanical equipment.

1.2 RELATED WORK

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to work of this Section.

1.3 QUALITY ASSURANCE

- A. Wherever possible, match elements of electrical provisions of mechanical work with similar elements of electrical work specified in Division 26 sections for electrical work not otherwise specified.
- B. For electrical equipment and products, comply with applicable NEMA standards, and refer to NEMA standards for definitions of terminology. Comply with National Electrical Code (NFPA 70) for workmanship and installation requirements.

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1.4 SUBMITTALS

- A. Include in listing of motors, voltage, notation of whether motor starter is furnished or installed integrally with motor or equipment containing motors.

PART 2 - PRODUCTS

2.1 MOTORS

- A. Provide motors for mechanical equipment manufactured by one of the following:
 - 1. Baldor Electric Company
 - 2. Century Electric Div., Inc.
 - 3. General Electric Co.
 - 4. Louis Allis Div.; Litton Industrial Products, Inc.
 - 5. Lincoln Electric
 - 6. Marathon Electric Mfg. Corp.
 - 7. Reliance Electric Co.
 - 8. Westinghouse Electric Corp.
 - 9. WEG
- B. Motor Characteristics. Except where more stringent requirements are indicated, and except where required items of mechanical equipment cannot be obtained with fully complying motors, comply with the following requirements for motors of mechanical work:
- C. Temperature Rating. Rated for 40 Degrees C environment with maximum 50 Degrees C temperature rise for continuous duty at full load (Class A Insulation).
- D. Provide each motor capable of making starts as frequently as indicated by automatic control system, and not less than 5 starts per hour for manually controlled motors.
- E. Phases and Current Characteristics. Provide squirrel-cage induction polyphase motors for 3/4hp and larger and provide capacitor-start single-phase motors for 1/2hp and smaller, except 1/6hp and smaller may, at equipment manufacturer's option, be split-phase type. Coordinate current characteristics with power specified in Division 26 sections, and with individual equipment requirements specified in other Division 23 requirements. For 2-speed motors provide 2 separate windings on polyphase motors. Do not purchase motors until power characteristics available at locations of motors have been confirmed, and until rotation directions have been confirmed.
- F. Service Factor. 1.15 for polyphase motors and 1.35 for single-phase motors.
- G. Motor Construction. Provide general purpose, continuous duty motors, Design "B" except "C" where required for high starting torque.
 - 1. Frames. NEMA #56.
 - 2. Bearings are to be ball or roller bearings with inner and outer shaft seals, regreasable except permanently sealed where motor is inaccessible for regular maintenance. Where belt drives and other drives produce lateral or axial thrust in motor, provide bearings designed to resist thrust loading. Refer to individual section of Division 23 for fractional-hp light-duty motors where sleeve-type bearings are permitted.

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3. Except as indicated, provide open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation, and provide guarded drip-proof motors where exposed to contact by employees or building occupants. Provide weather-protected Type I for outdoor use, Type II where not housed. Refer to individual sections of Division 23 for other enclosure requirements.
 4. Provide built-in thermal overload protection and, where indicated, provide internal sensing device suitable for signaling and stopping motor at starter.
 5. Noise Rating: Provide "Quiet" rating on motors.
- H. All motors shall be premium efficiency.
- I. Provide an inverter duty motor on all equipment that utilizes a variable frequency drive.

2.2 EQUIPMENT FABRICATION

- A. Fabricate mechanical equipment for secure mounting of motors and other electrical items included in work. Provide either permanent alignment of motors with equipment, or adjustable mountings as applicable for belt drives, gear drives, special couplings and similar indirect coupling of equipment. Provide safe, secure, durable, and removable guards for motor drives. Arrange for lubrication and similar running-maintenance without removal of guards.

2.3 GENERAL REQUIREMENTS – SHAFT GROUNDING RINGS

- A. All motors operated on variable frequency drives shall be equipped with a maintenance-free, conductive microfiber shaft grounding ring to meet NEMA MG-1, 3.4.4.4.3 requirements, with a minimum of two rows of circumferential microfibers to discharge damaging shaft voltages away from the bearings to ground. SGR's Service Life: Designed to last for service life of motor. Provide AEGIS SGR Conductive MicroFiber Shaft Grounding Ring or approved equal.
- B. Application Note: Motors up to 100 HP shall be provided with one shaft ground ring installed on either the drive end or non-drive end. Grounding rings shall be provided and installed by the motor manufacturer's recommendations.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install motors on motor mounting systems in accordance with motor manufacturer's instructions, anchored to resist torque, drive thrusts, and other external forces inherent in mechanical work. Secure sheaves and other drive units to motor shafts with keys and Allen set screws on flat surface of shaft. Unless otherwise indicated, set motor shafts parallel with machine shafts.
- B. Verify voltage with Electrical Plans.

END OF SECTION

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SECTION 230514

HVAC CONDENSATE DRAIN PIPING SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide and install air conditioning condensate drains.

1.2 RELATED WORK

- A. Division 23 - Mechanical
 - 1. Insulation
 - 2. Mini Split Units
 - 3. Packaged Rooftop Air Conditioners

PART 2 - PRODUCTS

2.1 PIPE MATERIAL

- A. Type L copper with drainage pattern fittings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install the system to facilitate easy removal.
 - 1. Use threaded plugged tee at each change of direction to permit cleaning.
 - 2. Install a cleanout every 50 feet of straight run piping
 - 3. Maintain a positive slope on all piping
- B. Install a water seal trap leg based on the fan pressure.
 - 1. Size the length of the trap leg 1 inch larger than the actual system pressure.
- C. Install traps and cleanout as shown in the drawing details.
 - 1. Confirm requirements with manufacturer's installation instructions

3.2 SIZE PIPE AS SHOWN ON DRAWINGS.

- A. Do not install piping sized smaller than the unit drain connection size.

3.3 SECONDARY DRAINS

- A. Provide secondary drains where required by code, shown on the drawings, or where equipment has secondary drain connections.

END OF SECTION

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SECTION 230517

HVAC ACCESS DOORS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install access doors in wall or ceiling locations as required or shown for access to valves, controls, fire dampers, air distribution devices and other equipment requiring maintenance, adjustment or operation.

PART 2 - PRODUCTS

2.1 NON-FIRE RATED ACCESS DOORS

- A. 16-Gauge frames
- B. 14-gauge steel panels
- C. Continuous fully concealed hinges
- D. Recessed keyed operation for Owner selection
- E. Automatic spring closing with angled cam lock
- F. Prime coat finish
- G. Brushed satin stainless-steel finish for restroom, kitchen or cafeteria installation
- H. Material suitable for wall and/or ceiling mounting

2.2 FIRE RATED ACCESS DOORS

- A. UL listed, 1-1/2 hour Label "B", access doors
- B. 16-Gauge stainless steel
- C. 20-Gauge insulated sandwich-type door panel.
- D. Two inch thick with fire rated insulation
- E. Continuous fully concealed hinge
- F. Automatic spring closing with angled cam lock
- G. Recessed key operation for Owner selection
- H. Interior latch release slide for opening from inside
- I. Prime coat finish
- J. Material suitable for wall and/or ceiling mounting

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2.3 ACCEPTABLE MANUFACTURERS

- A. Elmdor
- B. MIFAB
- C. Acudor
- D. Milcor

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Access doors specified in Division 23 will be installed by other crafts. Not all required access doors are shown. Coordinate with the Contractor to locate access doors for ease of operation and maintenance of concealed equipment.
- B. Installation shall be in accordance with the manufacturer's printed instructions.
- C. Minimum size required:
 - 1. 36" x 24" for Mechanical HVAC equipment related items
 - 2. 18" x 18" for electrical related items

END OF SECTION

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SECTION 230518

VARIABLE FREQUENCY INVERTER

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install a variable frequency inverter for the following equipment items.
 - 1. Fans

1.2 RELATED WORK

- A. Division 23 Mechanical
 - 1. Electrical Provisions of Mechanical Work.
 - 2. Building Management Control System Sequences

1.3 COOPERATION WITH OTHER TRADES

- A. Coordinate this work with work under Division 26 Electrical to ensure that intended functions are achieved.
- B. Coordinate the size of the variable frequency inverter with the equipment being served by the inverter. The rated current output amps are to be equal to or greater than motor rated full load amps.

1.4 SUBMITTALS

- A. Submit manufacturer's information and shop drawings as specified.
 - 1. Complete technical details.
 - 2. Dimensions and manufacturer's installation manual.
 - 3. Schematic diagrams of the circuitry and field connections.
 - 4. Manufacturer's start-up manual.

1.5 STANDARDS

- A. UL
- B. CSA
- C. ISO 9001
- D. NEC
- E. FCC

1.6 WARRANTY

- A. The manufacturer shall provide a full parts and labor warranty for a period of five (5) years from substantial completion.

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PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. ABB
- B. Danfoss Graham

2.2 CABINET

- A. The inverter and all accessories shall be provided within a wall mounted UL Listed NEMA 1 enclosure in interior AHU mechanical rooms and in NEMA 12 enclosure with deadsides and removable hinged, gasketed doors with provisions for locking in all Plant locations. Cabinet shall be constructed of metal for reduction of radio frequency interference (RFI) and electromagnetic frequency interference.

2.3 INTERFERENCE WITH OTHER SYSTEMS

- A. The inverter shall be designed and constructed to comply with IEEE Standard 519-1993 with respect to line noise and RFI generation. All units shall generate less than 3% total harmonic distortion back to the incoming power line at the point of common connection with sensitive equipment. A harmonic analysis shall be submitted with the approval drawings to verify compliance with the latest version of IEEE-519 voltage and current distortion limits as shown in Table 1.2 and 10.3 at the point of common coupling (PCC). The PCC shall be defined as the consumer-utility interface or primary side of the main distribution transformer.
- B. Dual DC Bus filtered chokes (factory installed and wired in the drive enclosure) equivalent to 5% input line reactors shall be provided to minimize harmonics reflected onto the input line.
 - 1. Shall not interfere with computer and other electronic systems in the building.
 - 2. If not inherently protected, provide a suitable isolation transformer.
 - 3. The system shall not produce spikes on the incoming line.
- C. Any inverter that generates sufficient electrical line noise to interfere with the operation of sensitive building equipment shall be field modified or replaced by the inverter supplier at no additional cost to the Owner.

2.4 PROTECTIVE CIRCUITS

- A. Provide the following protection:
 - 1. Input line fuses or molded case circuit breaker rated at 100 AIC.
 - 2. Input line noise suppression with MOV's (metal oxide varistors) and snubber circuits. MOV's shall be provided across incoming line terminals, AC input reactors, DC choke filters, and transistors to protect inverter from voltage surges and spikes.
 - 3. Protection of solid state inverter devices by limiting output current to 110% of inverter rating, automatically prevent overcurrent trip due to momentary overload conditions.
 - 4. Current limiting DC buss fuse between input and output sections of inverter.
 - 5. Input overvoltage trip at 480 vac + 10% trip.
 - 6. Input undervoltage at 480 vac - 10% trip
 - 7. Instantaneous overcurrent protection of solid state inverter devices.
 - 8. Individual overcurrent protection of solid state inverter devices.
 - 9. Output overvoltage trip.
 - 10. Loss of input phase, phase reversals, or blown fuse.

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11. Thermal overload trip for overload protection of solid state devices.
12. Ground fault protection on start-up.
13. Output line to line short circuit protection.
14. Phase to phase short circuit or severe overload conditions of output.
15. Overload of motor.
16. Frequency stall.
17. DC buss high voltage.
18. Control function error.
19. Heatsink over temperature (Max. operating ambient: 122 degrees F)
20. Controller able to operate without a motor or any other equipment connected to the output (To facilitate startup and troubleshooting).
21. Capable of restarting into a rotating motor without component damage.
22. Shut down safely without component failure in the event of a sustained power loss, and will automatically return to normal operation, if start is "on" and power is restored.
23. Shut down safely without component failure in the event of a momentary power loss. Automatically return to normal operation if the start is "on", and normal power is restored. Capable of establishing speed control without shutdown or component failure.
24. Designed for input power contactor opening or closing while control is activated, without damage to the controller.
25. Automatically reset trip resulting from overcurrent, undervoltage, overvoltage, or over temperature, and automatically restart after removal, or correction of the faulty condition.
26. Provide status lights or digital display for indication of failure conditions, and form C relay provided for remote indication. Digital display or status lights to indicate power on, at speed, and drive enabled.
27. Operation and fault diagnostic function circuits shall be built into each inverter that provides information in determining the cause and source of a fault. Diagnostics to provide the following information:
 - a. Operating mode at trip (Accel, Decel, Constant speed).
 - b. Output current at trip.
 - c. Output voltage at trip.
 - d. Additional faults that occurred simultaneously or immediately before displayed tripped.Any drive requiring separate card to provide this information shall provide a diagnostic card for each drive.
28. DC link reactor.
29. Input power disconnect, lockable type.
30. Input power disconnect switch / circuit breaker, with lockable type handle.

2.5 OPERATOR DEVICES

- A. The following operator devices shall be door or remote mounted:
 1. Digital keypad and LCD provided to perform all parameter adjustments, operation monitoring, and operation programming.
 2. Power on indication light.
 3. Flush mounted meters or digital display to indicate output voltage, output frequency, and output current, in percent of maximum 0 to 100%.
 4. Manual/Off/Auto 3 position selector switch (hand-off-auto) and manual speed setting control to provide the following control sequences:
 - a. In automatic mode, controller shall follow an external control signal and respond to remote start-stop contact.

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- b. In manual (hand) mode, controller shall follow speed signal set via door mounted keypad and start/stop switch. Switching from "hand" to "auto" and vice versa shall require a single keystroke to a dedicated changeover key. Inverters requiring multiple keystrokes and/or reprogramming of internal parameters to accomplish changeovers are not acceptable.
- c. An integral "safety interlock" protection shutdown circuit shall be provided for interface with firestats, smoke detectors, high static pressure limit switches, vibration switches, etc.
- 5. Programmable lockout code to prevent unauthorized programming.
- 6. Critical frequency avoidance capability (up to 3 resonant points).

2.6 FIELD ADJUSTMENTS

- A. The following shall be adjustable in the field:
 - 1. Maximum Speed: 0 to 125% adjustable.
 - 2. Minimum Speed: 0 to 100% adjustable.
 - 3. Acceleration/deceleration rates: 0 to 3600 sec.
 - 4. Instantaneous overcurrent trip: 50% to 2000%.
 - 5. Volts/hertz ratio: Field adjustable to 16 patterns or set for automatic selection of proper V/F load profile to operate motor without overdriving or overloading.
 - 6. Current limit circuit: 60 to 100%.
 - 7. Carrier frequency: 6 to 16 KHZ.
 - 8. Control interface: selectable to follow a 0-5 VDC, 0-10 VDC, 4-20 MA, either direct or indirect acting.
 - 9. Control signal Bias: 0 to 80 HZ.
 - 10. Control signal gain: 0 to 80 HZ.
 - 11. Calibration of remote speed signal: 0 to 80 HZ.

2.7 ELECTRICAL CONSTANT SPEED BYPASS

- A. Provide all components and circuitry necessary to provide manual bypass of the inverter. The bypass package shall be mounted in a cabinet common with the inverter and shall be constructed in such a manner that the inverter can be removed for repair while still operating the motor in the "bypass" mode. Manual bypass shall contain the following:
 - 1. Two contactors mechanically interlocked via a three position through the door selector switch to provide the following control:
 - a. "Inverter" Mode connects the motor to the output of the inverter.
 - b. "Bypass" Mode connects the motor to the input sine wave power. Transfer must occur with input disconnect open. Motor is protected via thermal overload.
 - c. "Off" Mode disconnects motor from all input power.
 - 2. A molded case circuit breaker or fused disconnect switch with door interlocked handle (lock out type) that interrupts input power to both the bypass circuitry and the drive.
 - 3. An input contactor, interlocked with both the thermal motor overload and external safeties which disconnects power to the motor regardless of the mode of operation (either "inverter" or "bypass" mode).
 - 4. A thermal overload to provide protection of motor in the bypass mode.
 - 5. A safety interlock circuit that disconnects power to the motor (regardless of the mode of operation – "inverter" or "bypass") in response to a signal from the thermal overload and/or external safety circuits.
 - 6. Line voltage to 24 volt DC power source, fused per NEC, shall provide power to all bypass control circuits.

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2.8 SERIAL COMMUNICATIONS

- A. The VFD shall have the capability of communicating with the EMS control system via an RS-485 serial port.
- B. VFD shall be provided with protocol information specific to the selected EMS control manufacturer and shall be pre-configured at the factory to automatic communications, without the need for field programming.
- C. Serial communications capabilities shall be included, but not limited to: run/stop control, speed set adjustment, proportional/integral or PID control adjustments, current limit and accel/decel time adjustments. The drive shall also have the capability of allowing the DDC system to monitor the following feedback signals: process variable, output speed/frequency, current, torque, power (KW), operating hours, kilowatt hours; relay outputs, and diagnostic warning and fault information.
- D. The VFD shall allow the DDC system to control the drive's digital and analog outputs and monitor all drive digital and analog inputs via the serial interface.
- E. Provide BACnet interface card.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation as per manufacturer's recommendations and requirements.
 - 1. Inverter chassis is properly grounded.
 - 2. Line, Load, Control, and Fire/Safety wiring are installed in separate conduits.
 - 3. Both ends of conduit entering and leaving VFD into AHU cabinets and motors must be sealed air tight.

3.2 MANUFACTURER START-UP SERVICE

- A. Factory trained personnel shall be provided for start-up assistance, minimum (1) day per unit.
 - 1. The manufacturer shall provide start-up commissioning of the VFD and its optional circuits by a factory certified service technician who is experienced in start-up and repair services. Sales personnel and other agents who are not factory certified shall not be acceptable as commissioning agents.
 - 2. Start-up services shall include checking for verification of proper operation and installation for the VFD, its options and its interface wiring to the building automation system.
 - 3. Adjustable devices, components, and assemblies to assure optimum performance.
 - 4. Make final adjustments to the installed drive to assure proper operation of the fan system. Obtain performance requirements from installer of driven loads.
 - 5. Assistance will be provided to the Owner (upon request) to determine the optimum capacitance for per factory correction and avoidance of potential resonance problems and will determine optimum line filter required.
 - 6. A written report, duly signed by the technician detailing set points of adjustable devices, amperages recorded, and any other pertinent data. This information is to be included in the operation and maintenance manual.

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- B. Input DC voltage to dry motor windings when fan is not in operation at the following locations:
 - 1. Cooling tower fan motor
 - 2. Motors downstream of coils
 - 3. Rooftop unit motors

3.3 DEMONSTRATION AND TRAINING

- A. Provide system demonstration to personnel, Owner, and/or Owner's selected representatives.
- B. Demonstrate operation of controllers in the automatic and manual modes.
- C. Provide a minimum of two days of technical training for the owner's operating and technical staff. Schedule training with owner's authorized representatives, during normal business hours and not less than 30 days prior to planned session.
- D. Training may be consecutive or random, at Owner's option.

END OF SECTION

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SECTION 230548

VIBRATION ISOLATION

PART 1 - GENERAL

1.1 SCOPE

- A. Furnish, install, and adjust vibration isolation.

1.2 RELATED WORK

- A. Division 23 Mechanical
 - 1. Refer to the Section on Ductwork for flexible connections between fans and ducts.
 - 2. Refer to the Section on Equipment Supports for equipment foundation pads.

1.3 SUBMITTALS

- A. Submit product data showing type, size, load, deflection and other information required. Include clearly outlined procedures for installing and adjusting isolators.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Amber Booth
- B. Kinetics
- C. Mason
- D. Korfund
- E. TECO
- F. Vibration Eliminator Co., Inc.
- G. Metraflex

2.2 ISOLATOR TYPES

- A. Neoprene mountings shall have a minimum static deflection of 0.35 inches (9mm). All metal surfaces shall be neoprene covered and have friction pads both top and bottom. Bolt holes shall be provided on the bottom and a tapped hole and cap screw on top. Steel rails shall be used above the mountings under equipment such as small vent sets to compensate for the overhang.
- B. Spring isolators shall be free standing and laterally stable without any housing and complete with a molded neoprene cup or ¼ inch (6mm) neoprene acoustical friction pad between the base plate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Installed and operating heights shall be equal. The ratio of the spring diameter divided by the compressed spring height shall be no less than 0.8. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Submittals shall include spring diameters, deflection, compressed spring height and solid spring height.

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- C. Hangers shall consist of rigid steel frames containing minimum 1-1/4 inch (32mm) thick neoprene elements at the top and a steel spring with general characteristics as in specification B seated in a steel washer reinforced neoprene cup on the bottom. The neoprene element and the cup shall have neoprene bushings projecting through the steel box. In order to maintain stability, the boxes shall not be articulated as clevis hangers, nor the neoprene element stacked on top of the spring. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30-degree arc from side to side before contacting the cup bushing and short circuiting the spring. Submittals shall include a hanger drawing showing the 30-degree capability.

2.3 ISOLATOR APPLICATION

EQUIPMENT	ISOLATOR TYPE	MINIMUM DEFLECTION
Condensing Units	A	0.35"
Inline Fans	C	0.5"

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Stock Requirements. The isolation manufacturer's representative shall maintain an adequate stock of springs and isolators of type used so that changes required during construction and installation can be made.
- B. Factory Representation. After installation, furnish factory-trained representative of the isolation manufacturer to check various isolators and report measured versus anticipated deflection on all isolators. Have the representative certify that isolators have been installed in accordance with manufacturer's recommendations and approved submittals. Provide written report to Engineer indicating compliance prior to final acceptance.

END OF SECTION

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SECTION 230593

TESTING, BALANCING AND ADJUSTING (TAB) OF ENVIRONMENTAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Balance, adjust and test the air distribution system including the exhaust system.
- B. Verify and record the duct test results performed by the mechanical contractor.

1.2 RELATED SECTIONS

- A. COORDINATION OF TESTING AND BALANCING

1.3 PAYMENT PROCEDURES

- A. The work of this Section of the Specifications shall bid as an allowance directly to the Owner.

1.4 SUBMITTALS

- A. History of the TAB organization
- B. Agency certification
- C. Personnel qualifications
- D. TAB data forms
- E. Instrumentation list
- F. Name of the project supervising engineer
- G. Name and address and contact person of five successfully completed projects of similar size and scope.
- H. To perform required professional services, the balancing agency shall have a minimum of one test and balance engineer certified by the Associated Air Balance Council.

1.5 TAB FIRM QUALIFICATIONS

- A. The organization performing the work shall be a Certified member in good standing of the (AABC) Associated Air Balance Council.
- B. Able to furnish evidence of having contracted for and completed not less than five systems of comparable size and type that have served their Owners satisfactorily for not less than five years.
- C. A specialist in this field and have the personnel, experience, training, skill, and the organization to perform the work.

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- D. The balancing agency shall furnish all necessary calibrated instrumentation to adequately perform the specified services. An inventory of all instruments and devices in possession of the balancing agency may be required by the engineer to determine the balancing agency's performance capability.
- E. The balancing agency shall have operated for a minimum of five years under its current name.
- F. Personnel:
 - 1. The project supervisor shall be a Professional Engineer registered in Texas.
 - a. Extensive knowledge of the work involved.
 - b. At least five years experience conducting tests of the type specified.
 - c. This test and balance engineer shall be responsible for the supervision and certification of the total work herein specified.
 - 2. All work shall be conducted under the direct supervision of the supervising engineer.
 - 3. Technicians shall be trained and experienced in the work they conduct.

1.6 WARRANTY

- A. Provide (AABC) guarantee in writing.
- B. Extended warranty.
 - 1. Include an extended warranty of 2 years after completion of test and balance work, during which time the Architect/Engineer may request a retest or resetting of any outlet or other items as listed in the test report.
 - 2. Provide technicians and instruments to assist the Architect/Engineer in making any tests he may require during this period.
 - 3. The balancing agency shall perform an inspection of the HVAC system during the opposite season from that which the initial adjustments were made. The balancing agency shall make any necessary modifications to the initial adjustments to produce optimum system operation.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 TAB TOLERANCES

- A. The outside air, supply air, return air, and exhaust air for each system shall be adjusted to within +/- 5% of the value scheduled on the drawings.

3.2 SITE VISITS

- A. During construction, the balancing agency shall inspect the installation of the piping systems, sheetmetal work, temperature controls, energy management system, and other component parts of the heating, ventilating, and air conditioning systems. One inspection shall take place when 60% of the ductwork is installed and another inspection shall take place when 90% of the equipment is installed. The balancing agency shall submit a brief written report of each inspection to the architect and engineer.

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- B. Upon completion of the installation and start-up of the mechanical equipment by the mechanical contractor, the balancing agency shall test and balance the system components to obtain optimum conditions in each conditioned space of the building. If construction deficiencies are encountered that preclude obtaining optimum conditions, and the deficiencies cannot be corrected by the mechanical contractor within a reasonable period of time, the balancing agency shall cease testing and balancing services and advise the architect, engineer, general contractor and owner, in writing, of the deficiencies.
- C. Note proper piping installation, location of valves, and flow measuring instruments.
- D. Make one series of visits, phased as required by construction progress, prior to installation of the ceiling. Note proper installation of balancing dampers.
- E. Continue the site visits up to completion of project. In each succeeding report, list corrections made from previous reports.

3.3 TESTING INSTRUMENTS

- A. Submit a list of all instruments to be used for the test and balance procedures.
 - 1. Catalog sheets
 - 2. Certificate of last calibration
 - 3. Calibration within a period of six months prior to balancing
- B. Testing equipment shall be in good working order and tested for accuracy prior to start of work.

3.4 COORDINATION WITH OTHER SPECIFICATION SECTIONS

- A. Review the related ductwork shop drawings and piping shop drawings. Make recommendations concerning suitability with respect to the testing, balancing and adjusting work.
- B. Make tests to verify proper placement of the static pressure sensors for the variable air volume fan system control.
- C. In cooperation with the work specified in Building Management and Control System section, a systematic listing of the testing and verification shall be included in the final TAB report. The TAB firm shall provide a laptop computer to operate with the Building Management and Control System. Building Management and Control System shall provide all necessary software and special interface cables, as required, to communicate with the DDC system:
 - 1. Work with the temperature control contractor to ensure the most effective total system operation within the design limitations, and to obtain mutual understanding of the intended control performance.
 - 2. Verify that all control devices are properly connected.
 - 3. Verify that all dampers, valves, and other controlled devices, are operated by the intended controller.
 - 4. Verify that all dampers and valves are in the position indicated by the controller (open, closed or modulating).
 - 5. Verify the integrity of valves and dampers in terms of tightness of close-off and full open positions. This includes dampers in multizone units, terminal boxes and fire/smoke dampers.

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6. Observe that all valves are properly installed in piping system in relation to direction of flow and location.
 7. Observe the calibration of all controllers.
 8. Verify the proper application of all normally opened and normally closed valves.
 9. Observe the locations of all thermostats and humidistats for potential erratic operation from outside influences such as sunlight, drafts or cold walls.
 10. Observe the location of all sensors to determine whether their position will allow them to sense only the intended temperatures or pressures of the media. Control contractor will relocate as deemed necessary by the Engineer.
 11. Verify that the sequence of operation for any control mode is in accordance with the approved shop drawings and specifications. Verify that no simultaneous heating and cooling occurs.
 12. Verify the correct operation of all interlock systems and installation is per the manufacturer recommendations.
 13. Check all dampers for free operation.
 14. Verify that all controller setpoints meet the design intent.
- D. Upon completion of the testing and balancing, submit three days prior notice that the systems are ready for a running test. A qualified representative of the test and balance organization shall be present, with a representative from the Engineer's office to field verify TAB report readings. Specific and random selections of data recorded in the certified test and balance report will be reviewed.

3.5 INSTRUMENT TEST HOLES

- A. When it is required to make holes in the field to measure temperature, static pressure or velocity in the ducts:
1. Drill holes, plug and tape external duct insulation.
 2. Repair damaged insulation to Engineer's approval.

3.6 TESTING THE AIR DISTRIBUTION SYSTEM

- A. The TAB agency shall verify that all ductwork, dampers, grilles, registers, and diffusers have been installed per design and set full open. The TAB agency shall perform the following TAB procedures in accordance with the AABC National Standards and all results shall be recorded in the TAB report:
1. Supply Fans:
 - a. Fan speeds: Test and adjust fan RPM to achieve design CFM requirements.
 - b. Current and Voltage: Test and record motor voltage and amperage, and compare data with the nameplate limits to ensure fan motor is not in or above the service factor.
 - c. Pitot-Tube Traverse: Perform a Pitot-Tube traverse of the main supply and return ducts, as applicable, to obtain total CFM. If a Pitot-Tube traverse is not practical, an explanation of why a traverse was not made must appear on the appropriate data sheet. Measurements must be recorded with an Inclined Manometer or an Inclined/Vertical Manometer.
 - d. Outside Air: Test and adjust the outside air on applicable equipment using a Pitot-Tube traverse. If a Pitot-Tube traverse is not practical, an explanation of why a traverse was not made must appear on the appropriate data sheet. If a traverse is not practical, use the mixed air temperature method, if the inside and outside temperature difference is at least 20°F, or use the difference between Pitot-tube traverse of the supply and return ducts.

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- e. Static Pressure: Test and record system static pressure, including the static pressure profile of each supply fan.
- 2. All Other Fans:
 - a. Fan speeds: Test and adjust fan RPM to achieve design CFM requirements.
 - b. Current and Voltage: Test and record motor voltage and amperage and compare data with the nameplate limits to ensure fan motor is not in or above the service factor.
 - c. Pitot-Tube Traverse: Perform a Pitot-Tube traverse of the main return ducts, as applicable, to obtain total CFM. If a Pitot-Tube traverse is not practical, an explanation of why a traverse was not made must appear on the appropriate data sheet. Measurements must be recorded with an Inclined Manometer or an Inclined/Vertical Manometer.
 - d. Static Pressure: Test and record system static pressure, including the static pressure profile of each return fan.
- 3. Diffusers, Registers and Grilles:
 - a. Tolerances: Test, adjust, and balance each diffuser, grille, and register to within 5% of design requirements. Minimize drafts. Observe throws are in direction as indicated on drawings.
- 4. Coils (including electric coils):
 - a. Air Temperature: Once air flows are set to acceptable limits, take wet bulb (cooling coil only) and dry bulb air temperatures on the entering and leaving side of each coil. Calculate the sensible and latent (cooling coil only) capacity of the coil. Provide information in TAB report.
- B. Record preliminary air handler data, including fan RPM and static pressures across filter, fans and coils.
- C. Perform a velocity traverse of the main supply ducts using a pitot-tube and inclined manometer to establish initial air delivery. Perform a Pitot-tube traverse of main supply and return ducts, as applicable, to obtain total CFM. If a pitot-tube traverse is not practical, a detailed explanation of why a traverse was not made must appear on the appropriate data sheet.
- D. Where air measuring stations are installed, use pitot tube traverse readings to verify and record the correct calibration of the stations output.
- E. Make adjustments in fan RPM and damper settings, as required, to obtain design supply air, return air, and outside air.
- F. Measure and adjust all supply and return branches to design air delivery.
- G. Measure and adjust all diffusers to design air delivery to +/- 5% of design requirements.
- H. Make a set of recordings showing final system conditions.

3.7 EQUIPMENT POWER READINGS

- A. Record the following information for each motor:
 - 1. Equipment designation.
 - 2. Manufacturer.
 - 3. Unit model number and serial number and frame.
 - 4. Motor nameplate horsepower; nameplate voltage; phase and full load amperes.

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5. Heater coil in starter.
 - a. Rating in amperes.
 - b. Manufacturer's recommendation.
6. Motor RPM/driven equipment RPM.
7. Power reading (voltage, amperes of all legs at motor terminals).

3.8 DIRECT EXPANSION EQUIPMENT

- A. With each unit operating at near design conditions, measure and record the following:
 1. Manufacturer, model number, serial number and all nameplate data.
 2. Ambient temperature, condenser discharge temperature.
 3. Amperage and voltage for each phase.
 4. Leaving and entering air temperatures.
 5. Suction and discharge pressures and temperatures.
 6. Tons of cooling.
 7. Verification that moisture indicator shows dry refrigerant.

3.9 TAB REPORT

- A. The activities described in this specification shall be recorded in a report form; and four individually bound copies shall be provided to the Architect and Engineer. Neatly type and arrange data. Include with the data the date tested, personnel present, weather conditions, nameplate record of the test instruments used and list all measurements taken after all corrections are made to the system. Record all failures and corrective action taken to remedy any incorrect situation. The intent of the final report is to provide a reference of actual operating conditions for the Owner's operations personnel. Provide a "Preface" which shall include a general discussion of the system and any abnormalities or problems encountered.
- B. All measurements and recorded readings (of air, water, electricity, etc.) that appear in the report must have been recorded on site by the permanently employed technicians or engineers of the TAB firm.
- C. The TAB report shall be provided to Owner prior to substantial completion. Warranty on all HVAC equipment shall not begin until the Owner receives the full TAB report.
- D. Submit reports on forms approved by the engineer that will include the following data as a minimum:
 1. Title Page
 - a. Company Name
 - b. Company Address
 - c. Company telephone number
 - d. Project name
 - e. Project location
 - f. Project Manager
 - g. Project Engineer
 - h. Project Contractor
 - i. Project Identification Number
 2. Summary of the TAB report data
 3. Index

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4. Instrument List
 - a. Instrument
 - b. Manufacturer
 - c. Model
 - d. Serial Number
 - e. Range
 - f. Calibration Date
 - g. What test instrument is to be used for:
5. Fan Data
 - a. Location
 - b. Manufacturer
 - c. Model
 - d. Air flow, specified and actual
 - e. Total static pressure (total external) specified and actual
 - f. Inlet pressure
 - g. Discharge pressure
 - h. Fan RPM
6. Return Air/Outside Air Data
 - a. Identification/location
 - b. Design return air flow
 - c. Actual return air flow
 - d. Design outside air flow
 - e. Actual outside air flow
 - f. Return air temperature
 - g. Outside air temperature
 - h. Required mixed air temperature
 - i. Actual mixed air temperature
7. Electric Motors
 - a. Manufacturer
 - b. HP/BHP
 - c. Phase, voltage, amperage, nameplate, actual
 - d. PM
 - e. Service Factor
 - f. Starter size, heater elements, rating
8. V-Belt Drive
 - a. Identification/location
 - b. Required driven RPM
 - c. Drive sheave, diameter and RPM
 - d. Belt, size and quantity
 - e. Motor sheave, diameter and RPM
 - f. Center-to-center distance, maximum, minimum and actual
9. Duct Traverse
 - a. System zone/branch
 - b. Duct size
 - c. Area
 - d. Design velocity
 - e. Design air flow
 - f. Test velocity
 - g. Test air flow
 - h. Duct static pressure
 - i. Air correction factor

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10. Air Distribution Test Sheet
 - a. Air terminal number
 - b. Room number/location
 - c. Terminal type
 - d. Terminal size
 - e. Correction factor
 - f. Design velocity
 - g. Design air flow
 - h. Test (final) velocity
 - i. Test (final) air flow
11. Cooling Coil Data
 - a. Identification/number
 - b. Location
 - c. Service
 - d. Manufacturer
 - e. Entering air DB temperature, design and actual
 - f. Entering air WB temperature, design and actual
 - g. Leaving air DB temperature, design and actual
 - h. Leaving air WB temperature, design and actual
 - i. Air pressure drop, design and actual
 - j. Capacity - sensible and latent
12. Heating Coil Data
 - a. Identification/number
 - b. Location
 - c. Service
 - d. Manufacturer
 - e. Entering air DB temperature, design and actual
 - f. Leaving air DB temperature, design and actual
 - g. Air pressure drop, design and actual.
 - h. Capacity
13. Control verification indicating date performed and any abnormalities identified.
 - a. Point Location/Description
 - b. EMS Readout (Setpoint and Actual)
 - c. Actual Readout of all points
 - d. Interlocks
 - e. Safeties
 - f. Variable speed drive tracking with EMS input
 - g. Variable speed drive Bypass operation
 - h. Sequence of operation

END OF SECTION

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SECTION 230594

COORDINATION OF TESTING AND BALANCING

PART 1 - TESTING, BALANCING AND ADJUSTING

1.1 WORK INCLUDED

- A. Balancing and adjusting of the environmental systems is specified in Section 23 05 93.
- B. Coordination of the work is specified in this Section.

PART 2 - PRODUCTS / NOT USED

PART 3 - EXECUTION

3.1 COORDINATION

- A. Bring the work to a state of readiness for testing, balancing, and adjusting.
 - 1. Install air terminal devices.
 - 2. Provide specified filters in air handling equipment. Install clean filters just prior to the start of the test and balance work.
 - 3. Verify lubrication of equipment.
 - 4. Install permanent instrumentation.
 - 5. Clean piping systems and fill with clean water.
 - 6. Complete "Start-up" of equipment.
 - 7. Check rotation and alignment of rotating equipment and tension of belted drives.
 - 8. Verify ratings of overload heaters in motor starters.
 - 9. Verify that safety and operating control set points are as designed and automatic control sequences have been checked.
 - 10. Provide control diagrams and sequence of operation.
 - 11. Collect material for maintenance manuals and prepare one manual especially for use in testing and balancing.
 - 12. Verify that graphic operational data such as start/stop instructions, valve tag schedules, and piping identification schedules have been provided where needed.
 - 13. Verify that equipment and piping identification work has been completed with valve tags, schedules, and piping identification system.
 - 14. Comb out fins on extended-surface heat transfer coils where damaged.
 - 15. Clean all strainers as required.
 - 16. Remove construction strainers after water is cleaned and treated.
 - 17. Remove all temporary filters from HVAC equipment.
 - 18. Provide start-up reports listing all start-up information and manufacturer's information attached.
- B. Provide and install new pulleys and belts as required to affect the correct speed ratio. Adjustments where no belt or pulley change is required, is specified in Section 23 05 93.
- C. Verify that the systems are ready for balancing and adjusting.

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- D. Submit a letter stating:
 - 1. The specified pieces of equipment have been checked, started, and adjusted by the manufacturer.
 - 2. Other equipment has been checked and started.
 - 3. The systems have been operated for the specified period of time.
 - 4. The automatic controls system has been adjusted, calibrated, and checked, and is operating as specified.
- E. Provide the services of a technician full time at all times at the project when testing, balancing and adjusting work is being conducted.
- F. Provide instrumentation and services to take readings of the required data for the refrigerant circuits.
- G. Provide and install volume dampers required for balancing by the TAB Contractor.

3.2 START-UP OF EQUIPMENT

- A. Pre-start & Start-up equipment using the procedures as recommended by the manufacturers.
- B. Complete start-up of equipment prior to start of testing & balancing.
- C. Submit start-up procedures as outlined by the manufacturers and complete the "HVAC FAN / AIR HANDLING / START-UP REPORT FORM" to Engineer.

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SECTION 230713

EXTERNAL DUCT INSULATION

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install external insulation on supply, return, exhaust and outside air ductwork.
- B. External insulation of concealed and exposed ducts is included in this Section. Internal acoustic duct lining is specified under ductwork and not included in this Section.

1.2 RELATED WORK

- A. Division 9 - FINISHES. Painting and Color Coding.
- B. Division 23 - MECHANICAL
 - 1. Internal Duct Liner. Internal duct liner is specified in the section on ductwork.
 - 2. Insulation. Refer to specific sections on individual insulation types.
 - 3. Refer to insulation and liner plan detail.

1.3 QUALITY ASSURANCE

- A. The intent of insulation specifications is to obtain superior quality workmanship, resulting in an installation that is absolutely satisfactory in both function and appearance. Provide insulation in accordance with the specifications for each type of service and apply as recommended by the manufacturer and as specified.
- B. An approved contractor for this work under this Division shall be:
 - 1. A specialist in this field and have the personnel, experience, training, skill, and the organization to provide a practical working system.
 - 2. Able to furnish evidence of having contracted for and installed not less than 3 systems of comparable size and type that have served their Owners satisfactorily for not less than 3 years.
- C. All duct insulation used on the project inside the building must have a flame spread rating not exceeding 25 and a smoke developed rating not exceeding 50 as determined by test procedures ASTM E84, NFPA 255 and UL 723. These ratings must be as tested on the composite of insulation, jacket or facing, and adhesive. Components such as adhesives, mastics and cements must meet the same individual ratings as the minimum requirements and bear the UL label.
- D. Condensation on any insulated system is not approved.
- E. Replace insulation damaged by either moisture or other means. Insulation that has been wet, whether dried or not, is considered damaged. Make repairs where condensation is caused by improper installation of insulation. Also repair any damage caused by the condensation.
- F. Where existing insulated ductwork or other services are tapped, remove existing insulation back to undamaged sections and replace with new insulation of the same type and thickness as existing insulation. Apply as specified for insulation of the same service.

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- G. Fiberglass insulation shall not contain formaldehyde, asbestos, lead, mercury, mercury compounds, or poly-brominated diphenyl ether fire retardants.

1.4 APPROVALS

- A. Submittals. Submit product data on each insulation type, adhesive, and finish to be used in the work. Make the submittal as specified in Division 1 General Requirements and obtain approval before beginning installation. Include product description, list of materials and thickness for each service and location, and the manufacturer's installation instructions for each product.
- B. Sample Application. Make an application of each type of insulation to display the material, quality and application method. Obtain approval of the sample application before proceeding with installation of the work.

PART 2 - PRODUCTS

2.1 INSULATION

- A. Glass fiber rigid duct insulation.
1. Minimum density of 3 pcf, installed R value to be 6.0 (when located in a conditioned plenum) and minimum density of 0.75 pcf, installed R value to be 8.0 (when located in an unconditioned plenum) at 75°F mean, facing of 0.7 mil aluminum foil reinforced with glass yarn mesh and laminated to 40 lbs. fire-resistant Kraft. R-value to be indicated on exterior side of insulation to be verified by City inspector.
 2. Acceptable Manufacturers
 - a. Manson AK Board
 - b. Owens-Corning Type 703 Board FSK
 - c. Knauf Earthwool Board FSK
- B. Glass fiber blanket duct insulation.
1. Minimum density of 1.0 pcf, installed R value to be 6.0 (when located in a conditioned plenum) and minimum density of 0.75 pcf, installed R value to be 8.0 (when located in an unconditioned plenum) at 75°F mean, facing of 0.35 mil foil reinforced with glass yarn mesh and laminated to 40 lbs. fire resistant Kraft. R-value to be indicated on exterior side of insulation to be verified by City inspector.
 2. Acceptable Manufacturers
 - a. Johns Manville R-series Microlite FSKL
 - b. Owens-Corning SOFTR Duct Wrap
 - c. Knauf Performance+ Duct Wrap FSK
 - d. Manson Alley Wrap B Duct Wrap
- C. Fiberglass reinforcing cloth mesh.
1. Acceptable Manufacturers
 - a. Perma Glass Mesh
 - b. Alpha Glass Mesh
 - c. Childers Chil-Glas #10
 - d. Foster Mast a Fab
 - e. Vimasco
- D. Mastics, sealants, coatings and adhesives.
1. Acceptable Manufacturers
 - a. Childers
 - b. Foster
 - c. Vimasco

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2.2 COATING AND ADHESIVE

- A. Coating. Provide Childers CP-38 or Foster 30-80 vapor barrier coating. Coating must meet MIL Spec C-19565C, Type II and be QPL Listed. Permeance shall be 0.013 perms or less at 43 mils dry. Tested at 100°F and 90% RH per ASTM E96.
- B. Outdoors: Provide as insulation coating Childers Encacel X or Foster Monolar 60-90. Permeance shall be 0.03 perms or less at 30 mils dry. Tested at 100°F and 90% RH per ASTM F 1249.
- C. Adhesive. Provide Childers CP-82 or Foster 85-20 vapor barrier adhesive.
- D. Reinforcing Mesh. Provide 10 x 10 white glass or polyester reinforcing mesh.

PART 3 - EXECUTION

3.1 FIRE SAFETY REQUIREMENTS

- A. Do not extend duct coverings through walls or floors required to be fire-stopped or required to have a fire resistance rating. Interrupt duct coverings in the immediate vicinity of heat sources such as electric resistance or fuel-burning heater.

3.2 CONCEALED DUCT

- A. Provide flexible glass fiber insulation with factory-applied, reinforced UL labeled Foil-Skrim-Kraft (FSK) facing.
- B. Standing Seams. Insulate standing seams and stiffeners, which protrude through the insulation with 0.6 lb. per cubic foot density, 1-1/2" thick, faced, flexible blanket insulation. Insulation shall not prevent adjustment of damper operators.
- C. Insulation shall be wrapped tightly on the ductwork with all circumferential joints butted and longitudinal joints overlapped a minimum of 2". Duct wrap insulation shall not be compressed more than 25% during installation. In addition, for all ducts 18" and wider, secure insulation to the bottom of rectangular ductwork by the use of either weld pins with washers or cup-head pins welded to the ductwork or perforated based insulation hangers glued to the duct on twelve-inch centers to prevent sagging of insulation.
- D. On circumferential joint, the 2" flange on the facing shall be stapled with 9/16" outward clinch steel staples on 2" centers and taped with a minimum 3" wide strip of glass fabric embedded in coating. Cover all seams, joints, pin penetrations and other breaks with vapor barrier coating reinforced with reinforcing mesh. Fabric shall not be visible after coating.
- E. Ductwork in mechanical rooms is considered concealed spaces.

3.3 EXPOSED DUCT INSULATION

- A. Ductwork in exposed locations is to be insulated with fiberglass rigid / semi-rigid board insulation.
 - 1. Apply fabric and mastic to provide a smooth surface for painting.
- B. Standing Seams: Insulate standing seams and stiffeners which protrude through the insulation with 0.6 lb per cubic foot density, 1-1/2 inch thick, faced insulation. As a vapor seal, use reinforcing mesh with vapor barrier coating. Insulation shall not prevent adjustment of damper operators.

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- C. Adhere insulation to ductwork with adhesive. In addition, for all ducts 18" and wider, secure insulation to the bottom of rectangular ductwork by the use of either weld pins with washers or cup-head pins welded to the ductwork or perforated based insulation hangers glued to the duct on 12-inch centers to prevent sagging of insulation.
- D. Cover all seams, joints, pin penetrations and other breaks with coating reinforced with reinforcing mesh. Fabric shall not be visible after coating.

3.5 GENERAL INSTALLATION

- A. Install materials in accordance with manufacturer's instructions and the North American Commercial and Industrial Insulation Standards manual.
- B. Apply insulation on clean, dry surfaces only.
- C. Continue insulation with vapor barrier through penetrations.
- D. Neatly finish insulation at supports, protrusions and interruptions.
- E. Install insulation on clean, dry surfaces, and only after building is weatherproofed sufficiently to preclude any rainwater on insulation.
- F. Apply mastic over the fiberglass reinforcing mesh to a thickness where fabric is not visible after completion.
- G. Install fiberglass blanket duct insulation on top of supply air grilles not fire rated.

END OF SECTION

SECTION 230719

HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install piping insulation, jackets, accessories and covering of specified materials. The insulation shall be used for high and low temperature piping applications including refrigerant and condensate piping.

1.2 QUALITY ASSURANCE

- A. The intent of insulation specifications is to obtain superior quality workmanship resulting in an installation that is absolutely satisfactory in both function and appearance. Provide insulation in accordance with the specifications for each type of service and apply as recommended by the manufacturer and as specified.
- B. An approved contractor for this work under this Division shall be:
 - 1. A specialist in this field and have the personnel, experience, training, skill, and the organization to provide a practical working system.
 - 2. Able to furnish evidence of having contracted for and installed not less than 3 systems of comparable size and type that have served their owners satisfactorily for not less than 3 years.
- C. All piping insulation used on the project inside the building must have a flame spread rating not exceeding 25 and a smoke developed rating not exceeding 50, as determined by test procedures ASTM E 84, NFPA 255 and UL 723. These ratings must be as tested on the composite of insulation, jacket or facing, and adhesive. Components such as adhesives, mastics and cements must meet the same individual ratings as the minimum requirements and bear the UL label.
- D. Condensation on any insulated piping system is not acceptable.
- E. Replace insulation damaged by either moisture or other means. Insulation that has been wet, whether dried or not, is considered damaged. Make repairs where condensation is caused by improper installation of insulation. Also repair any damage caused by the condensation.
- F. Where existing insulated piping, or other surfaces are tapped, remove existing insulation back to undamaged sections for hot surfaces or to nearest insulation stop for cold surfaces, and replace with new insulation of the same type and thickness as existing insulation. Apply as specified for insulation of the same service.
- G. Fiberglass insulation shall not contain formaldehyde, asbestos, lead, mercury, mercury compounds, or poly-brominated diphenyl ether fire retardants.

1.3 SUBMITTALS

- A. Submit product data on each insulation type, adhesive, and finish to be used in the work. Make the submittal as specified in General Requirements and obtain approval before beginning installation. Include product description, list of materials and thickness for each service and location and the manufacturer's installation instructions for each product.

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- B. Make a field application of each type of insulation to display the material, quality and application method. Obtain approval of the sample application before proceeding with installation of the work.

1.4 RELATED WORK

- A. Finishes. Painting and color-coding

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Elastomeric Insulation
 - 1. Armacell
 - 2. Aeroflex
- B. Weather Resistant Coating
 - 1. WB Armaflex Finish
 - 2. Foster 30-64
- C. Aluminum Jacketing:
 - 1. Johns Manville
 - 2. RPR Products

2.2 ELASTOMERIC INSULATION

- A. Insulation material shall be flexible, closed-cell elastomeric insulation in tubular or sheet form. Material shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less when tested in accordance with ASTM E84, latest revision. Sheet material with a thickness greater than $\frac{3}{4}$ " shall have a flame spread rating of 25 or less and a smoke developed rating of 100 or less when tested in accordance with ASTM E84, latest revision. In addition, the product, when tested, shall not melt or drip flaming particles, and the flame shall not be progressive. In addition, all materials shall pass simulated end-use fire test.
 - 1. Thermal conductivity 0.27 at 75°F mean (ASTM C177 or C518)

2.3 ALUMINUM JACKETING

- A. Smooth prefabricated Z-lock aluminum jacket 0.020" thick with factory applied 1 mil polyethylene/40 lb and Fab strap. Kraft moisture barrier.
- B. Valves, Fittings and Flanges. For finishing valves, fittings, flanges and similar installations, provide formed aluminum covers, 0.024" thick.
- C. Straps and Seals. Provide $\frac{1}{2}$ " x 0.020 stainless steel strapping and seals for jackets and covers according to manufacturer's recommendations.

PART 3 - EXECUTION

3.1 REFRIGERANT AND CONDENSATE PIPING

- A. Cover all pipe with elastomeric insulation by slitting tubular sections or sliding unslit sections over the open ends of piping or tubing. Seams and butt joints shall be adhered and sealed using Foster 85-75, Childers CP-82 or Armstrong 520 Adhesive.

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- B. All fittings shall be insulated with the same insulation thickness as the adjacent piping. All seams and mitered joints shall be adhered with Foster 85-75, Childers CP-82 or 520 Adhesive.
- C. Pipe Saddles: Formed galvanized sheets at each support point for insulated pipe, shaped to fit pipe, and covering bottom half of pipe. Length at saddle shall be not less than twice the insulation outside diameter.
- D. Outdoor exposed piping insulation shall be protected from damage due to sunlight, moisture, equipment maintenance, wind, and solar radiation. Adhesive tape shall not be permitted. Finish outdoor condensate piping with two coats of either Armaflex WB Finish or Foster 30-64 elastomer foam coating. Finish outdoor refrigerant piping with aluminum jacketing as specified.

3.2 ALUMINUM JACKETING

- A. Apply smooth aluminum jacket on piping, valves, fittings and flange covers according to manufacturer's recommendations, using stainless steel strapping and seals, to provide weather tight covering and to shed water.
- B. Aluminum jacketing is not considered as contributing to the vapor barrier or the insulation jacket. The vapor barrier must be sufficient in itself for this function. Lap each adjoining jacket section a minimum of 3" to make a weather tight seal with the application of 1/8" bead of Childers CP-76 or Foster 95-44 metal jacketing sealant.
- C. Install straps on 9" centers and at each circumferential lap joint.
- D. Cover and seal all exposed surfaces.
- E. The use of screws and rivets is not approved.
- F. Provide isolation (30# felt) between the aluminum jacket and the sheetmetal protection shield at each pipe support point.

3.3 MISCELLANEOUS

- A. Install materials after piping has been tested and approved.
- B. Apply insulation on clean, dry surfaces only.
- C. Apply weather protective finish on elastomeric insulation installed in non-conditioned spaces. Provide a minimum of three coats.
- D. Install materials in accordance with manufacturer's instructions and North American Commercial and Industrial Insulation Standards manual.

3.4 INSULATION THICKNESS

<u>INSULATED UNIT</u>	<u>THICKNESS</u> <u>(Inches)</u>
Condensate Drains	1
Refrigerant Piping	1-1/2

END OF SECTION

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SECTION 230800

MECHANICAL COMMISSIONING COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section outlines commissioning requirements and activities of Contractor, Owner, CxA and Design Professionals as related to the Division 23 Mechanical.
- B. Related Sections:
 - 1. Division 22 – Plumbing
 - 2. Division 23 – Mechanical
 - 3. Division 26 – Electrical

1.2 DEFINITIONS

- A. Refer to Specification Section 01 91 13, General Commissioning for definitions.

1.3 CONTACT INFORMATION

- A. The Owner will contract directly for commissioning services.
 - 1. Commissioning Agent fee will be paid for directly by the owner.
 - 2. Cost of contractor coordination with the CxA is specified in this section.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. Contractor shall provide all standard and specialized testing equipment required to perform Start-up and Functional Performance Testing. Test equipment required for Functional Performance Testing including, but not limited to equipment listed below. Data logging equipment and software required to test equipment shall be provided by the Contractor.
- B. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 1.0°F and a resolution of + or - 0.2°F. Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year. All equipment shall be calibrated according to the manufacturer's recommended intervals and following any repairs to the equipment. Calibration tags shall be affixed or certificates readily available.
- C. Test equipment includes:
 - 1. Air flow measuring devices (hoods, anemometers, etc.)
 - 2. Water flow measuring devices
 - 3. Temperature measuring devices (air and water)
 - 4. Humidity sensors
 - 5. Pressure gauges (air and water)
 - 6. CO2 sensors

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2.2 OTHER CONTRACTOR PROVIDED EQUIPMENT

- A. Ladders and/or lifts and appropriate fall protection as required by Contractor site requirements.

PART 3 - EXECUTION

3.1 COORDINATION - GENERAL

- A. Except for the activities to be performed by the CxA called for herein, all component and system installation work required by the Division 22, 23 and 26 specifications including specific contractor furnished items indicated by this Section shall be provided by the Contractor.

3.2 SUBMITTALS

- A. Mechanical
 - 1. Ductwork Layouts
 - 2. Piping Layouts
 - 3. Equipment Room Layouts
 - 4. Mechanical Equipment as needed

3.3 EQUIPMENT START-UP

- A. Notification
 - 1. Contractor shall provide ten Owner business days' notice to CxA, Owner and Design Team of start-up dates.
- B. Prior to start-up, contractor shall:
 - 1. Verify that equipment and systems are complete, accessible, correctly connected to utilities and ready for operation. Perform all pre-start inspections and tests as called for in Division 23.
 - 2. Comply with pre-start requirements of manufacturer and complete applicable documentation.
 - 3. Complete applicable sections of Prefunctional Checklists.
 - 4. Coordinate start-up attendance by manufacturer or authorized representative as required by specifications or manufacturer.
- C. At start-up, contractor shall:
 - 1. Supervise the activities of the authorized start-up technician or manufacturer's representative.
 - 2. Verify proper voltage, phase, overcurrent protection, drive rotation and any other conditions that may cause damage if not correct.
 - 3. Execute start-up under supervision of qualified contractor and equipment manufacturer personnel and in accordance with the manufacturer's instruction.
 - 4. Complete manufacturer start-up requirements and documentation. Provide a copy of documentation to the CxA for inclusion in the Cx Manual.
 - 5. Complete PFC's and provide documentation to CxA.
 - 6. Provide documentation of any issues noted during start-up to CxA, Owner and Design Team. Outline recommendations for corrective action.

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3.4 PIPE AND DUCT PRESSURE/LEAKAGE TESTING

- A. General
 - 1. The following procedures are meant as general procedures and do not alleviate Contractor of more stringent procedures specified elsewhere in Division 23.
- B. Notification
 - 1. Contractor shall provide adequate notice to CxA, Owner and Design Team of testing dates.
- C. Duct Pressure Testing:
 - 1. Prior to testing, contractor shall:
 - a. Select duct sections with approval by Design Team.
 - b. Calculate duct areas and acceptable leakage rates.
 - c. Verify that test equipment is of appropriate capacity for duct sections tested. Ideally, the pressure testing equipment will be at the midpoint of the system tested.
 - d. Verify that test equipment has been calibrated with NIST traceable certificates within the past 12 months or shorter time span if specified elsewhere in Division 23.
 - e. Isolate and seal duct sections.
 - 2. During testing, contractor shall:
 - a. Conduct testing in a safe manner.
 - b. Operate test equipment at a minimum of 3" wg for ductwork between AHU and terminal unit, or as specified elsewhere in Division 23.
 - c. Operate test equipment at a minimum of 2" wg for ductwork downstream of terminal units and exhaust ductwork, or as specified elsewhere in Division 23.
 - d. Record all applicable test data.
 - 3. Upon completion of testing, contractor shall:
 - a. Remedy sections that do not pass and schedule a retest.
 - b. Submit test results to Owner, Design Team and CxA for review.
- D. Pipe Pressure Testing
 - 1. Prior to testing, contractor shall:
 - a. Verify that test equipment has been calibrated with NIST traceable certificates within the past 12 months or shorter time span if specified elsewhere in Division 23.
 - b. Isolate and seal pipe sections to be tested.
 - c. Isolate equipment or apparatus connected to the piping system that may be damaged during the testing.
 - d. Clean and flush piping sections and fill with clean water, venting all air.
 - e. Allow adequate time for water and piping to reach ambient temperature.
 - 2. During testing:
 - a. Maintain a safe condition in the area surrounding the test system.
 - b. Pressurize piping to 150% of design working pressure, but not greater than piping design pressure.
 - c. Pipe shall hold pressure for minimum of 2 hours.
 - d. Record temperature of piping and ambient air at beginning and end of test.
 - e. Record pressure on piping system at beginning and end of test.
 - 3. Upon completion of testing, contractor shall:
 - a. Remedy sections that do not pass and schedule a retest.
 - b. Submit test results to Owner, Design Team and CxA for review.

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3.5 PRE-FUNCTIONAL CHECKLISTS

- A. Contractor shall forward completed copies of PFCs to the CxA for inclusion into the Cx documentation. PFCs will be provided by the CxA. As an alternate, contractor shall submit their versions of the PFCs to the CxA for review and comment.
- B. Contractor shall complete PFC for each of the following equipment:
 - 1. Mechanical:
 - a. Split Systems
 - b. Fans

3.6 TEST AND BALANCE

- A. Contractor shall forward the T&B Execution Plan to the CxA prior to performing the field T&B activities. CxA will review and comment on Plan.
- B. Contractor shall notify CxA a minimum of three (3) days prior to conducting field T&B activities. Failure to provide CxA with adequate notification may result in additional field time by T&B Contractor to demonstrate T&B results.
- C. Key T&B activities that CxA requires notification on:
 - 1. Packaged Rooftop Units

3.7 FUNCTIONAL TESTING

- A. General
 - 1. Contractor shall organize and schedule Construction Team members to execute the functional testing, which will be directed by CxA. Construction Team members may include Mechanical Sub, T&B Sub, Controls Sub, Electrical Sub, Fire Alarm Sub or Plumbing Sub. Contractor shall note that certain activities, such as sensor calibration, can be organized so that the T&B Sub is scheduled efficiently.
- B. Packaged Rooftop Units
 - 1. Graphics
 - 2. Start/Stop/Schedule
 - 3. Fan Operation (On/Off/Hand/Auto)
 - 4. Temperature Calibration (Air/Water)
 - 5. Damper Positions (Off/On/Safety)
 - 6. Safeties (Low Limit/Smoke Detectors/Fire Alarm/Static Pressure)
 - 7. Alarms (Filter/Temperature/etc.)
 - 8. Damper Operation (Normal/Economizer)
 - 9. Fan Speed Control (VFD)
- C. Fans
 - 1. Graphics
 - 2. Start/Stop/Schedule
 - 3. Thermostat Operation
 - 4. Flow Station Calibration
 - 5. Pressure Sensor Calibration
 - 6. Speed Control (VFD)
 - 7. Sequencing and Alarms

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- D. Split Systems
 - 1. Graphics
 - 2. Start/Stop/Schedule
 - 3. Fan Operation (On/Off/Hand/Auto)
 - 4. Temperature Calibration
 - 5. Thermostat Operation
 - 6. Safeties (Low Limit/Smoke Detectors/Fire Alarm/Static Pressure)
 - 7. Alarms (Filter/Temperature/etc.)
 - 8. Fan Speed Control (VFD)

3.8 TREND DATA

- A. Contractor shall enable trend data as indicated herein and as specified by contract documents and Owner's requirements. Trends shall be stored to a repository device that can be recalled at any time period. Sampling rate shall vary based upon the trend and may range from change of value (COV) to a maximum of 15 minutes.
- B. Ambient (Outdoor) Conditions
 - 1. Dry Bulb Temperature
 - 2. Wet Bulb Temperature
 - 3. CO2 Level
- C. Packaged Rooftop Unit Supply Air
 - 1. Supply Air Temperature
 - 2. Supply Air Temperature Setpoint
 - 3. Mixed Air Temperature
 - 4. Mixed Air Temperature Setpoint
- D. Split System Units
 - 1. Room Temperature
 - 2. Room Temperature Setpoint
 - 3. Supply Air Temperature
 - 4. Fan Status
 - 5. Cooling/Heating Mode
- E. Fans
 - 1. Room Temperature
 - 2. Room Temperature Setpoint
 - 3. Fan Status/Speed

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SECTION 230933

BUILDING MANAGEMENT AND CONTROL SYSTEM

PART 1 - GENERAL

1.1 SCOPE

- A. This specification section addresses the existing control system modifications and expansions associated with the addition of new equipment at existing campus. The existing Building Management and Control System is Reliable Controls by Enviromatic Systems. Provide and install all Building Management and Control System (BMCS) components required for the equipment being added, including industrial instrumentation necessary to obtain functions and results specified.
 - 1. Any new or modified equipment or systems shall be provided with new controls and all associated components including but not limited to sensors, valves, dampers, valve and damper operators, DDC panels, relays, terminal equipment controllers, mounting brackets and thermowell, etc. and be part of a new control system. Integrate all components to provide a complete and functioning system. Disconnecting and removal of the existing controls from the existing equipment being demolished is responsibility of this contractor and shall be coordinated prior to the start of demolition. Modified equipment or systems is inclusive of any system that is having any HVAC scope being performed, i.e. ductwork modifications.
 - 2. All existing equipment to remain throughout all buildings on the campus shall continue to be on the existing control systems and remain fully operational throughout construction. Existing control system shall be protected and preserved. Contractor shall schedule with owner, architect and engineer three meetings to demonstrate and review the current operation and state of the existing control system, prior to construction, midway through construction and prior to substantial completion. The control system state noted at the first demonstration and review session shall be maintained for the entire duration of construction. If items are found to be nonfunctional at the middle and last demonstration and review that weren't noted in the first review session, the contractor shall be responsible for restoring those items to their original operating state with no costs to the owner.
 - 3. Upon completion of construction the campus will consist of a single control system for all new and existing equipment and systems associated with the existing campus and new additions.
- B. Temperature Control System components:
 - 1. Electronic instruments as specified
 - 2. Electric instruments as specified
 - 3. Microcomputer instruments as specified
- C. All control devices of the same type product shall be of a single manufacturer.
- D. Control, power and interlock wiring necessary to accomplish sequences specified in this Section shall be provided and installed by the Control Subcontractor. Materials and methods of execution as specified in Division 26, Electrical.
 - 1. Coordinate current characteristics of all electrical instruments and equipment with Division 26 of the specifications and related electrical drawings.

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- E. The entire Building Management and Control System (BMCS) shall be installed by the Automation System Manufacturer or Authorized Distributor.
 - 1. All components and elements
 - 2. The testing and acceptance procedure
- F. The manufacturer of the building automation system shall provide documentation supporting compliance with ISO-9002 (Model for Quality Assurance in Production, Installation, and Servicing). The intent of this specification requirement is to ensure that the products from the manufacturer are delivered through a Quality System and Framework that will assure consistency in the products delivered for this project.
- G. The entire Building Management and Control System (BMCS) shall be installed, Commissioned, and tested; all performed by the Automation System Manufacturer or Authorized Distributor if approved by engineer.
 - 1. All components and elements.
 - 2. Start-up and point verification.
 - 3. The testing and acceptance procedure.

1.2 RELATED WORK

- A. Division 23, Mechanical
- B. Division 26, Electrical

1.3 SUBMITTALS

- A. Submit items of the Building Management and Control System (BMCS).
 - 1. Temperature control equipment & Field devices.
 - 2. Wiring & Flow diagrams.
 - 3. Sequence of operation.
 - 4. Complete, detailed, control and interlock-wiring diagram.
 - 5. Indicate mechanical and electrical equipment furnished and electrical interlocks, indicating terminal designation of equipment. Respective equipment manufacturers shall furnish through the Mechanical Contractor, approved drawings of equipment to be incorporated in this diagram.
 - 6. Submit Input / Output summary of all points.
 - 7. Submit an outline of testing procedures from section Testing and Acceptance.
 - 8. Mark up a copy of the specifications for the product. Indicate in the margin of each paragraph the following: "Comply", "Do Not Comply", or "Not Applicable". Explain all "Do Not Comply" statements.
 - 9. Submit sample of space temperature sensor and guards for review prior to purchase or installation.

1.4 COOPERATION WITH OTHER TRADES

- A. Furnish control valves, temperature sensing element wells, flow and pressure sensing devices, dampers and other similar devices to the Mechanical Contractor in a timely manner for installation under the Building Management and Control System (BMCS), Subcontractor's supervision.

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1.5 WARRANTY

- A. Provide with a manufacturer's parts and labor warranty for a period of one year from substantial completion.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. The BMCS system shall be an extension to and 100% compatible with the Owner's existing BACnet Building Management Control System. Communications will be over Owner's wide area network. Provide the latest version of software for the proposed system (must include animated graphics, DDC graphical programming, multipoint trending, scheduling and all configuration software and a software license). The operator's workstation, all building controllers, application controllers, and all input/output devices shall communicate using an open protocol. In other words, all workstations and controllers, including unitary controllers, shall be open protocol devices. No gateways shall be used for communication to controllers installed under this section.
- B. Approved Bidders:
 - 1. Reliable Controls by Enviromatic Systems.

2.2 SYSTEM ARCHITECTURE

- A. The Building Management and Control System (BMCS) shall consist of an information-sharing network of stand-alone Direct Digital Control Panels (DDCP) to monitor and control equipment as specified of the control sequence and input/output summary.
- B. "Information sharing" shall be defined as: The function of each DDCP to exchange data on the network trunk with other DDCP's without the need for additional devices such as network managers, gateways or central computers.
- C. "Stand-alone" shall be defined as: The function of each DDCP to independently monitor and control connected equipment through its own microcomputer.

2.3 COMMUNICATIONS PROCESSING

- A. The BMCS shall operate as a true token-pass peer-to-peer communication network. Resident processors in each DDCP shall provide for full exchange of system data between other DDCP's on the network trunk. Systems that limit data exchange to a defined number of system points are not acceptable.
- B. Systems that operate via polled response or other types of protocols that rely on a central processor or similar device to manage DDCP to DDCP communications may be considered only if a similar device is provided as a stand-by. Upon a failure or malfunction of the primary device, the stand-by shall automatically, without any operator intervention, assume all BMCS network management activities.
- C. The failure of any DDCP on the network shall not affect the operation of other DDCP's. All DDCP failure shall be annunciated at the specified alarm printers and terminals.
- D. Network shall support a minimum communications speed of 115.2 Kbps.
- E. The network shall support a minimum of 100 DDC controllers and PC workstations.

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- F. Each PC workstation shall support a minimum of 4 peer-to-peer networks, either by hardwired connection or dial up.
- G. The system shall support integration of third-party systems (fire alarm, security, lighting, PCL, via panel mounted open protocol processor. This processor shall exchange data between the two systems for inter-process control. All exchange points shall have full system functionality as specified herein for hardwired points. Provide examples of 5 reference projects utilizing gateways required for this project.

2.4 DDCP HARDWARE

- A. Each DDCP shall consist of a 32-bit microprocessor and controller, power supply, input / output boards and communication board. All program and point databases shall be stored in battery-backed RAM. Provide a minimum of 1.2 MEG RAM in each DDCP to allow for point expansion and trend data storage.
- B. Each DDCP shall incorporate a real-time clock.
- C. Each DDCP shall be provided with two RS232 communications port. Connecting an operator terminal, whether portable or stationery, shall allow the user to communicate with the entire network.
- D. Each DDCP shall provide for input / output connections to field equipment. The following point types shall be supported:
 - 1. Analog inputs - for measuring sensed variables. Inputs shall be capable of accepting voltage, resistance, current or pressure signals.
 - 2. Analog outputs - for controlling end devices. Outputs shall be capable of producing voltage, resistance, current or pressure signals. Pneumatic outputs shall be provided with a manual override for adjusting outputs in the event of a power loss at the DDCP.
 - 3. Digital inputs - for monitoring dry contacts such as relays, switches, pulses, etc.
 - 4. Digital outputs - to control two position devices such as starters, actuators, relays, etc.
- E. Each DDCP shall be listed under UL916 (Energy Management Systems), and shall be tested to comply with sub-part J of Part 15 FCC rules for Class A computing equipment.
- F. Each DDC Controller shall have sufficient memory to support its own operating system and databases, including:
 - 1. Control processes
 - 2. Energy management applications
 - 3. Alarm management applications including custom alarm messages for each level alarm for each point in the system.
 - 4. Historical/trend data for points specified
 - 5. Maintenance support applications
 - 6. Custom processes
 - 7. Operator I/O
 - 8. Dial-up communications
 - 9. Manual override monitoring

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- G. Operator shall have the ability to manually override automatic or centrally executed commands at the DDC Controller via local, point discrete, on-board hand/off/auto operator override switches for digital control type points and gradual switches for analog control type points.
 - 1. Switches shall be mounted either within the DDC Controllers key-accessed enclosure, or externally mounted with each switch keyed to prevent unauthorized overrides.
 - 2. DDC Controllers shall monitor the status of all overrides and inform the operator that automatic control has been inhibited. DDC Controllers shall also collect override activity information for reports.
- H. DDC Controllers shall provide local LED status indication for each digital input and output for constant, up-to-date verification of all point conditions without the need for an operator I/O device. Graduated intensity LEDs or analog indication of value shall also be provided for each analog output. Status indication shall be visible without opening the panel door.
- I. In the event of the loss of normal power, there shall be an orderly shutdown of all DDC Controllers to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 72 hours.
 - 1. Upon restoration of normal power, the DDC Controller shall automatically resume full operation without manual intervention.
 - 2. Should DDC Controller memory be lost for any reason, the user shall have the capability of reloading the DDC Controller via the local RS-232C port, via telephone line dial-in or from a network workstation PC.
 - 3. Upon restoration of normal power, the DDC Controller shall automatically resume full operation without manual intervention.

2.5 PROGRAMMING FUNCTIONS

- A. Resident software in each DDCP shall provide custom programming of control strategies.
 - 1. Point database
 - 2. Operator interface
 - 3. Network communications
 - 4. Facilities and energy management functions
- B. Programming of control and energy management strategies shall be accomplished via a high-level computer language such as BASIC, JC BASIC, C, or Powers Process Control Language. A standard math processor shall be part of the programming language. All analog loops shall be capable of proportional, integral and derivative control.
- C. Each DDCP shall incorporate an operator interface program (OIP) that provides an English language user interface. The OIP shall allow the user to program, interrogate, command and edit the BMCS via a self-prompting method. Operator terminals, whether textual or graphical, shall be able to access the entire network from any DDCP. Access shall be accomplished in a transparent fashion; that is, the operator shall not be required to address specific DDCP's in order to display or command system points.

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2.6 FACILITY MANAGEMENT SOFTWARE

- A. The BMCS shall be provided with standard and custom report generation functions that include:
 - 1. Alarm summaries
 - 2. Motor status summaries
 - 3. Point displays by type, system, status, overrides, failures, location, equipment and enabled/disabled.
 - 4. Program listings
- B. All reports shall be either displayed or printed by:
 - 1. Operator request.
 - 2. Time of day.
 - 3. Event conditions (such as in response to an alarm, interlock, etc.).
- C. All reports shall be time and date stamped.
- D. An alarm-processing program shall be provided to annunciate those points designated as alarmable. Alarm points shall, upon alarm occurrence, be displayed or printed at designated terminals.
- E. Historical trend data shall be collected and stored at each DDCP for later retrieval. Retrieval shall be manual or automatic. Any point, physical or calculated, may be designated for trending. The system shall allow for two methods of trend collection: Either by a pre-defined time interval sample or upon a pre-defined change of value. Trend data shall be presented in a columnar format. Each sample shall be timed stamped. Trend reports may be a single point or may be a group of points, up to a maximum of (8) points in any single group. Any point, regardless of physical location in the system may become part of a multiple point group.
- F. Trend and historical data shall be gathered and recorded for digital/binary and analog points and include but not be limited to sensors values, damper position, valve position, and relative humidity. Digital/binary points shall be change of value trend and analog points shall be trended on a 15-minute interval (adjustable per point). Data shall be available to be displayed in a chart form and allow for multiple values to be trended on a single chart. All trends shall be passed through to the front end to be permanently stored.
- G. Each BMCS network shall provide a point-monitoring function that can display single or multiple points in a continuous updated fashion for dynamic displays of point values.
- H. A database and configuration report program shall be provided that allows the user to interrogate BMCS status. As a minimum, the user shall be able to: Verify available RAM at each DDCP, verify DDCP status (on-line, off-line, and failed) and set the system clock.
- I. Any invalid operator entry shall result in an error message.
- J. DDCP's shall contain a password access routine that will assign an operator to one of three level of access. Level 1 shall permit display function only; level 2 shall additionally permit commanding of system points and level 3 shall additionally permit full program and database editing.
- K. DDCP's shall provide for the accumulation of totalized values for the purposes of run-time or energy totalization. Totalized values may be displayed or printed automatically or by operator request.

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2.7 ENERGY MANAGEMENT SOFTWARE

- A. The BMCS shall be provided with an optimal start program such that the building may be divided into ten zones for optimum start. Warm-up and cool-down shall occur in sequence with succeeding zones starting only after the preceding zone has completed its warm-up or cool-down.
 - 1. The optimum start-up time of assigned equipment shall be determined based on a software calculation that takes into consideration outdoor air conditions, space conditions, and building thermal characteristics ("U" factor).
 - 2. The optimum start program shall control start-up of the cooling and heating equipment to achieve the target occupancy space temperature at the precise time of building occupancy.
 - 3. A built-in "learning" technique shall cause the BMCS to automatically adjust itself to the most effective time to start equipment based on historical data.
- B. The BMCS shall be provided with an operator interactive time of day (TOD) program. TOD programming and modifying shall be accomplished in a calendar-like format that prompts the user in English language to specify month, year, day and time and associated point commands. It shall be possible to assign single points or groups of points to any on or off time. Appropriate time delays shall be provided to "stagger" on times.
 - 1. TOD shall incorporate a holiday and special day schedule capability, which will automatically bring up a pre-defined holiday or special day schedule of operation. Holidays or special days can be scheduled up to one year in advance.
 - 2. In addition to the time dependent two-state control, TOD also provides time dependent setpoint control. This control provides the capability to output assignable, proportional setpoint values in accordance with the time of day and day of week. This program shall be used to accomplish night setback, morning warm-up and normal daily operating setpoints of all control system loops controlled by the BMCS. As with the two-state control, time dependent setpoint control shall be subject to the holiday schedule. The setpoints desired shall be user definable at any operator terminal.
 - 3. The operator shall be capable of reading and/or altering all sorted data pertaining to time of day, day of week, on/off times, setpoint values, and holiday designation.
 - 4. The TOD program shall also provide an override function that allows the user to conveniently change a start or stop time for any point up to one week in advance. The override command shall be temporary. Once executed the TOD program shall revert to its original schedule.
 - 5. The TOD program shall interface with the optimal start program (OSP) such that stop times may be assigned by OSP.
 - 6. Schedules shall be quickly accessible by no more than two mouse clicks from all graphical pages. Schedules shall incorporate an area for users to add notes for description of event and author names.
 - 7. System shall allow user defined common space group schedule creation and be fully customizable. For example, groups such as all kitchens, all gyms, all athletics, all hallways, etc.
 - 8. System shall incorporate schedule modifications immediately and utilize the new schedule from time of creation.
 - 9. System shall notify user of schedule not downloading and event not occurring as planned.
 - 10. Schedules shall be fully accessible from mobile devices and use a scalable or responsive technology to provide full capabilities and functionality that is provided with the desktop software. Refer to Web Server requirements for mobile devices.

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- C. Additional Program functions required are to be installed and programmed as requested by end user at no additional cost:
 - 1. Enthalpy optimization.
 - 2. Supply air reset.
 - 3. Volumetric control.
 - 4. Dead band control. Install single set point as requested by user.
 - 5. Carbon dioxide based demand control ventilation.
 - 6. All specified energy management programs, whether or not applicable to this project shall be provided such that the owner may enable the program at a future date without the need to purchase additional software or modify existing software.

2.8 WEB SERVER ACCESSIBILITY

- A. Industry leading encryption technology to provide accessibility through a web browser.
- B. Building Manager's ability to access, view and command critical building information in real time over the intranet or internet.
 - 1. Alarm Display
 - 2. Point Commanding
 - 3. Graphic Display
 - 4. Scheduling
 - 5. Running Reports
 - 6. Point Details
- C. Building Manager's access must be compatible with a wide range of mobile device platforms including but not limited to Apple IOS, Android, and Microsoft Windows. Mobile access shall match features and abilities available via a desktop computer browser.

2.9 REMOTE NOTIFICATION

- A. Remote notification sends Alarm and System Event information to various notification devices as indicated below but not limited to. Operators can receive their building automation system alarms without restricting them to dedicated workstations.
 - 1. Cell phones via text messaging
 - 2. Email
 - 3. Phones via voice message service

2.10 POINT EXPANSION MODULES

- A. Capable of extending its input/output capabilities via special purpose modules.
 - 1. Modules may be mounted remote from the DDCP.
 - 2. Shall communicate with the DDCP over a pair of twisted cables.
 - 3. Operator shall have the ability to manually override automatic or centrally executed commands at the DDC Controller via local, point discrete, on-board hand/off/auto operator override switches for digital control type points and gradual switches for analog control type points.

2.11 TERMINAL EQUIPMENT CONTROLLERS

- A. Provide for control of each piece of equipment, including, but not limited to, the following:
 - 1. Unit Conditioners
 - 2. Unit Ventilators
 - 3. Fan Coil Units

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- B. Include the following items:
1. All input and outputs necessary to perform the specified control sequences.
 2. Analog outputs shall be industry standard signals such as 24V floating control.
 3. Sufficient memory to accommodate point database, operating programs, local alarming and local trending.
 4. All databases and programs shall be stored in non-volatile EEPROM, EPROM and PROM, or minimum of 100-hour battery backup shall be provided.
 5. Return to full normal operation without user intervention after a power outage of unlimited duration.
 6. Operation programs shall be field selectable for specific applications.
 7. Specific control strategy requirements, allowing for additional system flexibility.
 8. Controllers that require factory changes of all applications are not acceptable.
 9. The failure of any terminal equipment controllers on the network shall not affect the operation of other terminal equipment controllers and be capable of standalone operation. All terminal equipment controller failures shall be annunciated at the specified alarm pages.
 10. Terminal unit controllers and damper actuators shall be separate and individually replaceable.

2.12 ELECTRONIC DAMPER ACTUATORS

- A. Two position damper operators:
1. Spring return to full travel position.
 2. Built in auxiliary switches (motor end switches)
 3. Switch shall be fully adjustable so that cut-in/cut-out points may be preset at any point within angular travel of the motor.
 4. Minimum torque 60-in-lb
- B. Modulating damper operators:
1. Sized with sufficient reserve power to provide smooth modulating action and tight close off against the system pressure
 2. Select the operator with available torque to exceed the maximum required operating torque by not less than 100%
 3. Minimum torque 100 in-lb.
- C. Damper actuators shall not have integral controllers.
- D. Outside air dampers shall be interlocked such that damper operates in hand or auto via the starter. The damper end switch shall energize the unit to run only with end switch for fully open is signaled.
- E. Acceptable Manufacturers:
1. Belimo
 2. Johnson Controls

2.13 ETHERNET CARD

- A. Ethernet Card:
1. Local area network connection interface card.

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2.14 CONTROL CABINETS

- A. Fully enclosed NEMA 1 for indoors, NEMA 4 for outdoors.
 - 1. Powder coat painted on all sides
 - 2. Cabinet with continuously piano type hinged door
 - 3. Locking latch
 - 4. All locks shall use a common key
 - 5. Devices on the panel face must be identified with engraved nameplates.
 - 6. Panels or termination panels must be identified with engraved nameplates.
 - 7. Provide enamel beige finish and extruded aluminum alloy frame UL 50 certified.

2.15 TEMPERATURE AND HUMIDITY SENSORS

- A. Space Temperature Sensors
 - 1. Thermister with resistance of 10,000 ohms at 77°F.
 - 2. Accuracy shall be +/-1/2°F.
 - 3. Range of 55° to 95° F.
 - 4. Provide manufacturers calibration certificate.
 - 5. Surface Mounted
 - a. Ventilation ring for fast response
 - b. Setpoint slide or dial for adjustment
 - c. Override button not permitted
 - d. Color to be approved by Architect / Owner, submit sample for review
 - 6. Provide stainless steel face plate sensor in gyms, corridors, locker rooms and cafeterias.
 - 7. Location and height to be approved by Architect/Engineer prior to installation.
 - 8. Electrical stub-up and back-box for space sensor shall be by Division 26. Coordinate work as required.
- B. Space / Duct Humidity Sensor
 - 1. Capacitance element in the space or duct as required and output a 4 to 20 MA signal proportional to 0 to 100% RH to the DDC.
 - 2. Capacitance element shall be field replaceable and not require calibration.
 - 3. Accuracy shall be +/-2% in the range from 20 to 95% RH.
 - 4. Relative humidity sensors shall have the sensing element of inorganic resistance media.
 - 5. Provide manufacturers calibration certificate.
 - 6. Provide stainless steel face plate sensor in gyms, corridors, locker rooms and cafeterias.
 - 7. Electrical stub-up and back-box for space sensor shall be by Division 26. Coordinate work as required.
- C. Duct Temperature Sensors
 - 1. Range of 20° to 120°F.
 - 2. Single point sensing of temperature.
 - 3. Averaging elements of sufficient length to sense temperature across 2/3 duct width.
 - 4. Averaging elements of sufficient length to provide accurate, representative indication and control.
 - 5. Averaging elements of sufficient length to prevent variances in temperature or stratification.

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2.16 CURRENT SENSITIVE RELAYS

- A. Ensure compatibility with VFD applications for variable speed motor status.
 - 1. Provide with adjustable set point.
 - 2. Relays must be mounted and not hung by power wires thru CT.
 - 3. Provide split-core type current sensors.
 - 4. Loop powered.
 - 5. LED Status.
 - 6. Acceptable Manufacturer: Veris Industries / Hawkeye
 - 7. Relays shall close status contacts in response to current flow in power leads to the equipment being monitored

2.17 ELECTRIC REMOTE BULB THERMOSTAT

- A. Two position remote bulb thermostat:
 - 1. Bimetal controlled.
 - 2. Sealed mercury switches.
 - 3. Provide specified control action.
 - 4. Adjustment can be made by removing unit cover.
 - 5. Element with capillary length as required for the location.

2.18 ELECTRIC SPACE THERMOSTAT

- A. Two position space thermostat.
 - 1. Single Pole switch actuated by bi-metal sensing element.
 - 2. Range shall be 60°F to 90°F.
 - 3. Removable external knob adjustment means.

2.19 HIGH STATIC PRESSURE SWITCH

- A. With manual reset switch
 - 1. Approved manufacturer: Cleveland AFS-460.

2.20 CONTROL DAMPERS

- A. Opposed blade dampers.
 - 1. Frames of 13-gauge galvanized sheet metal.
 - 2. Provisions for duct mounting.
 - 3. Damper blades not exceeding 8" in width.
 - 4. Blades of two sheets of 16-gauge galvanized sheet metal.
 - 5. Blades suitable for high velocity performance.
 - 6. Bearings of nylon or oil-impregnated, sintered bronze.
 - 7. Shafts of 1/2" zinc-plated steel
 - 8. Leakage does not exceed 1/2% based on 2000 fpm and 4" static pressure.
 - 9. Replaceable resilient seals along top, bottom and sides of frame and blade edge.
 - 10. Submit leakage and flow characteristics data with shop drawings.
 - 11. Linkage shall be concealed out of the air stream within damper frame.
 - 12. Provide exhaust fan dampers with end switches.
 - 13. Acceptable Model is Ruskin Model CD60.

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2.21 PHOTO CELL CONTROL

- A. Light Sensitive Resistor.
 - 1. 4-20 output or switch.
 - 2. On = 3.0 / fc. Off 10.0 / fc.
 - 3. UL Approved.

2.22 DRAIN PAN FLOAT SWITCH

- A. Rated at 10 Amps.
 - 1. Shuts off equipment if water level becomes too high.
 - 2. DPDT Contacts.

2.23 CO2 SENSOR

- A. Telaire Model T5100 combination CO2/Temperature Sensor or approved equivalent by controls manufacturer.
 - 1. Local indication of CO2 levels in enclosed spaces.
 - 2. Pre-calibrated with factory default settings of 1000 ppm and 1500 ppm CO2 levels
 - 3. LED indicator transitions between green, yellow, and red as the CO2 threshold is exceeded.
 - a) Accuracy: +/- 77 ppm @ 72°F
 - b) Output: 0-10 V (100Ω output impedance) and NTC 20k Thermistor

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The control system shall be installed, and final adjustments made by full-time employees of the factory approved BMCS Building Management Control Subcontractor.
- B. The contractor shall collaborate through Architect / Engineer and Owner to determine the Owner's preference for naming conventions, etc. before entering the data into the system.
- C. Due to actual operational or space conditions, it may be necessary for the Contractor to make sequence of operation modifications and/or controller adjustments, change the location or type of sensor to obtain proper operation and coverage of the system in each room or space. These change, if requested by the Owner or Engineer, shall be performed at no additional cost to the Owner. Therefore, labor allowances should be made for such changes and adjustments if requested.
- D. Points listed within this section are to be connected to the BMCS system as hard-wired points to cards and not connected thru BacNet integration. The BacNet interface is for read only points not included within sequences of this specification.

3.2 EXISTING AUTOMATION SYSTEM

- A. The new system shall be fully integrated with the existing Building Automation System Host computer located at the maintenance facility.
- B. The integrating shall include, but not be limited to, database additions, creation of graphics and implementing auto/answer and auto/dial telephone communications. Integration shall be consistent with Owner standards and practices.

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- C. The bid for the control work shall be based on the premise that existing control devices are operational and are not in need of repair or replacement, unless otherwise noted.
- D. This subcontractor shall notify the Owner's representative of existing control devices that need to be replaced or repaired that may be noted in the process of installation of the new work.

3.3 INTERLOCK AND SAFETY CIRCUITS

- A. Close the outdoor air dampers when the related HVAC unit supply or exhaust fan is de-energized:
 - 1. The damper and actuators are specified in this section.
 - 2. Outdoor air damper shall be fully opened before related air handling unit is energized for 100% outside air use.
 - 3. Provide motorized outside air dampers for roof mounted exhaust fans (except kitchen hood exhausts).
- B. Exhaust/Supply Fans:
 - 1. Interlock the related exhaust and supply fans and the related outside air damper.
 - 2. Interlock the exhaust fans with the related air-handling unit through software.
 - 3. Provide additional interlocks as indicated on fan schedule and on drawings.
- C. Freeze Protection:
 - 1. Provide a freeze protection sequence to ensure proper operation of equipment during a freeze condition.
 - 2. Temperature low limit switch wired with double pole single throw switch with one switch leg hard-wired to de-energize fan and one switch leg to signal BMCS.
- D. Drain Pan Float Protection:
 - 1. Interlock to shut down unit.
 - 2. Provide for each cooling coil location.
 - 3. Signal BMCS alarm point
- E. Domestic Hot Water System:
 - 1. The domestic water heater(s) and associated circulation pumps shall be enabled/disabled by the BMCS based on a time schedule.
 - 2. The domestic hot water supply temperature for the water heater(s) shall be monitored and shall generate an alarm upon exceedingly above or dropping below its assigned alarm limits (adjustable).

3.4 GRAPHICS

- A. Furnish as-built drawings indicating finally corrected "as installed" diagram(s) of the complete Building Management Control System.
 - 1. Modification of existing control systems shall be included.
 - 2. These must be as-built and any changes during the warranty period drawings must be revised and updated.
 - 3. Provide final sequence of operation in written format.
- B. Provide a set of the "as installed" diagram(s) of the complete control system laminated in plastic and hung in the main mechanical room or as directed by Owner.

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- C. Provide a color-coded floor plan of the building showing the location of each system, and the area served by each AHU or related zone. These must be of professional quality. Floor plan is to hang in main mechanical room near central control panel.
- D. Provide computer graphics for each system. Floor plan graphics to include 3D rendered drawings of each new area under BMCS control, with dynamic thermal gradient graphics to indicate variance between space temperature and active setpoint per equipment zone and real-time analysis of equipment performance.
- E. Final graphic room names and numbers shall be based on final Owner room names and numbers in lieu of architectural room names and numbers shown in contract documents. Obtain a graphic submittal package for review. Construction Drawing room numbers are not to be used unless approved in writing.
- F. Provide a TABLE page for each system:
 - 1. Tables shall include all data outlined here within.
 - 2. Tables shall include all read and write points for each system and equipment type.
 - 3. Tables shall be capable of being navigated similar as the graphics with linked systems.
- G. Graphics shall clearly display % open from 0-100% on all valves and dampers.
- H. Graphics shall clearly display % run from 0-100% for all VFDs. Displaying current operating hertz only is not acceptable.
- I. All graphics must reside on main system front end server. Graphics shall not be stored on controllers.

3.5 IDENTIFICATION

- A. Provide a laminated engraved nameplate on all control panels and devices shown on the "as installed" control diagrams. Coordinate engraving with nomenclature used on the diagrams.
- B. A black-white-black laminated plastic engraved identifying nameplate shall be secured to each terminal cabinet, and control panels. Identifying nameplates shall have ½ inch high, engraved letters.
- C. Provide each sensor with label located on the inside of sensor cover. The label shall indicate which device sensor is controlling. If multiple sensors control a single device the sensors shall be labeled with an "A" or "B" etc.
- D. Provide identification label on each transformer and relay with what devices they serve and their function.
- E. Provide identification label on each wire used for this system. Labels shall be affixed to each end of the wire.
- F. Provide a black and white label affixed to the ceiling grid below all terminal units and labeled with the unit tag with those used on the "as installed" control diagrams. Coordinate labeling with nomenclature used on the diagrams.

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3.6 WIRING FOR BUILDING MANAGEMENT AND CONTROL SYSTEMS

- A. Furnish and install all wire, conduit, raceways and cable systems required for the complete operation of the Building Management and Control System.
- B. All wiring for the Building Management and Control System is specified in this section and includes, but is not limited to:
 - 1. Wiring of interlock system.
 - 2. Wiring of control instruments.
 - 3. Wiring of control panels.
 - 4. Wiring of related power supplies, i.e., transformers.
- C. All materials and methods specified in this section shall comply with the requirements specified in Division 26 of this specification. Coordinate wiring of 120 VAC power circuits for control panels and devices with Division 26
- D. All power supply requirements shall be connected to the building electrical distribution system in an approved manner. Do not connect control equipment of circuits common with other building loads or devices.
- E. Temperature control wiring shall be jacketed cables installed with or without conduit as specified below or single conductors installed in conduit. Control wiring shall have minimum 300V insulation for low voltage wiring and 600V insulation for line voltage wiring.
- F. All line voltage control wiring, all low voltage control wiring which is exposed in the central plant, penthouse, and other similar spaces; all low voltage control wiring which is routed through concealed inaccessible locations shall be installed in conduit.
- G. All low voltage control wiring which is routed through concealed accessible locations may be run without conduit provided that the wiring run without conduit is properly supported from the building structure on maximum 5' centers and does not depend upon the ceiling grid or the ceiling support system for support. Wiring run in plenum spaces shall be plenum rated. Support all plenum wiring in accessible locations in bridle rings, J-hooks, D rings. Plenum wiring is not to be supported within building structure or attached to conduit raceways. All low voltage wiring must be installed through supports. Wires shall be supported on 5' centers and identified at each termination point and at 50' centers minimum. Install wire parallel or perpendicular to the structural features of the building.
- H. Line and low voltage control wiring shall not be installed in the same conduit with control wiring and shall not be installed in the same conduit with power wiring.
- I. All wiring associated with building management and control system cover shall be as follows:
 - 1. Sensor jacket color, White
 - 2. LAN communications, Purple
 - 3. All THHN wiring shall comply with Division 26 insulation color identification

3.7 EXHAUST AND SUPPLY FANS

- A. Provide interlocks as scheduled on the plans unless shown on the electrical drawings.
- B. Provide BMCS override to disable operation of all exhaust and supply fans interlocked and/or specified throughout project.

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- C. Provide a separate exhaust fan graphics page.

POINT DESCRIPTION	TYPE	DEVICE
Start/Stop	DO	Control Relay
Outside/Exhaust Air Damper	DO	Electronic Operator
Fan Status	DI	Current Sensitive Relay

3.8 MISCELLANEOUS

- A. Exterior Lighting Control:

1. Provide individual time/photocell and time-based control of each lighting relay and/or contactor specified in Division 26.
2. The exterior lights shall be controlled by the BMCS using both time schedules and sunrise/sunset. The exterior lights shall automatically come on when the sun sets based on the longitude and latitude coordinates of the facility. At 11 p.m. (adjustable) the time schedule shall turn off the exterior lights. At 4:00 a.m. (adjustable) the exterior lights shall automatically turn on based on time schedule. Upon sunrise, which shall be based on longitude / latitude of the facility the exterior lights shall turn off.
3. Between sunrise and sunset, photocell shall override scheduling if ambient light levels fall below set point (adjustable).
4. Provide momentary push buttons located in the Electrical Room to energize exterior lighting for a preprogrammed length of time. Final locations of switches to be submitted for review and approval by Owner, Architect, and Engineer.
5. Provide separate control of each lighting relay and/or contactor. Building façade lighting and landscaping lighting shall be controlled separately.

POINT DESCRIPTION	TYPE	DEVICE
Lighting Relay and/or Contactor	DO	Control Relay

- B. Photocell: Provide a photocell mounted on the north side of the building. Location is to be approved by Owner / Architect / Engineer.

POINT DESCRIPTION	TYPE	DEVICE
Photocell	AI	Contact

3.9 PACKAGED ROOFTOP UNIT WITH GAS HEAT

- A. A room thermistor shall, through a direct digital control panel, stage the cooling and heating to maintain space temperature. The unit shall be started and stopped from the BMCS system.
- B. If the factory A2L refrigerant leak detector is triggered, BMCS shall receive an alarm and enable RTU supply fan and deactivate heater. When the A2L refrigerant leak detection system is reset, all systems shall resume normal operation. Refer to Packaged Rooftop Unit specifications for additional information and coordinate with equipment manufacturer to ensure all points and sequence of operations are in compliance with manufacturer requirements.

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POINT DESCRIPTION	TYPE	DEVICE
Fan Status	DI	Current Sensitive Relay
Start/Stop	DO	Control Relay
Space Humidity	AI	Space Humidity Sensor (where indicated)
Space Temperature	AI	Space Thermistor
Discharge Air Temperature	AI	Duct Thermistor
Outside Air Damper	AO	Electronic Operator
Refrigerant Leak Alarm	DI	Factory A2L Leak Detection System

3.10 START-UP AND POINT VERIFICATION

- A. Final startup and point verification shall include the following information.
1. Field panel checkout:
 - a. Verify enclosure is not mounted on vibrating surface.
 - b. Verify class I and class II wiring is separated within enclosure.
 - c. Check for shorts/grounds/induced voltages/proper voltages.
 - d. Verify proper point terminations in accordance with as-builts.
 - e. Verify that all modules are in proper place and addressed.
 - f. Verify proper power voltage.
 - g. Load database and programming.
 - h. Startup the panel.
 - i. Point and device checkout.
 2. Analog input point checkout:
 - a. Verify the correct wiring terminations per the design documentation package, at the field panel. Verify that all wiring and terminations are neat and dressed.
 - b. Verify the point address by checking that the analog input instrument is wired to the correct piece of field equipment. Do this by altering the environment at the sensing element or by disconnecting one of the wires at the sensor, and verifying that the reading at the field panel has reacted to this change.
 - c. Verify the point database to be correct, (i.e., alarmability, alarm limits, slope/intercept, engineering units, etc.). Verify that the correct change of value (COV) limit has been defined.
 - d. Verify the sensor has the correct range and input signal. (i.e., 20-120°F, 4 - 20 ma). Verify that the device is mounted in the correct location and is wired and installed correctly per the design documentation package.
 - e. Set-up and/or calibrate any associated equipment (i.e., panel LCD meters, loop isolators, etc.). Verify that these auxiliary devices are mounted in the correct location and are wired and installed correctly per the design documentation package.
 - f. Verify the correct reading at the field panel using appropriate MMI devices. Verify that any associated LCD panel meters indicate the correct measured value.
 3. Digital input point checkout:
 - a. Verify the device is correctly wired and terminated as shown in the design documentation package. Verify that all wiring and terminations are neat and properly secured.
 - b. Verify the point address by verifying that the digital input is correctly terminated at the controlled piece of equipment.
 - c. Verify the point database is correct (i.e., point name, address, alarmability, etc.).

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- d. Set-up and/or calibrate the associated equipment, i.e., smoke detector, high/low temp detector, high/low static switch, end switch, current relay, pressure switch, etc. is mounted in the correct location, and is wired and installed correctly per the control system installation drawings.
 - e. With the controlled equipment running or energized as described in the digital output checkout procedures, verify the correct operation of the digital input point and associated equipment by putting the digital input monitored equipment into its two states. Verify that the proof or status point indicates the correct value at the operator's terminal and that the status led is giving the proper indication in each mode of operation (on/off).
4. Digital output point checkout:
- a. Verify that device is correctly wired and terminated as shown in the design documentation package.
 - b. Verify that the correct voltage is utilized in the circuit.
 - c. Verify the point database to be correct (i.e., point name, address, etc.).
 - d. Check and verify that the end device responds appropriately to the digital output(s).
 - e. After verifying the set-up and operation of any associated digital input/proof points, check and verify correct operation of the logical point and associated equipment by commanding the point to all possible states (i.e., off, on, fast, slow, auto, etc.). Verify that the defined proof delay is adequate for all modes of operation.
 - f. If any interlocked equipment exists that has independent hand-off-auto or auxiliary control wiring, verify correct operation of same. Also check that any interlocked equipment such as EP switches for damper operation or exhaust and return fans are wired correctly and operate correctly.
 - g. Verify that the controlled piece or pieces of equipment cannot be caused to change state via the digital output if an associated hand-off-auto switch is in the hand/on or hand/off mode of operation, unless specified as a fireman's override point etc.
5. Analog output point checkout:
- a. Verify the correct wiring or piping terminations per the design documentation package, at the field panel. Verify that all wiring and piping terminations are neat and dressed.
 - b. Ensure that the correct output device(s) are installed per the Control System Installation Drawings. (i.e., I/P or P/I transducers, transformers, power supply, etc.). Verify that these devices are installed, wired and piped correctly. Verify that any configuration jumpers are in the proper settings for the required application. Verify related transformers are fused in accordance with installation drawings.
 - c. Verify the point database to be correct. Verify that the correct COV limit has been defined.
 - d. Verify the point address by checking that the analog output is wired and/or piped to the correct output transducer and/or equipment.
 - e. Verify that the controlled device is calibrated (i.e., 3-8PSI valve, 8-13 PSI damper motor, 4-20 ma variable frequency drive, etc.) and is in the correct location, and is wired or piped and installed correctly per the design documentation package. If the controlled device is not calibrated, then a three-point (high, low and mid-point) calibration procedure must take place. Verify proper operation of the end device. When calibration has been verified, ensure that installation drawings, point database, and PPCL have been updated.

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- f. Set-up and or calibrate any associated equipment, (i.e., panel LCD meters, loop isolators, pneumatic gauges, etc.). Also verify that these auxiliary devices are mounted in the correct location and are wired or piped and installed correctly per the design documentation package.
 - g. After verifying the set-up and operation of any associated equipment check for the correct operation of the logical point and associated equipment by commanding the analog output to the top and bottom of its range. Verify that the control device(s) responded appropriately as indicated by the design documentation package. Check to ensure that all network terminals, host console devices, etc. can also command these outputs.
 - h. Check that all pneumatic gauges, pilot positioners and LCD panel meters indicate the correct values.
- 6. Terminal equipment controller checkout:
 - a. Load program database
 - b. Enable programs
 - c. Verify sequence of operations
- 7. Programming checkout:
 - a. Provide checkout for each system and sequence of operation.
 - b. The following are sample sequence of operations tests. The intent of these procedures is to provide a plan of action to verify system operations via block checks of the project specific sequence of operations. The procedures may be used in this format, or one procedure to a page should more detail be required. The procedures outlined below should be verified for accuracy and may be modified to meet your specific requirements.
 - c. Description of Test: AHU Alarm Checkout. Verify AHU-1 discharge air temperature alarming is operational and is received at the designated terminal.
 - d. Input to Trigger Test: Change discharge temperature high alarm limit through software to a value below the current discharge temperature (discharge temperature - 10°F).
 - e. Expected Outcome: A high temperature alarm will be received per the Alarm Definition Report at its designated terminal.
 - f. Provide signoff sheet with indication for test Pass, Fail, Date of test and Initials for signoff.
- 8. Workstation checkout:
 - a. Verify the operation of all trunk interface equipment.
 - b. Verify all workstation software, including options, based upon the installation instructions for the PC.
 - c. Perform software backup (site, options, etc.)
 - d. Complete workstation configuration report for owner signoff.
 - e. Provide verification that all graphics have been created, as required by project bid documents.

3.11 TESTING AND ACCEPTANCE

- A. General:
 - 1. After completion of installation and start-up procedures, commence the specified 3-phase verification and testing sequence leading to final acceptance.
 - a. Follow in the order specified.
 - b. Each testing phase shall be satisfactorily completed before entering the next phase.
 - 2. Prior to entering each phase of the sequence, submit for approval, a written agenda describing in detail the procedure to be followed to meet the requirements for each specified verification, test or demonstration.

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3. Submit for approval, a sample of the form on which the test will be reported.
 - a. Identify project.
 - b. Provide a list of all points, arrange in numerical order of point addresses.
 - 1) Show point descriptor and location of each.
 - 2) Indicate DDC panel that processes each point.
 - 3) Use the list as a basis for the specified report form.
 - c. Signatures of participants and observers.
 - d. Results.
 - e. Description of adjustment or corrections of points in error.
 - f. Date.
 4. Provide schedule of tests. Estimate dates of significant events.
 5. Test, calibrate and adjust each point in the system as specified.
 6. Provide documentation of all tests and verifications as specified.
 7. Provide trend reports indicating proper control of all points for an extended period of time.
- B. Phase 1 - Testing, Calibrating, and Adjusting:
1. Operate each analog point in the entire system.
 - a. At a point in the upper quarter of its range.
 - b. At a point in the lower quarter of its range.
 - c. At its operating point.
 2. Provide personnel and diagnostic instruments at both the central and remote locations.
 3. Provide testing stimulants for alarms.
 4. Use digital meters of double the accuracy of the instruments being calibrated.
 5. Provide an approved test device for simulating high and low temperatures.
 6. When the function is performed, read values at the central control and observe the actual function at the field instrument.
 7. Exercise each binary point and observe indication at console and simultaneously observe operation in the field.
 8. Submit an operation report for each point in the system, in approved format, and describe any corrective or adjusting action taken.
 9. Test all power transducers with a Dranetz Power Analyzer.
- C. Phase 2 - Equipment and Point Verification:
1. Verify calibration or function of each point.
 - a. Verify analog points at operating value.
 - b. Record on specified form.
 - c. Make approved adjustments to out of tolerance points.
 - 1) Identify these points for ready reference.
 2. After verification procedure is completed:
 - a. Verify corrected points.
 - b. Record on specified form.
 - c. Points requiring correction.
 - 1) Replace sensor or actuator if electrical measurements indicated components are out of specified tolerance.
- D. Phase 3 - Software Verification:
1. Submit agenda and report format for software demonstrations.
 2. Demonstrate to the Owner and the Engineer that all software programs and automatic control sequences function as specified.

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3. Demonstrate compliance with response time specifications.
 - a. Simulate normal heavy load conditions.
 - b. Initiate at least ten successive occurrences on normal heavy load conditions as specified, and measure response time of typical alarms and status changes.
 4. Provide written documentation of demonstration, signed by representatives of the Contractor and Engineer.
- E. Provide the following reports to Engineer at final completion of all Testing:
1. List of all points.
 2. List of all points currently in alarm.
 3. List of all disabled points.
 4. List of all points in over-ride status.
 5. List of all points currently locked out.
 6. List of user accounts and access levels.
 7. List all weekly schedules.
 8. List of holiday programming schedules.
 9. List of limits and deadbands.
 10. System diagnostics reports including, list of DDC panels on line and communicating, status of all DDC terminal units device points.
 11. List of programs.
 12. Provide trend data reports to ensure proper operation and sequence control of BMCS.
- F. Substantial Completion of the BMCS will not occur until completion and acceptance of all testing and acceptance procedures.

3.12 TRAINING

- A. The contractor shall provide factory-trained instructor to give full instruction to designated personnel in the operation of the system installed. Instructors shall be thoroughly familiar with all aspects of the subject matter they are to teach. The contractor shall provide all students with a student binder containing product specific training modules for the system installed. All training shall be held during normal working hours of 8:00 am to 4:30 PM weekdays.
- B. Provide minimum 24 hours of training for Owner's designated operating personnel. Training shall include:
1. Explanation of drawings, operations and maintenance manuals
 2. Walk-through of the job to locate control components
 3. Operator workstation and peripherals
 4. DDC controller and ASC operation/function
 5. Operator control functions including graphic generation and field panel programming
 6. Operation of portable operator's terminal
 7. Explanation of adjustment, calibration and replacement procedures
 8. Student binder with training modules
- C. Since the Owner may require personnel to have more comprehensive understanding of the hardware and software, additional training must be available from the Contractor.

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3.13 PROJECT MANAGEMENT

- A. Provide a designated project manager who will be responsible for the following:
1. Construct and maintain project schedule.
 2. Authorized to accept and execute orders or instructions from General Contractor, Owner / Architect & Engineer.
 3. Attend project meetings as necessary to avoid conflict and delays.
 4. Make necessary field decisions relating to this section.
 5. Coordination / Single point contact.
 6. Have Internet access for project management.

END OF SECTION

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SECTION 232000

HVAC PIPE AND PIPE FITTINGS - GENERAL

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install pipe and pipe fittings for piping systems specified in Division 23 - Mechanical.

1.2 RELATED WORK

- A. Division 23 Mechanical:
 - 1. Insulation
 - 2. Other Piping Sections

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

- A. The particular type of pipe and fittings for each system is specified in the individual sections.

2.2 JOINTS

- A. Make screwed joints using machine cut USASI taper pipe threads. Apply a suitable joint compound to the male threads only. Ream the pipe to full inside diameter after cutting. All-thread nipples are not permitted.
- B. Dissimilar Metals. Make joints between copper and steel pipe and equipment using insulating unions or couplings such as Crane Company #1259; EPCO as manufactured by EPCO Sales, Inc.; or an approved equal.
- C. Solder joints.
 - 1. Prior to making joints, cut pipe square and ream to full inside diameter. Clean exterior of pipe and socket. Apply a thin coat of suitable fluxing compound to both pipe and socket, and fit parts together immediately.
 - 2. Heat assembled joint only as required to cause the solder to flow. Run the joint full, slightly beaded on the outside, and wipe to remove excess solder.
 - 3. Use silver brazing alloy or Sil-Fos on refrigerant piping and on underground piping. Use lead free solder on all other copper piping.
- D. Make welded joints as recommended by the standards of the American Welding Society. Ensure complete penetration of deposited metal with base metal. Provide filler metal suitable for use with base metal. Keep inside of fittings free from globules of weld metal. The use of mitered joints is not approved.
- E. Flanged.
 - 1. Prior to installation of bolts, center and align flanged joints to prevent mechanical pre-stressing of flanges, pipe or equipment. Align bolt holes to straddle the vertical, horizontal or north-south centerline. Do not exceed 3/64" per foot inclination of the flange face from true alignment.
 - 2. Use flat-face companion flanges only with flat-faced fittings, valves or equipment. Otherwise, use raised-face flanges.

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3. Install gaskets suitable for the intended service and factory cut to proper dimensions. Secure with manufacturers recommended gasket cement.
 4. Use ANSI nuts and bolts, galvanized or black to match flange material. Use ANSI 316 stainless steel nuts and bolts underground. Tighten bolts progressively to prevent unbalanced stress. Draw bolts tight to ensure proper seating of gaskets.
 5. Use carbon steel flanges conforming to ANSI B16.5 with pipe materials conforming to ASTM A 105 Grade II or ASTM A 108, Grade II, ASTM A 53, Grade B. Use slip-on type flanges on pipe only. Use welding neck type flanges on all fittings. Weld slip-on flanges inside and outside.
 6. Keep flange covers on equipment while fabricating piping. Remove when ready to install in system.
- F. Mechanical Joints: Provide a stuffing box type mechanical joint adapted to use gasket, cast iron gland and bolts. Coat bolts with bitumastic enamel. Use joint parts similar in design to one of the following:
1. Doublex Simplex Joint manufactured by the American Cast Iron Pipe Company, Birmingham, Alabama.
 2. U.S. joints manufactured by the United States Pipe and Foundry Company, Burlington, New Jersey.
 3. Boltite Joint manufactured by the McWane Cast Iron Pipe Company, Birmingham, Alabama.
 4. Flexlamp manufactured by the National Cast Iron Pipe Company, Birmingham, Alabama.

2.3 UNIONS

- A. Use 150 lb. standard (300 lb. WOG) malleable iron, ground joint unions with bronze seat. Provide flanged joints on piping 2-1/2" and larger.
1. Where pipe material of different types join, use a dielectric union. Union shall be threaded, solder or as required for its intended use.

2.4 BRANCH CONNECTIONS

- A. Pipe 2" and Smaller: For threaded piping, use straight size reducing tee. When branch is smaller than header, a nipple and reducing coupling or swagged nipple may be used.
- B. 2-1/2" through 36": For welding piping, when branch size is the same as header size, use welding tee. For threaded branch connections, use 3000 lb. full coupling or Thread-o-let welded to header.

2.5 GASKETS

- A. High Temperature Piping: Provide 1/16" thick ring gaskets of aramid reinforced SBR such as Garlock #3200 or 3400 or equal by Advanced Products and Systems.
- B. Other Piping: Provide ring rubber gaskets, Garlock #7992 or equal by Advanced Products and Systems. Use 1/8" thick cloth reinforced neoprene gaskets. For smaller than 6", use 1/16" thick gasket.

2.6 FLOORS AND CEILING PLATES

- A. Provide chrome-plated floor and ceiling plates around pipes exposed to view when passing through walls, floors, partitions, or ceilings in finished areas; size plates to fit pipe or insulation and lock in place.

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2.7 DOMESTIC MANUFACTURE

- A. All piping material, pipe and pipe fittings shall be manufactured in the United States of America.

PART 3 - EXECUTION

3.1 PIPE FABRICATION AND INSTALLATION

- A. Make piping layout and installation in the most advantageous manner possible with respect to headroom, valve access, opening and equipment clearance, and clearance for other work. Give particular attention to piping in the vicinity of equipment. Preserve the required minimum access clearances to various equipment parts, as recommended by the equipment manufacturer, for maintenance.
- B. Cut all pipes to measurement determined at the site. After cutting pipe, remove burrs by reaming. Bevel plain ends of ferrous pipe.
- C. Install piping neatly, free from unnecessary traps and pockets. Work into place without springing or forcing. Use fittings to make changes in direction. Field bending and mitering is prohibited. Make connections to equipment using flanged joints, unions or couplings. Make reducing connections with reducing fittings only.
- D. Install piping without tapping out of the bottom of pipe.

3.2 WELD

- A. Weld and fabricate piping in accordance with ANSI Standard B31.1, latest edition, Code for Pressure Piping.
- B. Align piping and equipment so that no part is offset more than 1/16". Set fittings and joints square and true, and preserve alignment during welding operation. Use of alignment rods inside pipe is prohibited.
- C. Do not permit any weld to project within the pipe so as to restrict flows. Tack welds, if used, must be of the same material and made by the same procedure as the completed weld. Otherwise, remove tack welds during welding operation.
- D. Do not split, bend, flatten or otherwise damage piping before, during or after installation.
- E. Remove dirt, scale and other foreign matter from inside piping before tying into existing piping sections, fittings, valves or equipment.
- F. Bevel ends of ferrous pipe.

3.3 OFFSETS AND FITTINGS

- A. Due to the small scale of drawings, the indication of offsets and fittings is not possible. Investigate the structural and finish conditions affecting the work and take steps required to meet these conditions.
- B. Install pipe close to walls, ceilings and columns so pipe will occupy minimum space. Provide proper spacing for insulation coverings, removal of pipe, special clearances, and offsets and fittings.

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3.4 SECURING AND SUPPORTING

- A. Support piping to maintain line and grade, with provision for expansion and contraction. Use approved clevis-type or trapeze-type hangers connected to structural members of the building. Single pipe runs to be supported by approved clevis type hangers. Multiple pipe runs to be supported by approved trapeze type hangers. Do not support piping from other piping or structural joist bridging. Review structural drawings for additional information.
- B. Provide supports both sides and within 12" of each horizontal elbow for pipe 6" and larger.
- C. Support vertical risers with steel strap pipe clamps of approved design and size, supported at each floor. Support piping assemblies in chases so they are rigid and self-supported before the chase is closed. Provide structural support for piping penetrating chase walls to fixtures. On chilled water pipe supports shall be outside the insulation.
- D. Where insulation occurs, design hangers to protect insulation from damage. Pipe saddles and insulation shields, where required, are specified in the appropriate insulation section and are sized in accordance with the schedule on the drawings.
- E. Install trapeze hangers, properly sized, to support the intended load without distortion. Use hangers with 1-1/2" minimum vertical adjustment.
- F. Use electro-galvanized or zinc plated beam clamps if acceptable to the structural engineer, threaded rods, nuts, washers and hangers. All hanger rods shall be trimmed neatly so that no more than 1 inch of excess hanger rod protrudes beyond the hanger nut. Use only on beams as directed by the Structural Engineer.
- G. At outdoor locations, all supports, brackets and structural members shall be hot-dipped galvanized.
- H. Provide hangers within 3' of pipe length from all coil connections.
- I. Support spacing: As recommended by the project structural engineer and support manufacturer, but not more than listed below. Not to exceed spacing requirements of smallest pipe.

Pipe Size	Copper & Steel Max. Support Spacing, Ft.	Cast Iron Max. Support Spacing, Ft.	Minimum Rod Diameter, Inches
1" & smaller	6		3/8
1-1/4" & 1-1/2"	8	5	3/8
2"	10	5	3/8
3"	10	5	1/2
4" & 5"	10	5	5/8
6" and above	10	5	3/4

3.5 PIPE SUPPORTS

- A. Provide P1001 or P 5000 Unistrut metal framing members and appurtenances for pipe support. Hot-dip galvanized members and appurtenances when located outside. Sagging of pipes or supports is not acceptable.
- B. Adjustable clevis hangers shall be used for single pipe supports; Anvil Fig. 260. When oversized clevis is used, a nipple shall be placed over the clevis bolt as a spacer to assure that the lower U-strap will not move in on the bolt. Provide adjustable clevis with a nut / washer above and below the hanger on the support rod. Ring type clevis hangers are not acceptable.

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- C. Provide Anvil Figure 45 galvanized or primed and painted channel assembly for trapeze hangers.

3.6 PIPE SUPPORTS ON ROOF

- A. Support condensate drain pipe on roof with Portable Pipe Hanger Model SS8-C with channel and fully adjustable height throughout pipe run. Secure pipe to support with channel clamp. Base material shall be high density / high impact polypropylene with UV inhibitors and antioxidants. Provide with hot dip galvanized rod finish and framing. Nuts and washers shall be hot dip galvanized.

3.7 ANCHORS

- A. Provide anchors as required. Use pipe anchors consisting of heavy steel collars with lugs and bolts for clamping to pipe and attaching anchor braces. Install anchor braces in the most effective manner to secure desired results. Do not install supports, anchors or similar devices where they will damage construction during installation or because of the weight or the expansion of the pipe. When possible, install sleeves in structural concrete prior to pouring of concrete.

3.8 FLOOR PENETRATIONS

- A. At locations where pipe passes through floors, provide watertight concrete curb around penetration.

3.9 PIPE SLEEVES

- A. Sleeves through masonry and concrete construction:
 - 1. Fabricate sleeves of Schedule 40 galvanized steel pipe.
 - 2. Size sleeve large enough to allow for movement due to expansion and to provide continuous insulation.
- B. Sleeves through gypsum wall construction.
 - 1. Fabricate sleeves of 16-gauge galvanized sheet metal.
- C. Sleeves through elevated slab construction.
 - 1. Fabricate sleeves of Schedule 40 galvanized steel pipe with welded center flange in floor.
- D. Extend each sleeve through the floor or wall. Cut the sleeve flush with each wall surface. Sleeves through floors shall extend 2" above floor lines for waterproofing purposes. Slab on grade floors shall not be sleeved except where penetrating waterproofing membrane or insect control is required.
- E. Caulk sleeves water and airtight. Seal annular space between pipes and sleeves with mastic compound to make the space water and airtight.
- F. For sleeves below grades in outside walls, provide Thunderline Link-Seal or Advance Product and System Interlynx, with 316 stainless steel nuts and bolts, with cast iron pressure plate.
- G. Provide chrome plated escutcheon plates on pipes passing through walls, floors or ceilings exposed to view. At exterior walls, stainless steel sheet metal is to be used.

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- H. For sleeves through fire and smoke rated walls, seal with a UL through-penetration firestop, rated to maintain the integrity of the time rated construction. Install in accordance with the manufacturer's installation instructions. Comply with UL and NFPA standards for the installation of firestops. Refer to Architectural drawings for all fire and smoke rated partitions, walls, floors, etc.

3.10 ISOLATION VALVES

- A. Provide piping systems with line size shutoff valves located at the risers, at main branch connections to mains for equipment, to isolate central plant, and at other locations.

3.11 DRAIN VALVES

- A. Install drain valves at low points of water piping systems so that these systems can be entirely drained. Install a line size drain valve for pipes smaller than 2" unless indicated otherwise. For pipes 2-1/2" and larger, provide 2" drain valves unless indicated otherwise. Drain valves shall be plugged when not in use and at completion.

3.12 CLEANING OF PIPING SYSTEMS

- A. General cleaning of piping systems. Purge pipe of construction debris and contamination before placing the systems in service. Provide and install temporary connections as required to clean, purge and circulate. Flush the chilled and hot water systems utilizing the filter feeders.
- B. Install temporary strainers at the inlet of pumps and other equipment as necessary where permanent strainers are not indicated. Keep strainers in service until the equipment has been tested, then remove either entire strainer or straining element only. Fit strainers with a line size blow down ball valve and pipe to nearest drain. Blow down strainers, remove and clean as frequently as necessary.
- C. Phase One: Initial flushing of system. Remove loose dirt, mill scale, weld beads, rust and other deleterious substances without damage to system components. Open valves, drains, vents and strainers at all system levels during flushing procedures. Flush until "potable water clear" and particles larger than 5 microns are removed.
- D. Connect dead-end supply and return headers, even if not shown on the drawings, and provide terminal drains in bottom of pipe end caps or blind flanges.
- E. Dispose of water in approved manner.
- F. Phase Two: Cleaning of Piping Systems. Remove, without chemical or mechanical damage to any system component, adherent dirt (organic soil), oil, grease, (hydrocarbons), welding and soldering flux, mill varnish, piping compounds, rust (iron oxide) and other deleterious substances not removed by initial flushing. Chemical shall be equal to Nalco 2578 prepping compound. Insert anti-foam compound as necessary. Circulate for 48 hours or as recommended by the manufacture. Dispose of water in approved manner. Flush system and replace with clean water. Verify compatibility of chemicals used with existing chemical treatment program on remodel projects.
- G. Phase Three: Final flushing and rinsing: Flush and rinse until "potable water clear" and particles larger than 5 microns are removed. Operate valves to dislodge any debris in valve body. Dispose of water in approved manner.

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- H. Submit status reports upon completion of each phase of work on each system.
- I. Special requirements, if any, are specified in the sections on each type of piping or in the section on Water Treatment Systems.

3.13 TESTING

- A. Test piping after installation with water hydrostatic pressure of 1-1/2 times operating pressure (150 psig minimum) and carefully check for leaks. Repair leaks and retest system until proven watertight.
- B. Do not insulate or conceal piping systems until tests are satisfactorily complete.
- C. If any leaks or other defects are observed, suspend the test and correct the condition at once. Repeat testing until leaks are eliminated and the full test period is achieved.
- D. The satisfactory completion of testing does not relieve the Contractor of responsibility for ultimate proper and satisfactory operation of piping systems and their accessories.

3.14 PIPE MARKERS

- A. Identify interior exposed piping and piping in accessible chases or plenums with Opti-Code Brady Pressure Sensitive Adhesive Pipe Markers, consisting of pipe marker and direction of flow arrow tape. Clean pipe prior to installation. Background colors of markers, arrows and tape for each type of system shall be the same. Meet ANSI/OSHA standards and clearly identify each system. Provide minimum 2-1/4-inch letters through 4-inch pipe and 4-inch letters for 5-inch pipe and larger.
- B. Identify exterior and mechanical room piping with Snap Around pipe markers through 4-inch pipe and Strap Around markers 5-inch pipe and larger. Pipe markers consisting of pipe marker and direction of flow arrow tape; background colors of markers, arrows and type for each type of system shall be the same. Meet ANSI / OSHA standards and clearly identify each system. Provide minimum 2-1/4-inch letters through 4-inch pipe and 4-inch letters for 5-inch pipe and larger.
- C. Install identification in the following locations:
 - 1. both sides of penetrations through walls, floors and ceilings.
 - 2. Close to valves or flanges.
 - 3. Intervals on straight pipe runs not to exceed 50 feet
 - 4. Apply marker where view is obstructed.
- D. Pipe markers shall meet or exceed the specifications of the ASME A13.1 "Scheme for Identification of Piping Systems".

END OF SECTION

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SECTION 232300

REFRIGERANT PIPING AND APPURTENANCES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install copper tubing, valves, strainers and sight glass for refrigerant piping.

1.2 RELATED WORK

- A. Division 23 Mechanical.
 - 1. Pipe and Pipe Fittings
 - 2. Piping Insulation

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

- A. Furnish refrigerant piping of Type K hard-drawn copper tubing with sweat-type, wrought copper fittings. Cast fittings are not permitted.

2.2 SERVICE VALVES

- A. Provide angle or globe service valves, with sweat connections. Use packed-type, wrench operated, valves with gasketed seal cap and back seat feature. Furnish valves designed for refrigerant service, in conformance with the ARI code.
- B. Place service valves at the inlet and outlet of each compressor, on both sides of each strainer and solenoid valve, and as otherwise shown and specified.

2.3 SOLENOID VALVES

- A. Furnish pilot-operated, floating-piston solenoid valves suitable for operation with refrigerant.
- B. Use valves with a bronze body and sweat-type connections.
- C. Provide stainless steel stem and plunger assembly and a stainless steel piston.
- D. Furnish sealed and moisture proof solenoid coils.
- E. Use electrical characteristics of 115 volt, 60 Hertz.

2.4 SIGHT GLASSES

- A. Provide suitable moisture and liquid sight glass in the liquid line leaving the condenser or receiver.

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2.5 FILTER DRYER

- A. Furnish replaceable core liquid line filter dryer.
- B. Provide filter dryer constructed to permit the removal of the core element without removing the filter dryer from the line.

PART 3 - EXECUTION

3.1 BRAZING

- A. During the brazing process, dry nitrogen shall be purged through the tubing to prevent oxides from forming.

3.2 PRESSURE TEST

- A. After refrigeration and piping system items are installed, charge the system with dry nitrogen and test to 450 psig.
 - 1. Test joints with a Halide torch or an electronic leak detector.
 - 2. Repair leaks and retest each system until proved tight.

3.3 EVACUATION AND DRYING

- A. After refrigerant system has been pressure-tested, connect a suitable vacuum pump and evacuate piping system, including lines and equipment.
 - 1. Maintain a vacuum as high as practicable for long enough to evaporate the moisture in the system (at least 48 hours).
 - 2. Check the humidity within the system with a wet bulb indicator, and maintain the vacuum until the wet bulb temperature is reduced to -40°F. After the system has been evacuated and dried, break the vacuum by charging proper refrigerant into the system.
- B. Refrigerant piping systems shall be pressure tested for strength and leak tested for tightness in accordance with the requirements of section 1110 Refrigeration Piping System Test in Chapter 11 of the 2021 International Mechanical Code after installation and before being placed in operation. Tests shall include both high and low pressure sides of each system.

3.4 PIPE SIZE

- A. Pipe shall be routed and sized per condensing unit manufacturer's instructions.

3.5 MINIMUM HEIGHT

- A. Exposed refrigerant piping installed in open spaces shall be installed 7'-3" or higher above finished floor.

3.6 REFRIGERANT PIPE ENCLOSURE

- A. Refrigerant piping shall be protected by locating it within building elements when routed below 7'-3" above finished floor except where located within 6'-0" of the refrigerant unit.

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3.7 PIPE IDENTIFICATION

- A. Pipe identification shall be located at intervals not exceeding 20 feet on the refrigerant piping or pipe insulation.
- B. The minimum height of the lettering of the identification label shall be ½”.
- C. The identification shall indicate the refrigerant designation and safety group classification of refrigerant used in the piping system. For group A2, A3, B2, B3 refrigerants, the identification shall also include the following statement: “DANGER – Risk of Fire or Explosion.” For any group B refrigerant, the identification shall also include the following statement: “DANGER – Toxic Refrigerant.”

3.8 REFRIGERANT PIPE PROTECTION

- A. Where A2L and B2L refrigerant piping is located in concealed locations where the pipe is installed in studs, joists, rafters, or similar member spaces and located less than 1.5” from the nearest edge of the member, a shield plate shall be installed for continuous protection. Protective steel shield plates having a minimum of 16 gauge shall cover the area of the pipe plus the area extending 2” or more beyond both sides of the pipe.
- B. Refrigerant piping shall be installed as to prevent strains and stresses that exceed the structural strength of the pipe. Pipe must be protected from damaging resulting from vibration, expansion, contraction, and structural settlement

3.9 CONTRACTOR DECLARATION

- A. Installing contractor shall issue a certificate of test to the code official for all systems containing 55 lbs or more of refrigerant. The certificate shall include the test date, name of refrigerant, test medium and the field test pressure applied to the high-pressure side and the low pressure side of the system. The certification of the test shall be signed by the installing contractor and shall be made part of the public record.

3.10 STOP VALVES

- A. Stop valves shall be installed on the suction inlet and discharge outlet of each compressor or condensing unit and outlet of each liquid receiver for systems containing more than 6.6 lbs of refrigerant.
- B. In addition to part A. above, stop valves are also required on the inlet of each liquid receiver and inlet of each condenser where more than one condenser is used in parallel for systems containing more than 100 lbs of refrigerant.
- C. Stop valves shall be identified where their intended purpose is not obvious.

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SECTION 233113

DUCTWORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Duct construction, support and accessories. Dimensions shown on the drawings are free area dimensions.

1.2 RELATED WORK

- A. Division 23 Mechanical
 - 1. Air Devices
 - 2. Insulation
 - 3. Fans
 - 4. Packaged Rooftop Air Conditioners
 - 5. Testing, Balancing and Adjusting (TAB) of Environmental Systems
- B. Division 9 – Finishes, Painting and Color Coding

1.3 QUALITY ASSURANCE

- A. The intent of ductwork specifications is to obtain superior quality workmanship resulting in an installation that is absolutely satisfactory in both function and appearance. Provide ductwork in accordance with the specifications for each type of service.
- B. An approved contractor for this work under this division shall be:
 - 1. A specialist in this field and have the personnel, experience, training, skill, and the organization to provide a practical working system.
 - 2. Able to furnish evidence of having contracted for and installed not less than 5 systems of comparable size and type that have served their owners satisfactorily for not less than 5 years.

1.4 GUARANTEE

- A. Guarantee ductwork for 1 year from the date of substantial completion. The guarantee covers workmanship, noise, chatter, whistling, or vibration. Ductwork shall be free from pulsation under conditions of operation.

1.5 CONTRACTOR COORDINATION

- A. Erect ducts in the general locations shown but conform to structural and finish conditions of the building. Before fabricating any ductwork, check the physical conditions at the job site and make necessary changes in cross sections, offsets, and similar items, whether they are specifically indicated or not.
- B. Coordinate location of ductwork with structural members and Architectural drawings and requirements.

1.6 SHOP DRAWINGS AND SAMPLES

- A. Submit shop drawings of all ductwork layouts, including enlarged plans and elevations of all air handling equipment, and submit details of duct fittings, including particulars such as gauge sizes, welds, and configurations prior to starting work.

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- B. Submit product data and sealing materials to be used.
- C. Submit sound attenuation data.
- D. Submit shop drawings in plan, elevation and sections, and three-dimensional view showing equipment in mechanical equipment areas.

PART 2 - PRODUCTS

2.1 STANDARDS AND CODES

- A. Except as otherwise indicated, sheet metal ductwork material and installation shall comply with the latest edition of SMACNA HVAC Duct Construction Standards. Air distribution devices (such as dampers) included in this specification shall comply with the latest applicable SMACNA Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems and NFPA 90A.

2.2 DUCT MATERIAL AND CONSTRUCTION

- A. Except for the special ducts specified below use lock forming quality prime galvanized steel sheets or coils up to 60" wide. Stencil each sheet with gauge and manufacturer's name. Stencil coils of sheet steel throughout on 10' centers with gauge and manufacturer's name. Provide certification of duct gauge and manufacturer for each size duct.
- B. Rectangular low pressure duct constructed of sheet metal in accordance with the latest edition of SMACNA HVAC Duct Construction Standards.
- C. Low pressure round ducts shall be shop fabricated with snap lock longitudinal seams. Ducts shall be constructed for a minimum of 2" w.g. static pressure.

2.3 ACOUSTICAL DUCT

- A. Duct and fittings:
 - 1. Double wall acoustically treated.
 - 2. Annular space packed with fiberglass insulation.
 - 3. Perforated metal liner to provide specific acoustic impedance
 - 4. Insulation 1.0 pcf. 1 inch thick
 - 5. United McGill Acousti-K27 spiral lockseam or approved equal
 - 6. Material as indicated below:
 - a. Paintable Galvanized Steel
- B. Pressure rating and tests as specified for single wall ductwork.

2.4 DUCT SEALING OF SEAMS AND JOINTS

- A. Follow seal classification as indicated in Table 1-2 of SMACNA "HVAC AIR DUCT LEAKAGE TEST MANUAL". Use seal class A for 4" w.g. static. All longitudinal and transverse joints and seams shall be sealed by use of a fireproof, non-hardening, and non-migrating elastomeric sealant. With the exception of continuously welded joints and machine-made spiral lock seams, joints and seams made airtight with duct sealer.
 - 1. Indoor applications – Foster 32-14
 - 2. Outdoor applications – Foster 32-17

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2.5 FLEXIBLE DUCT LOW PRESSURE

- A. Construction:
 - 1. Continuous galvanized spring steel wire helix, with reinforced metalized cover
 - a. The fabric shall be mechanically fastened to the steel helix without the use of adhesives.
 - 2. UL 181 Class I air duct label
 - 3. Reinforced vapor barrier jacket
 - 4. Rated for use at system pressure (6" wc minimum)
- B. Fire hazard classification:
 - 1. Flame spread rating 25 maximum.
 - 2. Smoke developed rating 50 maximum.
- C. Thermal characteristics:
 - 1. R-6 BTU/hr/sq. ft./°F (when located in a conditioned plenum)
 - 2. R-8 BTU/HR/Sq.Ft./°F (when located in an unconditioned plenum)
 - 3. 2" minimum wall thickness insulation with 1" overlap
- D. Acceptable manufacturers:
 - 1. Flexmaster
 - 2. Hart & Cooley
 - 3. Omniair
 - 4. Peppertree Air Solutions

2.6 FIRE DAMPERS

- A. Fire dampers for required wall ratings that are 95% minimum free area. Provide Type B or Type C UL dampers for low, medium and high-pressure rectangular, square or round ducts. Dampers shall be dynamic and activated by a fusible link designed to react at 165°F. Install per manufactures recommendations to provide a UL assembly. Provide sealed sleeve to meet desired leakage performance. Provide out-of-wall damper where duct terminates at air device in wall.
- B. Acceptable Manufacturers:
 - 1. Ruskin
 - 2. Prefco Products
 - 3. Air Balance
 - 4. Greenheck, Inc.
 - 5. Nailor Industries
 - 6. Pottorff

2.7 WALL LOUVERS

- A. Refer to schedule on drawings. Coordinate with Architectural Drawings.
- B. All louver frames shall be a minimum of 0.08" extruded aluminum. All blades shall be a minimum of 0.081" extruded aluminum. Beginning point of water penetration at 0.01 oz/sq.ft. Shall be a minimum of 800 ft/min.
- C. Provide all louvers with removable aluminum bird screen with 1/4" mesh.
- D. Louvers shall be AMCA-500 tested and approved.

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- E. Acceptable manufacturers:
 - 1. American Warming and Ventilation
 - 2. Arrow
 - 3. Greenheck
 - 4. NCA
 - 5. Pottorff
 - 6. Ruskin

2.8 STORM SHELTER WALL LOUVERS

- A. Refer to schedule on drawings. Coordinate with Architectural Drawings.
- B. All louver frames shall be a minimum of 0.08" extruded aluminum. All blades shall be a minimum of 0.081" extruded aluminum. Beginning point of water penetration at 0.01 oz/sq.ft. Shall be a minimum of 800 ft/min.
- C. Provide all louvers with removable aluminum bird screen with 1/4" mesh.
- D. Louver performance shall be certified in accordance with the AMCA 511 Certified Ratings Program for AMCA 500-L Air Performance and Water Penetration and shall be licensed to bear the AMCA seal.
- E. Louvers shall be UL Classified (Wind-storm Rated) and shall be tested in accordance with the ICC 500 debris impact standard of a 15 lb. 2 x 4 traveling at 100 mph as per the requirements indicated within the FEMA 361 construction guidelines for a FEMA 361 or FEMA 320 compliant storm shelter or safe room.
- F. Louvers shall be capable of withstanding positive or negative wind pressure loads up to 250 psf when installed in accordance with the manufacturer's published installation instructions.
- G. Acceptable manufacturers:
 - 1. Ruskin (XP500)
 - 2. United Enertech (FEMA-5)
 - 3. Greenheck (AFL-501)
 - 4. Pottorff (XAV-545)

2.9 FLUES FOR POWER EXHAUST AND HIGH EFFICIENCY BOILERS AND WATER HEATERS

- A. CPVC positive pressure chimney rated for 180°F maximum flue gas temperature and with a UL tested pressure rating of 40 inches w.c. All accessories shall be made by the same manufacturer and designed to be a part of a positive pressure chimney system.

2.10 FLUE CAPS

- A. Stainless steel flue caps of a design so that wind action from any direction will create a vacuum in the flue. Caps as manufactured by Breidert or equal are acceptable. Refer to installation details on drawings.

2.11 DUCT LINING

- A. Duct lining shall be 1" thick, 1-1/2 lb. density, flexible lining coated on the air stream side to reduce attrition. Liner shall be Johns Manville Linacoustic, Certain-Teed Toughgard, or equal meeting requirements of NFPA 90-A. Provide I.A.Q. rated liner.

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2.12 VOLUME DAMPERS

- A. Manual balancing dampers that meet or exceed the following minimum construction standards:
 - 1. Frame 16-gauge
 - 2. Blades 16-gauge
 - 3. Bearings corrosion resistant
 - 4. Concealed linkage
 - 5. Opposed blade dampers
- B. Acceptable manufacturer:
 - 1. Ruskin Model MD-35 or approved equal, by
 - 2. Arrow
 - 3. American Warming and Ventilating
 - 4. Nailor Industries
 - 5. Pottorff
 - 6. Greenheck

2.13 ACCESS DOORS

- A. Round spin-in door of galvanized steel.
 - 1. Fireproof sealing gaskets and quick fastening locking devices
 - 2. Insulated door
 - 3. Conform to the requirements of the NFPA
 - 4. Identification and use of each access door
 - 5. UL label to match the construction in which it is installed
 - 6. Cable attached to door and outer frame
 - 7. Low leakage Access Door
- B. Acceptable Manufacturer
 - 1. Flex master, Inspector Series
 - 2. Approved Equal

2.14 COMBINATION FIRE/SMOKE DAMPERS

- A. Combination fire/smoke dampers meeting the following requirements:
 - 1. Each combination fire/smoke damper shall be 1-1/2-hour fire rated under UL Standard 555, 4th Edition, and shall be further classified by Underwriters Laboratories as a leakage Rated Damper for use in smoke control systems under the latest version of UL555S, and bear a UL label attesting to same. The damper manufacturer shall have tested, and qualified with UL, a complete range of damper sizes covering all dampers required by this specification. Testing and qualifying a single damper size is not acceptable. The leakage rating under UL555S shall be Leakage Class II.
 - 2. The damper frame shall be a minimum of 16-gauge, galvanized steel, formed into a structural hat channel shape with tabbed corners for reinforcement, as approved in testing by Underwriters Laboratories. Bearings shall be integral high surface area non-electrolytic materials construction to incorporate a friction free frame blade lap seal, or molybdenum disulfide impregnated stainless steel or bronze oilite sleeve type turning in the damper frame. The dampers shall be opposed blade type. The blades shall be constructed with a minimum of 16-gauge galvanized steel. The blade edge seal material shall be able to withstand 450°F. The jamb seals shall be flexible stainless steel compression type.

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3. As part of the UL qualification, dampers shall have demonstrated a capacity to operate (open and close) under HVAC system operation conditions, with pressures of at least 4" water gauge in the closed position, and 2,000 fpm air velocity in the open position.
 4. Each combination fire/smoke damper shall be equipped with a controlled 7 to 15 second heat-actuated release device. The electric EFL shall close and lock the fire/smoke damper during test, smoke detection, power failure or fire conditions through actuator closure springs. To prevent duct and HVAC component damage, the damper shall at all times be connected to the actuator for controlled closure in not less than 7 seconds and no more than 15 seconds. Instantaneous damper closure is unacceptable. After exposure to high temperature of fire, the damper must be inspected prior to reset to ensure proper operation. Release temperature is 165°F.
 5. Provide UL555S qualified electric actuator at 120 VAC.
 6. Provide air-foil type blades.
- B. Provide integral sleeves
- C. Acceptable Manufacturers:
1. Ruskin
 2. Air Balance, Inc.
 3. Greenheck, Inc.
 4. Nailor Industries
 5. Pottorff

2.15 SMOKE DAMPERS

- A. Smoke dampers meeting the following requirements.
1. Each smoke damper shall be classified by Underwriters Laboratories as a leakage Rated Damper for use in smoke control systems under the latest version of UL555S and bear a UL label attesting to same. The damper manufacturer shall have tested, and qualified with UL, a complete range of damper sizes covering all dampers required by this specification. Testing and qualifying a single damper size is not acceptable. The leakage rating under UL555S shall be Leakage Class II.
 2. The damper frame shall be a minimum of 16-gauge, galvanized steel, formed into a structural hat channel shape with tabbed corners for reinforcement, as approved in testing by Underwriters Laboratories. Bearings shall be integral high surface area non-electrolytic materials construction to incorporate a friction free frame blade lap seal, or molybdenum disulfide impregnated stainless steel or bronze oilite sleeve type turning in the damper frame. The dampers shall be opposed blade type. The blades shall be constructed with a minimum of 16-gauge, galvanized steel. The blade edge seal material shall be able to withstand 450°F. The jamb seals shall be flexible stainless steel compression type.
 3. As part of the UL qualification, dampers shall have demonstrated a capacity to operate (open and close) under HVAC system operation conditions, with pressures of at least 4" water gauge in the closed position, and 2,000 fpm air velocity in the open position.
 4. Provide UL555S qualified electric actuator at 120 VAC.
 5. Provide air-foil type blades.
- B. Provide integral sleeves.

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- C. Acceptable Manufacturers:
1. Ruskin
 2. Air Balance, Inc.
 3. Greenheck, Inc.
 4. Nailor Industries
 5. Pottorff

2.16 DIFFUSER FITTINGS LOW PRESSURE TAPS

- A. Fitting shall meet or exceed the following minimum construction standards:
1. Conical with a base diameter two inches larger than the tap diameter.
 2. Construct fitting and damper of galvanized steel in accordance with ASTM A 527, G90 finish.
 - a. Fitting with a 3/16-inch-high stop bead approximately 2-1/2-inches from the discharge end of the fitting
 - b. Provide the fitting with a butterfly damper, damper rod, end bearings and heavy-duty locking quadrant.
 - c. Size the length of the straight section of the fitting to match the damper blade diameter. Center the damper blade in the straight section.
 3. Match the fitting body gauge to the SMACNA duct gauge, but not less than:
 - a. Through 8 inches: 26 gauge; Damper blade 22 gauge
 - b. 10 inches and 12 inches: 24 gauge; Damper blade 22 gauge
 - c. 14 inches and 16 inches: 22 gauge; Damper blade 22 gauge
 - d. 18 inches and 20 inches: 20 gauge; Damper blade 20 gauge
 4. Fasten damper blade to a 3/8 X 3/8 continuous square rod with minimum (2) galvanized U-bolts.
 5. Support the damper rod to the fitting with airtight nylon end bushings / bearings.
 6. Provide the damper with a self-locking regulator and handle.
 7. Provide a 2" sheet metal stand-off to extend the regulator.
 8. Flex duct grip area – 2 inches behind retaining bead
 9. Flex duct retaining bead – 1 inch from end
 10. Conical length of at least 3 inches
 11. Barrel length of at least 9 inches

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Use construction methods and requirements as outlined in SMACNA HVAC Duct Construction Standards as well as SMACNA Balancing and Adjusting publications, unless indicated otherwise in the specifications. Refer to details on the drawings for additional information.
- B. Reinforce ducts in accordance with recommended construction practice of SMACNA. Provide additional reinforcement of large plenums as required to prevent excessive flexing and or vibration.
- C. Cross break or bead sheet metal for rigidity, except ducts that are 12" or less in the longest dimension.
- D. Where ducts pass through walls in exposed areas, install suitable escutcheons made of sheet metal angles as closers.

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- E. At locations where ductwork passes through floors, provide watertight concrete curb around penetration.
- F. Support ducts where passing through floors with galvanized steel structural angles of adequate bearing surface.
- G. Metal or lined ductwork exposed to view through grilles, registers, and other openings shall be painted flat black. Do not install grilles, registers, or similar items until painting is complete.
- H. Fire Dampers shall be installed per manufacturer's recommendations to create a UL rated assembly.
- I. Install end bearing at all locations where damper shaft penetrates duct wall.
- J. Clean duct to remove accumulated dust. Ducts shall be closed on ends between phases of fabrication to assure that no foreign material enters the ducts.

3.2 DUCTWORK

- A. Construct rectangular ducts and round ducts in accordance with the latest SMACNA HVAC Duct Construction Standards. Use the static pressure specified on the air handling unit schedule or fan schedules as a minimum for duct construction.
- B. Provide adjustable, galvanized splitter-dampers, pivoted at the downstream end with appropriate control device at each supply duct split.
- C. For branch ducts wider than 18", and when shown on drawings provide extractors with an appropriate control device at each rectangular zone or branch supply duct connection. Provide controllers for extractors. Branch ducts shall have a 45° angle in the direction of flow. Do not provide extractor at branch ducts to sidewall registers where the registers are within 10 feet of the main duct.
- D. Shop manufactured curved blade scoops may be used for branch duct takeoffs up to 18" wide. Taper scoop blade to the end, to prevent any sagging that may cut into, or damage duct liner if specified during operation.
 - 1. Construct shop manufactured scoops and splitter blades of galvanized sheet metal 2 full gauges heavier than equivalent sheet metal gauge of branch duct (up to 16 gauge).
 - 2. Check extractors, scoops and splitter blades thoroughly for freedom of operation. Oil bearing points before installing.
- E. Use pushrod operator with locking nut and butt hinges assembly.
- F. Provide opposed-blade volume dampers with an appropriate control device in each of the following locations:
 - 1. Return air ductwork
 - 2. Outside air branch duct
 - 3. Exhaust branch duct
 - 4. Exhaust connections to hoods except kitchen grease hoods or equipment
 - 5. Where otherwise indicated or required for balancing coordinate location of additional dampers required by TAB Contractor.
 - 6. Provide multi-blade dampers when blade width exceeds 12". Provide end bearing where damper shaft penetrates duct wall.

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- G. Elbows:
1. Rectangular: Where square elbows are shown, or are required for good airflow, provide and install single-wall or airfoil turning vanes. Job-fabricated turning vanes, if used, shall be single-thickness vanes of galvanized steel sheets of the same gauge metal as the duct in which they are installed. Furnish vanes fabricated for the same angle as the duct offset. The use of radius elbows with a centerline radius of not less than 1-1/2 times the duct width may be provided in lieu of vaned elbows where space and air flow requirements permit.
 2. Round Oval Duct. Provide elbows with a centerline radius of 1-1/2 times the duct diameter or duct width. For round ducts, furnish smooth elbows or 5 piece, 90° elbows and 3 piece, 45° elbows.
- H. For control devices concealed by ceilings, furring, or in other inaccessible locations, furnish extension rods and appropriate recessed-type Young regulators, mounted on the surface of the ceiling or the furring, unless specified, or shown otherwise. Provide with chrome plated cover plates. Use only one mitered gear set for each control device.
- I. Install streamline deflectors at any point where dividing a sheet metal duct around piping or where other such obstruction is permitted. Where such obstructions occur in insulated ducts, fill space inside streamliner and around obstructions with glass fiber insulation.
- J. Insulated Flexible Duct:
1. Install in accordance with manufacturer's instructions, and the terms of its UL listing. Duct shall not exceed 6' in length. Make connections by use of sheet metal collars and stainless-steel circular screw clamps. Clamps shall encircle the duct completely and be tightened with a worm gear operator to the point that will provide an airtight connection without unnecessary deformation of the duct. Provide one clamp on flexible duct and one clamp on external insulation. Vapor barrier jacket shall be tucked inside to conceal insulation material.
 2. Construct bends over 45° with sheet metal elbows.
- K. Duct Supports:
1. Horizontal ducts up to 40". Support horizontal ducts up to and including 40" in their greater dimension by means of #18 U.S. gauge galvanized iron strap hangers attached to the ducts by a minimum of two locations per side by means of screws, rivets or clamps, and fastened to inserts with toggle bolts, beam clamps or other approved means. Place supports on maximum 8' centers. Use clamps to fasten hangers to reinforcing on sealed ducts.
 2. Horizontal ducts larger than 40". Support horizontal ducts larger than 40" in their greatest dimension by means of hanger rods bolted to angle iron trapeze hangers. Place supports on maximum 8' centers in accordance with SMACNA Standards.
 3. Support vertical ducts where they pass through the floor lines with 1-1/2" x 1-1/2" x 1/4" angles for ducts up to 60". Above 60", the angles shall be increased in strength and sized on an individual basis considering space requirements.
 4. Supports shall be suspended from structural or by independent support. Do not support from structural bridging. Upper attachments should be selected with a safety factor of 4- or 5-times actual load conditions and subject to Engineers approval. Double wrap straps over open web of joist.
 5. Support all exterior horizontal roof-mounted ducts with goal-post style hot-dip galvanized steel framing secured to polypropylene UV-inhibited isolation pads, equal to PHP-D by PHP Systems.

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3.3 PLENUMS

- A. Return air plenums shall be rectangular galvanized sheet metal ductwork.
- B. Fabricate plenums upstream of fan of 16-gauge material.
- C. Fabricate plenums upstream of filters minimum 18-gauge material.

3.4 FLEXIBLE CONNECTIONS

- A. Where ducts connect to fans or air handling units that are not internally isolated, make flexible airtight connections using "Ventglas" fabric. The fabric shall be fire-resistant, waterproof and mildew resistant with a weight of approximately 30 ounces per square yard. Provide a minimum of 1/2" slack in the connections, and a minimum of 2-1/2" distance between the edges of the ducts. Also, provide a minimum of 1" slack for each inch of static pressure on the fan system. Fasten fabric to apparatus and to adjacent ductwork by means of galvanized flats or draw bands. Where connections are made in outdoor locations, seal fabric to metal with mastic.

3.5 ACCESS DOORS

- A. Install ductwork access doors as noted below, arranged for convenient access. Stencil each door for specific use. Install access doors in each of the following locations:
 - 1. Fire Dampers
 - 2. Smoke Dampers
 - 3. Smoke/fire Dampers
 - 4. Outside Air Dampers
 - 5. Duct Mounted Coils (up-stream)
 - 6. Control Dampers
- B. Size access door 1" smaller than ductwork.
 - 1. Available Sizes: 8", 10", 12", 18", 24"
- C. Construct access door airtight and conform to recommendations of NFPA and SMACNA.
- D. Demonstrate suitability of access for the intended purpose. Install multiple access doors as required.

3.6 DUCT LINING

- A. Install glass fiber acoustical lining where shown on drawings. Secure to duct surfaces with Foster 85-62 / 85-60 or Childers CP-125-1 / CP-127 adhesive and sheet metal fasteners on 12" centers. Coat exposed edges and leading edges of cross-joints with adhesive.
- B. Provide metal nosing that is either channeled or "Z" profiled or are integrally-formed from the duct wall securely installed over transversely oriented liner edges facing the air stream at fan discharge and at any interval of lined duct preceded by unlined duct.
- C. Refer to Insulation & Liner Detail on drawings for locations requiring liner to be installed.
- D. Do not install liner in multi-zone unit ductwork.

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3.7 SEALING OF SEAMS AND JOINTS

- A. Seal supply, return, exhaust and outside air duct systems.

3.8 FLUES

- A. Provide and install flues for all gas fired equipment.
- B. Refer to plans for all related locations.
- C. Contractor is responsible for coordinating stack sizing, stack drains, stack test ports, stack termination fittings and all other required fittings with the selected equipment manufacturers.
- D. All fittings and accessories shall be manufactured by the flue manufacturer. The flue shall be installed per manufacturer's instruction.
- E. Terminate flues at height above roof to prevent flue gas from entering the building.

3.9 ACOUSTICAL DUCT

- A. Install in the following locations:
 - 1. Gymnasiums
 - 2. Where indicated on the drawings

3.10 SCREENS

- A. Furnish and install screens on all duct, fan, etc., openings furnished by the Contractor that lead to, or are, outdoors; screens shall be No. 16 gauge, one-half inch (1/2") mesh in removable galvanized steel frame. Provide safety screens meeting OSHA requirements for protection of maintenance personnel on all fan inlets and fan outlets to which no ductwork is connected.

3.11 PLENUMS

- A. Construct plenums with galvanized steel framing members and galvanized sheet steel, cross broken and rigidly braced with galvanized angles. Gauges and bracing shall conform to SMACNA recommendations for ductwork of like sizes. Openings for fans, access doors, etc., shall be framed with galvanized steel angles.
- B. Provide access doors.

3.12 CONNECTIONS TO LOUVERS

- A. Make watertight connections to all louvers. Ductwork behind louver shall have watertight soldered joints for a minimum of three feet and be sloped to bottom of louver. Lap duct to be over bottom louver blade where possible.
- B. Where plenums are installed on inside of louver, construct such that bottom of plenum will lap over bottom blade of louver to drain any water that may enter.

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3.13 TESTING OF LOW-PRESSURE DUCTWORK

- A. Test a minimum 25% of ductwork for leaks before concealing. Maximum allowable leakage is 5% of total airflow scheduled. Any ducts that exceed the allowable leakage shall be repaired and re-tested to meet the maximum allowed leakage. Should more than 20% of the ducts tested for leakage result in a failure to meet the maximum allowed leakage, Contractor shall then be responsible for, at no additional cost to the project or Owner, testing 100% of the ductwork and repairing all ducts to meet the maximum allowed leakage.
- B. Provide equipment necessary for performing tests, including rotary blower large enough to provide required static pressure at allowed CFM quantity, certified orifice section with proper papers, traceable serial numbers and pressure vs CFM leakage rate scale, U-tube gauge board complete with cocks, tubing, and inclined manometer for leakage rates.
- C. Mains: Test mains after risers and branches are tied in and all equipment set. Close runout connections and place fan in operation. Provide pressure in mains at 1-1/2 times design pressure. Visually inspect joints. Repair leaks detected by sound or touch. Release mains for completion after joints are tight.
- D. Ductwork down stream of terminal boxes, return, exhaust, and outside air ducts are to be visually inspected.

END OF SECTION

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SECTION 233416

FANS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install fans, including centrifugal, axial and propeller types, with supplemental equipment.

1.2 RELATED WORK

- A. Division 23 Mechanical:
 - 1. Ductwork
 - 2. Air Balance
 - 3. Electrical Provisions of Mechanical Work
 - 4. Vibration Isolation

1.3 PERFORMANCE

- A. Provide fan type, arrangement, rotation, capacity, size, motor horsepower, and motor voltage as shown. Fan capacities and characteristics are scheduled on the drawings. Provide fans capable of accommodating static pressure variations of +10% of scheduled design at the design air flow.
- B. Rate fans according to appropriate Air Moving and Conditioning Association, Inc. (AMCA), approved test codes and procedures. Supply fans with sound ratings below the maximums permitted by AMCA Standards. All fans provided must be licensed to bear the Certified Ratings Seal.
- C. Statically and dynamically balance all fans.
- D. Motors shall be sized so that they do not operate within the motor service factor.
- E. Fans shall be capable of 120% of the scheduled air capacities.
- F. All static pressures shown on schedules are external to fans. Manufacturer shall add damper and accessory losses to scheduled value before selecting fan.

1.4 SUBMITTALS

- A. Submit fan performance curves with system operating point plotted on curves.
- B. Submit manufacturer's printed installation instructions.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Cook
- B. Greenheck
- C. Twin City Fans
- D. Penn Barry

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2.2 PROTECTIVE COATINGS

- A. Manufacturer's Standard. Apply to fans, motors and accessories, the manufacturer's standard prime coat and finish, except on aluminum surfaces or where special coatings are required.
- B. Galvanizing. After fabrication of the parts, hot-dip coat surfaces that require galvanizing. Where galvanizing is specified, a zinc coating may be used. After fabrication, apply the zinc coating and air-dry the coating to 95% pure zinc. Acceptable zinc coatings include Zincilate, Sealube, Amercoat, Diametcoat, or an approved equal.

2.3 SUPPLEMENTAL EQUIPMENT

- A. Motor Covers. Provide weatherproof motor covers for installations out of doors. Apply the same finish as used on the fan.
- B. Provide direct drive fan motors.
- C. Safety Disconnect Switch: Provide a factory-wired to motor, safety disconnect switch on each unit.
- D. Prefabricated Roof Curbs: Furnish prefabricated roof curbs as detailed. The minimum height is 14". Include a resilient pad on each roof curb so the equipment can be mounted on the top flange for proper seal. Coordinate roof slope and curb to ensure equipment is installed in level position. Provide double shell to protect insulation from damage.
- E. Where motorized damper is scheduled:
 - 1. Provide manufacturer's integral motorized damper.
- F. All fans are to be provided with a durable, deep etched, .025" thick, factory installed aluminum identification plate with the following information. Plates are to be furnished with four mounting holes.
 - 1. Fan mark as indicated on the Contract Drawings
 - 2. Serial number
 - 3. Model number
 - 4. Capacity (CFM) and static pressure
 - 5. Motor HP
 - 6. Motor Amps
 - 7. Manufacturer
 - 8. Motor phase
 - 9. Motor volts

2.4 VENTILATION AND EXHAUST FANS

- A. Provide the ventilation and exhaust fans shown on the drawings.
- B. Provide each motor with internal overload protection.
- C. Provide approved safety screen where inlet or outlet is exposed.
- D. Provide duct flanges where required for connections.

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2.5 ROOFTOP VENTILATION AND EXHAUST SYSTEMS

- A. Provide the rooftop ventilation and exhaust systems shown on the drawings.
- B. Provide each motor with internal overload protection.
- C. Components:
 - 1. Aluminum, stainless steel or plastic coated bird guard.
 - 2. Screws and fasteners of stainless steel or nonferrous material.
 - 3. All aluminum construction unless indicated otherwise on fan schedule.
- D. Welded construction, corrosion resistant fasteners, minimum 16 gauge marine alloy aluminum.
- E. Aluminum base shall be continuously welded curb cap corners.

2.6 GRAVITY ROOFTOP INTAKE AND RELIEF VENTS

- A. Provide the rooftop intake and relief vent systems shown on the drawings.
- B. Provide with aluminum, stainless steel or plastic-coated bird guard.
 - 1. Screws and fasteners of stainless steel or nonferrous material
 - 2. All aluminum construction
- C. Welded construction, corrosion resistant fasteners, minimum 16-gauge marine alloy aluminum.
- D. Aluminum base shall be continuously welded curb cap corners.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install fans according to the manufacturer's instructions and in the locations shown on the drawings. Ensure fan location is installed at minimum distance from roof edge to meet code requirements.
- B. Do not operate fans or fan powered devices for any purpose until ductwork is clean, filters in place, bearings lubricated and the fan has been run under observation.
- C. Roof mounted fans and gravity rooftop intake and relief vents shall be secured to the curb with stainless steel lag screws at a minimum of 6-inches on center. Follow manufacturer's installation instructions if they are more stringent. Install roof mounted equipment in a level position. Units shall be seated on properly sized curb. Gap between base of the fan and top of the curb shall be sealed with neoprene 1" x 1/4" gasket. Gasket shall be glued or attached with pressure sensitive adhesive.
- D. Install curbs and equipment in level position.

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- E. Ceiling mounted in-line centrifugal blowers
 - 1. Shall be suspended from structure with 1/2-inch zinc plated all-thread rods secured to structure.
 - 2. Provide sub-structure where required.
 - 3. Mount bottom of fan no more than 18-inches above the finished ceiling height.

END OF SECTION

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SECTION 233713

AIR DEVICES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install air distribution devices, including grilles, diffusers, registers, dampers, and extractors.

1.2 RELATED WORK

- A. Division 23 Mechanical.
 - 1. Ductwork
 - 2. Air Balance

1.3 COOPERATION WITH OTHER TRADES

- A. Coordinate this work with work under Division 26 Electrical, to ensure that intended functions of lighting and air systems are achieved.

1.4 SUBMITTALS

- A. Submit product data for outlets, grilles, registers, control devices, and similar equipment for review prior to placement of purchase order.
- B. Submittal shall include performance sheet for each air device type. Performance sheet shall include NC levels, throw, and total pressure loss at various air flows.

1.5 FINISHES

- A. Paint exposed devices with factory standard prime coat, or factory finish coat, as specified.

PART 2 - PRODUCTS

2.1 DIFFUSERS, GRILLES AND REGISTERS - Refer to Drawing Schedule.

2.2 ACCEPTABLE MANUFACTURERS

- A. Titus
- B. Price
- C. Metal-Aire/Greenheck
- D. Krueger
- E. Nailor Industries

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2.3 ACCESSORIES

- A. Supply Grille Extractors. Provide supply grilles with an air control device capable of positively regulating the volume of air extracted from the supply duct.
- B. Select extractors similar to Titus Model AG25, tight closing in the minimum position. Include a key-operated or worm-gear adjusting mechanism to facilitate positioning from the grille opening. Where adjustment is not accessible at the grille opening, provide a square control rod equipped with a locking quadrant.
- C. Mounting Frames. Provide each grille or register not equipped with a removable core with a companion, all-purpose mounting frame constructed like grille frame to facilitate installation and removal of the grille or register without marring adjacent mounting surfaces.
 - 1. Furnish frames with 1/2" thick sponge rubber gasket to prevent air leakage.
 - 2. Provide a frame that neatly fits the grille. Mounting frames will not be required for grilles or registers mounted directly on exposed ductwork.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Do not install ceilings adjacent to fixtures until installation of fixtures, air supply assemblies, return-air blank-off strips and flexible duct have been approved. Remove and reinstall any part of the installation found incorrect.

3.2 INSTALLATION

- A. Louvered diffuser outlets mount tight against the ceiling. Fasten outlets to ductwork with sheet metal screws. For perforated diffusers, attach the frame assembly by a concealed hinge assembly to an outer frame compatible with the type of ceiling on which the diffuser is installed.

END OF SECTION

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SECTION 234100

AIR FILTRATION

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install air filters.

1.2 RELATED WORK

- A. Division 23 Mechanical.

1.3 SUBMITTALS

- A. Submit manufacturer's product data sheets and capacity information as specified.
- B. Submit recommended Dirty Filter pressure drop.

PART 2 - PRODUCTS

2.1 MEDIUM EFFICIENCY AIR FILTERS

- A. The filter cells:
 - 1. Pleated media.
 - 2. Disposable type.
 - 3. Contain not less than 4.6 sq. ft. of filtering media per square foot of face area.
 - 4. Minimum 15 pleats per linear foot of filter.
 - 5. 2" thick.
- B. Minimum MERV-8
 - 1. Average synthetic arrestance in excess of 93% when tested in accordance with the ASHRAE 52-68 test standard.
- C. Filter capable of operating with variable face velocities up to 500 fpm without impairing efficiency.
- D. Initial resistance to air flow:
 - 1. 300 fpm - 0.12" WG.
 - 2. 500 fpm - 0.28" WG.
- E. UL listed with Class II rating.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install the filters in accordance with the manufacturer's instructions.
- B. Replace all construction air filters at substantial completion per specification 23 05 00.

END OF SECTION

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SECTION 234300

AIR PURIFICATION SYSTEM

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Furnish and install an air purification system intended for the use as a part of another manufacturer's air handling unit as shown on the drawings, details and equipment schedules.

1.2 RELATED WORK

- A. Division 23 Mechanical
 - 1. Ductwork
 - 2. Air Balance
 - 3. Electrical Requirements for Mechanical Work
 - 4. Building Management and Control System
 - 5. Ductwork

1.3 REFERENCES

- A. ASHRAE Standard 62.1 – Ventilation for Acceptable Indoor Air Quality
- B. ASHRAE Standard 52.2 – Method of Testing General Air Cleaning Devices for Removal Efficiency by Particle Size
- C. NFPA 70 – National Electrical Code
- D. UL 867 – Electrostatic Air Cleaners
- E. UL 2998 - Environmental Claim Validation Procedure (ECVP)

1.4 SUBMITTALS

- A. Submit manufacturer's documentation in accordance with specification requirements.
- B. Submit the following information:
 - 1. Manufacturer's installation instructions.
 - 2. Minimum Circuit Ampacity.
 - 3. Maximum Overcurrent Protection size.
 - 4. Electrical interlocks.
- C. Submit recommended clearance dimensions for air flow and service.
- D. Submit a schedule, at the front of the submittal, of equipment indicating:
 - 1. Unit designation
 - 2. Model number
 - 3. Electrical characteristics
- E. Submit Copy of U.L. 2998 and U.L. 867 certificates for each product being submitted.

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- F. Mark-up a copy of the specifications, indicating in the margin of each paragraph, the following: COMPLY, DO NOT COMPLY, NOT APPLICABLE.

1.5 QUALITY ASSURANCE

- A. A qualified representative from the manufacturer shall be available to inspect the installation of the air purification system to ensure installation in accordance with manufacturer's recommendation.
- B. Manufacturers shall have their product tested to UL 2998 Environmental Standard for confirmation of no ozone with certificate available. The final report shall indicate the ozone levels and high voltage output the device's electrode(s) were operating during the test. Reports that do not include high voltage output during the UL 2998 testing shall not be acceptable.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver in factory fabricated shipping containers. Identify on outside of container type of product and location to be installed. Avoid crushing or bending.
- B. Store in original cartons and protect from weather and construction work traffic.
- C. Store indoors and in accordance with the manufacturers' recommendation for storage.

1.7 WARRANTY

- A. The manufacturer shall provide a parts warranty for a period of one (1) year from substantial completion.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Global Plasma Solutions
- B. Plasma Air
- C. Bioclimatic Air Systems

2.2 DESIGN AND PERFORMANCE CRITERIA

- A. Each piece of air handling equipment (Packaged Rooftop Air Conditioners), as designated on the plans, details, equipment schedules and/or specifications shall contain a Plasma Generator with Bi-polar Ionization output as described here within.
- B. The Bi-polar Ionization system shall be capable of:
1. Effectively killing microorganisms downstream of the bi-polar ionization equipment (mold, bacteria, virus, etc.).
 2. Controlling gas phase contaminants generated from human occupants, building structure, furnishings and outside air contaminants.
 3. Capable of reducing static space charges.
 4. Effectively reducing space particle counts.

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5. When mounted to the air entering side of a cooling coil, keep the cooling coil free from pathogen and mold growth. A non-contact voltage detector can confirm the entire coil is covered with airflow turned off. Devices that do not clean the entire coil are not acceptable.
 6. All manufacturers shall provide documentation by an independent NELEC accredited laboratory that proves the product has minimum kill rates for the following pathogens given the allotted time and in a space condition.
 - a) MRSA - >96% in 30 minutes or less
 - b) E.coli - > 99% in 15 minutes or less
 - c) TB - > 69% in 60 minutes or less
 - d) C. diff - >86% in 30 minutes or less
 - e) Noro Virus -> 93.5% in 30 minutes or less
 - f) Legionella -> 99.7% in 30 minutes or less
 - g) SARS-COV2 -> 99.4% in 30 minutes or less
 7. Capable of modular field assembly in six-inch (150mm) sections.
- C. The bi-polar ionization system shall operate in a manner such that equal amounts of positive and negative ions are produced. Ionizers with positive and negative output (DC type) shall be self-cleaning. Ionizers provided on AHUs shall be AC type ionizers with each electrode pulsing between positive and negative and the electrode shall be modular. Ionizers on RTUs shall be self-cleaning DC type ionization. All ionization systems shall use carbon fiber brushes.
1. Air exchange rates may vary through the full operating range of a constant volume or VAV system. The quantity of air exchange shall not be increased due to requirements of the air purification system.
 2. Velocity Profile: The air purification device shall not have maximum velocity profile.
- D. Humidity: Plasma Generators shall not require preheat protection when the relative humidity of the entering air exceeds 85%. Relative humidity from 0 - 100%, condensing, shall not cause damage, deterioration or dangerous conditions within the air purification system. Air purification system shall be capable of wash down duty.
- E. Equipment Requirements for Packaged Rooftop Air Conditioners:
1. Electrode Specifications (Bi-polar ionization):
 - a) Each alternating current (AC) Ionization Bar with Bi-polar Ionization output shall include a minimum of eighteen carbon fiber cluster ion needles per foot of coil face width shall be provided. The entire cooling coil width shall have equal distribution of ionization across the face. Systems without ion needles at least 0.50" (12.5mm) apart shall not be acceptable. The plasma electrode shall require no more than 1.0" (25mm) in the direction of airflow for mounting. AC ionization bars using any electrode material other than carbon fiber brushes, shall not be acceptable. All hardware required for mounting shall be provided by the air purification manufacturer except self-tapping screws for the power supply. Bi-polar ionization tubes manufactured of glass and steel mesh shall not be acceptable due to replacement requirements, maintenance, and performance output reduction over time, ozone production and corrosion.
 - b) Electrodes shall be provided in 6.0" (150mm) increments, epoxy filled for an IP55 rating and utilizing brass connection hardware that is recessed into the connection joint once fully engaged and assembled.
 - c) Electrodes shall be energized when the main unit disconnect is turned on.

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- d) The ionization output shall be a minimum of 140M ions/cc per inch of cooling coil width as measured 1 inch from the cold plasma needles. Provide multiple rows of bars to achieve equivalent output per inch listed above.
 - e) Ionization bars shall be provided with magnet mounting kits to prevent penetration into cooling coils.
 - f) Ionization bars shall be constructed of UL 94VO and UL746C composite material.
 - g) Device shall be OSPD certified.
- F. Electrical Requirements:
- 1. Wiring, conduit and junction boxes shall be installed within housing plenums in accordance with NEC NFPA 70. Plasma Generator shall accept an electrical service of 24VAC, 115 VAC or 208-230VAC, 1 phase, 50/60 Hz. The contractor shall coordinate electrical requirements with air purification manufacturer during submittals.
 - 2. All Plasma Generators shall have internal short circuit protection, overload protection, and automatic fault reset. Systems requiring fuses shall not be acceptable.
 - 3. The Plasma Generator power supply shall have internal circuitry to sense the ionization output and provide dry contact alarm status to the BMS as well as a local "Plasma On" indication light.
 - 4. The installing contractor shall mount and wire the Plasma device within the air handling unit specified or as shown on the plans. The contractor shall follow all manufacturer IOM instructions during installation.

PART 3 - EXECUTION

3.1 GENERAL

- A. The Contractor shall be responsible for maintaining all air systems until the substantial completion.

3.2 ASSEMBLY AND ERECTION: PLASMA GENERATOR

- A. All equipment shall be assembled and installed in a workman like manner to the satisfaction of the owner, architect, and engineer.
- B. Any material damaged by handling, water or moisture shall be replaced, by the mechanical contractor, at no cost to the owner.
- C. All equipment shall be protected from dust and damage on a daily basis throughout construction

3.3 TESTING

- A. Provide the manufacturers recommended electrical tests.

3.4 COMMISSIONING AND TRAINING

- A. A manufacturer's authorized representative shall provide start-up supervision and training of owner's personnel in the proper operation and maintenance of all equipment.

END OF SECTION

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SECTION 238121

SINGLE PACKAGE ROOFTOP AIR CONDITIONERS (w/gas heat)

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide and install a single-package, single-zone, electric air conditioner with gas heat for rooftop application.

1.2 RELATED WORK

- A. Division 23 Mechanical.
 - 1. Ductwork
 - 2. Air Balance
 - 3. Electrical provisions for mechanical work
 - 4. Air Filtration

1.3 PERFORMANCE

- A. As scheduled on drawings, with head pressure control to enable unit to start and operate down to 20 degrees F ambient.

1.4 SUBMITTALS

- A. Manufacturer's certified capacity data
- B. Submit manufacturer's installation, start-up and service instructions.
- C. Submit recommended clearance dimensions for air flow and service.
- D. Submit coordination drawings as specified. Consideration shall be given to adjacent structures and their effect on air flow patterns.
- E. Submit internal wiring diagram of Control Center
- F. Submit sequence of operation in narrative form.
- G. Mark-up a copy of the specifications indicating in the margin of each paragraph the following: COMPLY, DO NOT COMPLY, NOT APPLICABLE.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Unit shall be shipped with doors bolted shut to prevent damage during transport and thereafter while in storage awaiting installation.
- B. Follow Installation, Operation and Maintenance manual instructions for rigging, moving, and unloading the unit at its final location.
- C. Unit shall be stored in a clean, dry place protected from construction traffic in accordance with the Installation, Operation and Maintenance manual.

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1.6 WARRANTY

- A. Manufacturer shall provide a two year full parts non-prorated warranty and a ten year non-prorated compressor warranty. Warranty excludes parts associated with routine maintenance and refrigerant.
- B. Stainless steel heat exchanger shall be provided with a minimum 15-year non-prorated warranty.
- C. Contractor shall provide a 1-year labor warranty starting from the date of substantial completion.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Lennox
- B. Carrier
- C. AAON

2.2 COMPRESSOR

- A. Provide a thermally protected, serviceable semi-hermetic compressor or hermetic compressor with service valves, vibration isolation, crankcase heaters, and filter drier.
- B. Compressor shall be scroll type with minimum two stages, unless noted otherwise.
- C. Unit shall include a factory holding charge of refrigerant R-32 or R-454B.

2.3 EVAPORATOR, REHEAT AND CONDENSER COILS

- A. Provide copper tubes with mechanically bonded aluminum fins for evaporator and hot-gas reheat coils.
- B. Provide louvered microchannel condenser coils with a series of flat tubes containing multiple, parallel flow microchannel layered between the refrigerant manifolds.
- C. Provide factory installed hail / vandalism guards for condenser coils.
- D. A primary drain pan overflow safety shall shut off the unit and issue a warning before overflow occurs.

2.4 EVAPORATOR FANS

- A. Unit shall be equipped with a direct drive centrifugal evaporator fan, minimum two-speed.
- B. Blowers and motors shall be dynamically balanced and mounted on rubber isolators.
- C. Motor shall contain premium efficiency ODP with self-aligning ball bearings rated for 200,000 hours service with external lubrication ports grouped near the motor access side of the unit. Provide motor HP as indicated on the drawings.

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2.5 GAS HEATING SECTION

- A. Unit shall be equipped with corrosion resistant burners and heat exchangers.
- B. Gas Controls.
 - 1. Automatic gas valve and pressure regulator.
 - 2. A manual shutoff valve.
 - 3. Pilot valve.
 - 4. Two flame rollout limit switches.
 - 5. An adjustable fan control.
 - 6. Fixed high limit controls
- C. Unit shall be equipped with an electric spark pilot ignition system.
 - 1. Electronic flame detection.
 - 2. 100% safety shutoff.
- D. Combustion air shall be induced by a positive pressure power venting fan.
 - 1. Prepurge of combustion chamber.

2.6 CASING FILTERS AND DUCT CONNECTION

- A. Provide a cabinet constructed of galvanized or zinc-coated steel, primed and coated with baked enamel and suitable for outdoor installation.
- B. Provide duct connections on the bottom of each unit, as indicated on drawings.
- C. Provide manually operated outdoor air dampers and motorized shut-off damper.
- D. Furnish 2" thick filters as specified.
- E. Furnish through-the-bottom electrical service connection.
- F. Provide hinged access doors with quick release handles.

2.7 ROOF CURB

- A. Install a hot dipped galvanized welded steel roof curb.
 - 1. Curb shall be fully gasketed between the curb top and unit bottom with the curb providing full perimeter support, cross structure support and air seal for the unit. Curb gasket shall be furnished within the control compartment of the rooftop unit to be mounted on the curb immediately before mounting the rooftop unit.
 - 2. Use a design complying with National Roofing Contractors Association requirements.
 - 3. Level curb according to manufacturer's recommendations.
 - 4. Curb height shall be minimum 14".

2.8 OUTDOOR FANS

- A. Provide propeller type with direct driven permanently lubricated motor. Fan shall discharge upward.

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2.9 CONTROLS

- A. Provide staged heating and cooling as required, automatic changeover and fan control.
- B. Provide terminal block for field installation of controls.

2.10 HEAD PRESSURE CONTROL

- A. Provide solid state outdoor air fan speed control to permit unit to operate down to 20°F.

2.11 SHORT CYCLE CIRCUIT

- A. Provide circuit to prevent compressor from short cycling as a result of a rapid change in thermostat setting. Circuit also prevents compressor restart at least 5 minutes after shutdown.

2.12 CONVENIENCE OUTLET

- A. Provide non-powered 120V GFI outlet on unit cabinet where specified on drawings.

2.13 SERVICE DISCONNECT SWITCH

- A. Provide a factory-installed, field-wired non-fused disconnect switch with external locking handle.

2.14 MOTORIZED OUTSIDE AIR DAMPER

- A. Low leakage 14-gauge galvanized steel
 1. Airfoil Blades
 2. Ruskin CD60

2.15 DEHUMIDIFICATION PACKAGE

- A. Where specified, provide sub-cooling / reheat dehumidification coil located downstream of the evaporator coil. Dehumidification coil shall be controlled by space-mounted humidistat.

2.16 PHASE MONITORING PROTECTION

- A. Provide unit with phase monitoring protection to protect motors and compressors against issues associated with phase loss, phase imbalance and phase reversal.

2.17 EXHAUST/RETURN SECTION

- A. Provide barometric relief gravity type dampers to operate in conjunction with economizer to provide exhaust.
- B. Where specified, provide factory installed power exhaust assembly that shall assist the barometric relief damper in the economizer in relieving building pressurization.

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2.18 LOW LEAK ECONOMIZER WITH ENTHALPHY CONTROL

- A. Unit shall be provided with factory installed low leak economizer.
- B. Low leak economizer dampers shall meet and comply with California's Title 24 section 140.4 prescriptive requirements for leakage, reliability testing, etc., and ASHRAE 90.1-2019 requirements for damper leakage.
- C. Provide economizer with integrated, gear driven opposed blade design type capable of simultaneous economizer and compressor operation.
- D. Damper blades shall be galvanized steel with composite gears. Plastic or composite blades on intake or return shall not be acceptable.
- E. Shall be equipped with gear driven dampers for both the outdoor ventilation air and the return air for positive air stream control.
- F. Shall be capable of introducing up to 100% outdoor air.
- G. Economizer Controls:
 - 1. Meets California's Title 24 section 120.2 mandatory requirements for economizer Fault Detection and Diagnosis (FDD).
 - 2. Factory installed outdoor air and return air enthalpy sensors used to provide comparative enthalpy control of economizer cycle to determine if outside air is suitable for free cooling.

2.19 A2L REFRIGERANT LEAK DISSIPATION SYSTEM

- A. Leak dissipation system shall consist of control board and A2L sensor certified to UL 60335-2-40, integrated with unit controller.
- B. System shall be designed for the life of the unit.
- C. Dissipation system shall be automatic, ship pre-wired, and require no additional field connections to function.
- D. Refrigerant leak sensor shall be installed in UL-certified location and orientation. Sensor shall be self-correcting and resettable. Single use refrigerant leak sensor shall not be permitted.
- E. Factory-installed dissipation system shall use onboard microprocessor and include:
 - 1. Automatic leak detection and dissipation algorithm.
 - 2. Automatic reset after a dissipation event has occurred.
 - 3. Onboard LED with flash code to indicate current unit status and hardware failures.
 - 4. Depressible "Test" button to allow for a system test and recall/reset of leak detection history.
 - 5. 24-v dry contact alarm terminal on dissipation control board to allow for external notification of leak detection.
 - 6. Ability to notify BAS system of dissipation event via readable alarm point unit controller.
 - 7. Recallable dissipation alarm history on unit controller.
- F. Dissipation control board shall be accessible via normal maintenance locations and LED shall be visible.

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- G. Dissipation system shall "Fail Safe" per UL requirements.
- H. Dissipation shall allow smoke and building fire systems to override in case of event.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install according to manufacturer's recommendations and as shown on drawings.
- B. Unit is to be provided with a through-the-bottom service connection accessory package and must be used for electrical connections to unit. Use bulkhead connectors to make a waterproof connection.
- C. Seal all duct connections to roof curb for airtight connection. Install a 90-degree flanged ductwork connection to the roof curb. Provide and install gasketing around duct flanges. Provide and install gasketing around outer edge of roof curb.

3.2 STARTUP

- A. Provide the services of a factory-service technician employed full time by the unit manufacturer to start-up the system, or manufacturer's factory authorized representative under the supervision of the factory trained service technician. Upon completion of the installation, the system shall be started and commissioned by the manufacturer's factory authorized representative who will verify a complete fully functional system. The factory authorized representative will verify that accessories are installed and performing the specified functions. (Contractor startup is unacceptable.)
- B. The written startup report shall be provided to the owner and engineer upon completion.

3.3 CONTRACTOR DECLARATION

- A. Installing contractor shall issue a certificate of test to the code official for all systems containing 55 lbs or more of refrigerant. The certificate shall include the test date, name of refrigerant, test medium and the field test pressure applied to the high-pressure side and the low pressure side of the system. The certification of the test shall be signed by the installing contractor and shall be made part of the public record.

3.4 SEQUENCES OF OPERATION

- A. Occupied Mode:
 - 1. A space temperature sensor shall, through a direct digital control panel, stage the cooling and heating to maintain space temperature setpoint.
 - 2. Unit shall enter a warm-up/ cool-down sequence to start occupied mode. The outside air damper shall remain closed during warm-up/ cool-down sequence, and the heating/ cooling function shall be enabled until space temperature occupied setpoint is satisfied.
 - 3. The supply fan shall cycle during occupied mode to provide minimum ventilation. The outside air damper shall open to minimum position when the supply fan is energized, and shall close when supply fan is de-energized.

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- B. Unoccupied Mode:
1. Unit shall be controlled for night setback during unoccupied mode. Heating will be staged to maintain space temperature setpoint of 60°F (adjustable). Cooling will be staged to maintain space temperature setpoint of 85°F (adjustable).
 2. The supply fan shall be set to cycle with heating and cooling operation.
 3. The outside air damper shall remain closed during unoccupied mode.
- C. Cooling Mode:
1. Unit shall maintain zone cooling setpoint by modulating the supply fan speed more or less to meet the zone load demand-based temperature through the space temperature sensor. The unit will maintain discharge cooling setpoint by staging the compressor(s).
- D. Heating Mode:
1. Unit shall maintain zone heating setpoint by modulating the supply fan speed more or less to meet the zone load demand-based temperature through the space temperature sensor. The unit will maintain discharge heating setpoint by staging the heater.
- E. Dehumidification Mode:
1. A space humidity sensor shall enable the unit's dehumidification mode. The unit shall enter dehumidification mode if the space temperature setpoint is satisfied and the space relative humidity is above setpoint of 60% RH (adjustable).
 2. The compressor(s) shall be energized and the hot gas reheat valve shall open to allow the unit to supply neutral air until space relative humidity reaches 55% RH (adjustable).
 3. Dehumidification mode shall be disabled when space relative humidity is satisfied, or upon a call for cooling or heating from the space temperature sensor.
- F. Economizer Mode:
1. Compressor operation will be integrated with economizer cycle to allow free cooling to maintain space temperature setpoint.
 2. During cooling mode, outside air temperature and humidity sensors shall disable compressor operation and modulate outside air damper to 100% open when outside air enthalpy is below enthalpy setpoint of 60°F and 50% RH (adjustable).
 3. Economizer mode shall be disabled if outside air enthalpy exceeds enthalpy setpoint or if space temperature exceeds setpoint.
 4. Economizer mode shall be locked out when unit is in heating or dehumidification mode.
- G. Power Exhaust:
1. The power exhaust fan shall energize when the unit enters economizer mode.
- H. Demand Control Ventilation:
1. A space CO2 sensor shall modulate the outside air damper based on a CO2 setpoint of 1000 ppm (adjustable).
 2. Outside air damper shall not modulate down below the minimum ventilation scheduled during occupied mode.

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3. Should space CO2 level exceed setpoint, the outside air damper shall slowly modulate open until CO2 setpoint is satisfied, not exceeding 30% (adjustable) of supply airflow.
4. Demand control ventilation shall be overridden by economizer operation.

END OF SECTION

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SECTION 238218

MINI SPLIT DX UNITS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install mini split system. Complete with an indoor fan coil section with wired remote controller and a slim silhouette horizontal discharge outdoor condensing unit. Unit shall be provided with constant speed compressor, pre-charged with refrigerant. Air-cooled condensing units complete with casing, compressor, condenser coil, condenser fan and controls required for a split air conditioning system.

1.2 RELATED WORK

- A. Refrigerant Piping.
- B. Electrical Provisions of Mechanical Work.

1.3 PERFORMANCE

- A. Provide performance as scheduled on drawings, and head pressure control to enable unit to operate in temperatures as low as 20 degrees F. ambient.

1.4 QUALITY ASSURANCE

- A. The units shall be tested by a Nationally Recognized Testing Laboratory (NRTL) and bear the ETL label.
- B. All wiring shall be in accordance with the National Electrical Code (N.E.C.).
- C. The units shall be rated in accordance with Air-conditioning, Heating, and Refrigeration Institute's (AHRI) Standard 210 and bear the AHRI Certification label.
- D. The units shall be manufactured in a facility registered to ISO 9001 Quality assurance Standards and ISO 14001 which are set of standards applying to sustainability and environmental protection set by the International Standard Organization (ISO).
- E. A pressure charge of refrigerant sufficient for up to twenty-five (25) feet of refrigerant tubing shall be provided in the outdoor condensing unit.
- F. A dry air holding charge shall be provided in the indoor section.
- G. System efficiency shall meet or exceed 17.0 SEER.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Mitsubishi Electric / Trane
- B. LG

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2.2 INDOOR UNIT GENERAL

- A. The indoor shall be factory assembled, wired and run tested. Contained within the unit cabinet shall be all factory wiring, internal piping, electronic control circuit board and fan with fan motor.
- B. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, and auto restart after power interruption function, an emergency operation function and a test run switch.
- C. Indoor unit and refrigerant pipes shall be charged with dry air before shipment from the factory. All refrigerant piping must be insulated.

2.3 UNIT CABINET

- A. Multi directional drain and refrigerant piping offering four (4) directions for refrigerant piping and two (2) directions for draining shall be standard.

2.4 FAN

- A. The indoor unit fan shall be an assembly with a line-flow fan direct driven by a single motor mounted in rubber motor mount.
- B. The fan shall be statically and dynamically balanced and run on a motor with permanently lubricated bearings.
- C. The indoor unit fan motor shall operate in three (3) selectable speeds, High, Medium, and Low.

2.5 COIL

- A. The indoor unit (evaporator) coil shall be of nonferrous construction with smooth, pre-coated aluminum fins on copper tubing.
- B. Tubing shall have inner grooves for high efficiency heat exchange.
- C. All tube joints shall be brazed with PhosCopper or silver alloy.
- D. The coil shall be pressure tested at the factory.
- E. A sloped condensate pan and drain with extension hose shall be provided under the coil. Drain connections shall be provided at each end of the drain pan. A condensate mini-pump shall be provided to provide a means of condensate disposal when a gravity drain is not available.

2.6 ELECTRICAL

- A. The unit shall be equipped with a micro-processor control system directing indoor and outdoor unit coordinated operation.
- B. The indoor unit shall not have any supplemental electrical heat elements.

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2.7 CONTROL

- A. This system shall have a wired remote controller to perform input functions necessary to operate the system. The controller shall consist of a Power On / Off switch, Mode Selector, Temperature Setting, Timer Control, Fan Speed Select and Auto Vane Selector.
- B. Temperature changes shall be by 1°F increments with a range of 65°F to 87°F.
- C. There shall be a 24 hour On / Off timer.
- D. The unit shall have an emergency operation mode to allow operation without the remote controller.
- E. The microprocessor located in the indoor unit shall have the capability of sensing return air temperature and indoor coil temperature, receiving and processing commands from the wired remote controller, providing emergency operation and controlling the outdoor unit.
- F. The control voltage between the indoor unit and the outdoor unit shall be 115 volts, AC.
- G. The system shall be capable of automatic restart when power is restored after power interruption.
- H. The control system shall control the operation of the air sweep louvers, as well as provide on / off and system / mode function switching.

2.8 OUTDOOR UNIT GENERAL

- A. The outdoor unit is designed specifically for use with indoor units. These units are equipped with a circuit board that interfaces to the indoor unit circuit board. The outdoor unit shall be completely factory assembled, internally piped and wired. Each unit shall be run tested at the factory.

2.9 UNIT CABINET

- A. The casing shall be fabricated from zinc coated steel, bonderized with an electrostatically applied, thermally bonded, acrylic or polyester powder coating for corrosion protection.
- B. Case and mounting feet shall be galvanized steel base with welded mounting feet.

2.10 FAN

- A. The unit shall be furnished with a directive drive propeller type fan, statically and dynamically balanced for smooth and quiet operation.
- B. The fan motor shall have inherent protection, be equipped with permanently lubricated bearings. The fan motor shall be mounted and isolated for quiet operation.
- C. The fan shall be provided with a raised guard to prevent contact with moving parts.
- D. The outdoor unit shall have horizontal discharge airflow.

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2.11 COMPRESSOR

- A. The compressor shall be a high performance, hermetic, rolling piston, rotary type.
- B. Compressor shall be mounted using rubber isolating bushings to avoid the transmission of vibration.
- C. Compressor shall be protected by an automatic over current relay and a thermal overload switch.

2.12 OPERATION

- A. The outdoor unit shall have an accumulator.
- B. The outdoor unit must have the ability to operate with a maximum height difference of 35 feet between indoor and outdoor units.
- C. The unit shall have a maximum refrigerant tubing length of 65 feet between indoor and outdoor units without the need for line size changes, traps or additional oil. All refrigerant lines must be insulated.
- D. The unit shall be pre-charged for a maximum of 25 feet of refrigerant tubing.

2.13 ELECTRICAL

- A. The electrical power of the system shall be 208 volts, 1 phase, 60 hertz.

2.14 A2L REFRIGERANT LEAK DISSIPATION SYSTEM

- A. Leak dissipation system shall consist of control board and A2L sensor certified to UL 60335-2-40, integrated with unit controller.
- B. System shall be designed for the life of the unit.
- C. Dissipation system shall be automatic, ship pre-wired, and require no additional field connections to function.
- D. Refrigerant leak sensor shall be installed in UL-certified location and orientation. Sensor shall be self-correcting and resettable. Single use refrigerant leak sensor shall not be permitted.
- E. Factory-installed dissipation system shall use onboard microprocessor and include:
 - 1. Automatic leak detection and dissipation algorithm.
 - 2. Automatic reset after a dissipation event has occurred.
 - 3. Onboard LED with flash code to indicate current unit status and hardware failures.
 - 4. Depressible "Test" button to allow for a system test and recall/reset of leak detection history.
 - 5. 24-v dry contact alarm terminal on dissipation control board to allow for external notification of leak detection.
 - 6. Ability to notify BAS system of dissipation event via readable alarm point unit controller.
 - 7. Recallable dissipation alarm history on unit controller.

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- F. Dissipation control board shall be accessible via normal maintenance locations and LED shall be visible.
- G. Dissipation system shall "Fail Safe" per UL requirements.
- H. Dissipation shall allow smoke and building fire systems to override in case of event.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Mount condensing units on 4" foundation pads and pipe as shown on Drawings or as recommended by the equipment manufacturer. Install refrigerant filter dryer and sight indicating glass.
- B. Install units on vibration isolation pads.

3.2 CONTROL WIRING

- A. Furnish and install control wiring as required. Install control wiring in conduit.

3.3 DELIVERY, STORAGE AND HANDLING

- A. Unit shall be stored and handled according to the manufacturer's recommendations.
- B. The controller shall be shipped inside the carton with the indoor unit and able to withstand 105°F storage temperatures and 95% relative humidity without adverse effect.

3.4 WARRANTY

- A. The units shall have a manufacturer's parts and defects warranty for a period five (5) years from the date of the original installation. The compressor shall have a warranty of seven (7) years from date of installation. If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of the manufacturer. This warranty does not include labor.

3.5 START-UP

- A. Follow the manufacturer's start-up procedures.

END OF SECTION

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SECTION 238239

ELECTRIC UNIT HEATERS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide and install electric unit heaters complete with heating element, propeller mounting brackets and other options as specified.

1.2 RELATED WORK

- A. Division 23 - Mechanical.
 - 1. Electrical Provisions of Mechanical Work.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Modine
- B. Reznor
- C. QMark
- D. Markel / Redd-i
- E. Indeeco

2.2 COMPONENTS

- A. Casing:
 - 1. Construct casing of sheetmetal with a structural frame.
 - 2. Enamel or lacquer finish to manufacturer's standard.
- B. Electric Heating Elements:
 - 1. Shall bear the UL label.
 - 2. Corrosion resistant materials.
 - 3. Heating coil of 80-20 nickel-chrome wire.
- C. Components:
 - 1. Fused control circuits
 - 2. Contactors in accordance with the staging requirements
 - 3. Control power transformer
 - 4. Control voltage 120
- D. Louvers:
 - 1. Adjustable vertical and horizontal louvers for air discharge.
- E. Mounting brackets:
 - 1. As indicated

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2.3 CONTROLS

- A. Automatic controls:
 - 1. Factory mounted
 - 2. Prewired to the junction box
 - 3. Wall mounted thermostats 24-volt low voltage
- B. Safety Controls:
 - 1. A primary and secondary thermal cut-off to de-energize each circuit.
 - 2. Manual reset high limit
 - 3. All mounted thermostats

2.4 FAN

- A. Propeller blade fan:
 - 1. Construct the fan of aluminum or other corrosion-resistant material.
 - 2. Statically and dynamically balanced
 - 3. Substantial fan guard

2.5 MOTOR

- A. Totally enclosed ball bearing motor:
 - 1. Permanently lubricated bearings
 - 2. Voltage as specified on the drawings
 - 3. Sized to operate the fan at the required capacity

2.6 ELECTRICAL

- A. Single point connection:
 - 1. Factory wiring
 - 2. Only direct line supply and thermostat field connections
 - 3. Terminal blocks for line voltage wiring
 - 4. Wiring diagram permanently attached
 - 5. Balance phases

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Furnish units with suitable connections for mounting as shown or as otherwise approved.
- B. Provide start-up to ensure correct operation of unit.
- C. Adjust discharge louvers to control direction of air flow.

END OF SECTION

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SECTION 260100

BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section specifies the basic requirements for the electrical installations and includes requirements common to more than one section of Division 26. This section expands and supplements the requirements specified in sections of Division 01.
- B. Standards of the organizations listed below but referred to in the various sections by basic designation only, form a part of this specification to the extent indicated by the reference thereto:
 - 1. American Society for Testing and Materials (ASTM)
 - 2. National Fire Protection Association (NFPA)
 - 3. American National Standards Institute (ANSI)
 - 4. Illuminating Engineering Society (IES)
 - 5. Institute of Electrical and Electronics Engineers (IEEE)
 - 6. Insulated Cable Engineers Association (ICEA)
 - 7. National Electrical Manufacturer's Association (NEMA)
 - 8. National Electrical Contractors' Association (NECA)
 - 9. Underwriters' Laboratories, Inc. (UL)
 - 10. Factory Mutual (FM)
 - 11. Federal Specifications (FS)
 - 12. National Electrical Code (NEC)
 - 13. Local area amendments to the NEC (if applicable)
- C. References shall mean to the latest edition of the standard as adopted by the Authority Having Jurisdiction (AHJ).
- D. Conform to local ordinances and codes.

1.3 QUALITY ASSURANCE

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected. Contractor shall coordinate with the appropriate supplier, vendor, or subcontractor regarding the exact and specific rough-in requirements for equipment actually supplied.

1.4 ELECTRICAL INSTALLATIONS

- A. Installation shall comply with the latest adopted edition of the National Electrical Code and all applicable local and state amendments.

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- B. Coordinate electrical equipment and materials installation with other building components.
- C. Verify all dimensions by field measurement. Do not scale drawings.
- D. Arrange for chases, slots, and openings in other building components to allow for electrical installations.
- E. Coordinate the installation of required supporting devices and sleeves to be set in poured in place concrete and other structural components, as they are constructed.
- F. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing-in the building.
- G. Coordinate the access panel requirements with General Contractor to accommodate the installation of electrical equipment and materials.
- H. Where mounting heights are not detailed or dimensioned, install electrical services and overhead equipment to provide the maximum headroom possible.
- I. Install electrical equipment to facilitate maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
- J. Coordinate the installation of electrical materials and equipment above ceilings with suspension system, mechanical equipment and systems, and structural components.
- K. Contractor shall review Mechanical, Structural, Food Service, Low Voltage System, Architectural, and other consultant drawings prior to bid.
- L. Final connections and rough-in requirements to equipment shall be per manufacturer's approved wiring diagrams, details and instructions. It shall be the contractor's responsibility to provide materials and equipment compatible with equipment actually supplied including all raceways, boxes, wiring, wiring devices, etc.
- M. It is the intent of these drawings and specifications to establish a standard of quality.
- N. Work shall be performed in a workmanlike manner to the satisfaction of the Architect.
- O. Contractor shall verify and coordinate exact location of equipment to be furnished by others prior to rough-in.
- P. Verify exact locations of existing and new underground utilities, piping and raceway systems prior to trenching. Provide necessary trenching, backfill, excavation, supports, service feeders (conduit and/or wire), pullboxes, transformer pads, saw cutting and patching, concrete/paving, etc., required. Backfill trenches to 90% compaction and patch to match existing. Contractor shall obtain and verify exact utility company drawings and requirements.
- Q. Provide maintenance receptacle within 25'-0" of all mechanical or motorized equipment.
- R. Where mechanical equipment is installed above a gypboard ceiling requiring access through an access panel. Provide a receptacle, switch and light in the ceiling space at the access location.

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- S. Contractor shall be responsible for replacing equipment which is damaged due to incorrect field wiring provided under this section or factory wiring in equipment provided under this division.
- T. Contractors shall visit site prior to bid and verify that conditions are as indicated. Contractor shall include in his bid, costs required to make his work meet existing conditions.
- U. Proposed substitutions of electrical equipment or request for "or equivalent" or "approved equivalent" listing shall be submitted to architect in accordance with the Division 01 General Requirements.
- V. Systems shall be complete, operable and ready for continuous operations. Lights, switches, receptacles, motors, etc., shall be connected and operable.
- W. Electrical equipment 600 volts, nominal or less shall be located to maintain clear and level work spaces outlined in Part II of NEC 110. Panelboards, switchboards, transformers, disconnects, switches, breakers, etc. shall be located to comply with NEC 110.26(A). Where the clearances outlined in Part II of NEC 110 cannot be obtained, the Contractor shall notify the engineer prior to performing any rough-in.
- X. Provide shop drawing submittal with 1/4" scale layout drawings of rooms with electrical equipment and/or transformers. Layouts shall show locations of and shall be coordinated with mechanical equipment and equipment shall be drawn to scale. Although alternate equipment manufacturers are listed for use on this project, if the selected manufacturer cannot meet the physical constraints of this project their equipment in total is not acceptable. Drawings shall indicate, by dimension, that clearances required by code are provided.
- Y. Receptacles installed outside, on the building exterior or roof, in kitchens or within six feet horizontally from a sink or drinking fountain unless located below a counter or otherwise protected, shall be GFCI type and in full compliance with NEC 210.8(B).
- Z. Provide separate neutral conductor for each arc-fault, ground fault circuit, circuits on load side of dimmers and for multiwire branch circuits.
- AA. Coordinate the location of lighting fixtures with the architectural ceiling plan. Unless otherwise verified in writing, reflected ceiling plan shall govern.
- BB. Coordinate the location of all wall mounted equipment with the architectural interior and exterior elevations. Unless otherwise verified in writing, architectural drawings shall govern.
- CC. See Division 22 and 23 drawings for location of mechanical equipment. Provide service to and connect equipment as required. Provide fuses or HACR- type circuit breakers for all air conditioning equipment sized in accordance with manufacturer's nameplate.
- DD. Contractor shall provide controls, interlocks, accessories, etc., as required by the temperature control contractor. Refer to Division 23 drawings and temperature control diagrams for additional conduit, wire, relays, transformers, connections, etc. required for a complete and operable system.
- EE. Contractor shall refer to food service drawings for exact locations and additional requirements. Provide j-boxes, receptacles, connections, conduit, wire, interlocks, controls, etc. as required by food service equipment supplier.
- FF. Provide disconnecting means at each motor, controller, appliance, etc. in accordance with applicable NEC requirements.

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GG. All electrical testing required shall be performed by a third party NETA Certified Testing Agency.

1.5 ELECTRICAL SUBMITTALS

- A. Refer to the Conditions of the Contract (General and Supplementary) and the Division 01 General Requirements for submittal definitions, requirements, and procedures.
- B. Data shall be submitted at one time electronically, in PDF format and indexed as scheduled below. Partial submittals will not be reviewed unless as directed by the architect and owner prior to submission.
 - 1. 260100-Basic Electrical Requirements
 - 2. 260519-Low-Voltage Electrical Power Conductors and Cables
 - 3. 260526-Grounding and Bonding for Electrical Systems
 - 4. 260529-Hangers and Supports for Electrical Systems
 - 5. 260533-Raceways and Boxes for Electrical Systems
 - 6. 260536-Cable Trays for Electrical Systems
 - 7. 260543-Underground Ducts and Raceways for Electrical Systems
 - 8. 260544-Sleeves and Sleeve Seals for Electrical Raceways and Cabling
 - 9. 260548.16-Seismic Controls for Electrical Systems
 - 10. 260553-Identification for Electrical Systems
 - 11. 260573.13-Short-Circuit Studies
 - 12. 260573.16-Coordination Studies
 - 13. 260573.19-Arc-Flash Hazard Analysis
 - 14. 260800-Commissioning of Electrical Systems
 - 15. 260923-Lighting Control Devices
 - 16. 262300-Low-Voltage Switchgear
 - 17. 262313-Paralleling Low-Voltage Switchgear
 - 18. 262413-Switchboards
 - 19. 262416-Panelboards
 - 20. 262726-Wiring Devices
 - 21. 262813-Fuses
 - 22. 262816-Enclosed Switches and Circuit Breakers
 - 23. 263213.14-Diesel Emergency Engine Generators
 - 24. 263323.11-Central Battery Equipment for Emergency Lighting
 - 25. 263353-Static Uninterruptible Power Supply
 - 26. 263600-Transfer Switches
 - 27. 264113-Lightning Protection for Structures
 - 28. 265119-LED Interior Lighting
 - 29. 265213-Emergency and Exit Lighting
 - 30. 265613-Lighting Poles and Standards
 - 31. 265619-LED Exterior Lighting
- C. Submit shop drawings and product data grouped to include complete submittals of related systems, products and accessories in a single submittal.
- D. Identify products requiring color selections.
- E. Identify products for use on project.

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1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to project properly identified with names, model numbers, types, compliance labels and similar information needed for distinct identification; adequately packaged and protected to prevent damage during shipment, storage and handling.
- B. Contractor shall protect stored equipment and materials from damage and theft.
- C. Coordinate deliveries of electrical materials and equipment to minimize construction congestion. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations.

1.7 RECORD DOCUMENTS

- A. Refer to Division 01 - General Requirements for requirements. The following paragraphs supplement the requirements of Division 01.
- B. Mark drawings to indicate revisions to exterior and interior conduit size and location and actual equipment locations, dimensioned to column lines; concealed equipment, dimensioned to column lines; distribution and branch electrical circuitry; fuse and circuit breaker size and arrangement; support and hanger details; As-built conditions.
- C. Mark specifications to indicate approved substitutions; Addendums and equipment and materials used.

1.8 OPERATION AND MAINTENANCE DATA

- A. Refer to Division 01 - General Requirements for procedures and requirements for preparation and submittal of maintenance manuals.
- B. In addition to the information required by Division 01 for Maintenance Data, include the following information in English.
 - 1. Description of function, normal operating characteristics and limitations, performance curves, engineering data tests, and complete nomenclature and commercial numbers of all replaceable parts.
 - 2. Manufacturer's printed operating procedures to include start-up, break-in, routine and normal operating instructions; regulation, control, stopping, shut-down and emergency instructions and summer and winter operating instructions.
 - 3. Maintenance procedures for routine preventative maintenance and troubleshooting, disassembly, repair and reassembly; aligning and adjusting instructions.
 - 4. Servicing instructions and lubrication charts and schedules.
- C. Contractor installed labels/equipment marking and instruction shall be in English.
- D. Refer to Division 26 Equipment Specifications for additional requirements.

1.9 WARRANTIES

- A. Refer to the Division 01 - General Requirements for procedures and submittal requirements for warranties. Refer to individual equipment specifications for warranty requirements.

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- B. Compile and assemble the warranties specified in Division 26, into a separate set of vinyl covered, three ring binders, tabulated and indexed for easy reference.
- C. For each product or equipment provide complete warranty information for each item to include date of beginning of warranty or bond; duration of warranty or bond; and names, addresses and telephone numbers and procedures for filing a claim and obtaining warranty services.

1.10 CLEANING

- A. Refer to Division 01 - General Requirements for final cleaning requirements.

END OF SECTION

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SECTION 260100

COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes commissioning process requirements for electrical systems, assemblies, and equipment.
- B. Related Sections:
 - 1. Division 01 Section 016500 – “GENERAL COMMISSIONING REQUIREMENTS” for general commissioning process requirements.
 - 2. Division 22 Section 220100 – “COMMISSIONING OF PLUMBING SYSTEMS”.
 - 3. Division 23 Section 230100 - “COMMISSIONING OF MECHANICAL SYSTEMS”.

1.3 DEFINITIONS

- A. Refer to section 016500 - GENERAL COMMISSIONING REQUIREMENTS.

1.4 CONTRACTOR'S RESPONSIBILITIES

- A. Refer to section 016500 - GENERAL COMMISSIONING REQUIREMENTS.
- B. Perform commissioning tests at the direction of the CxA.
- C. Attend construction phase controls coordination meeting.
- D. Participate in electrical systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.
- E. Provide information requested by the CxA for final commissioning documentation.
- F. Provide Project-specific construction checklists and commissioning process test procedures for actual electrical systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.
- G. Direct and coordinate commissioning testing among subcontractors, suppliers, and vendors.
- H. Provide test data, inspection reports, and certificates for Systems Manual.

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1.5 COMMISSIONING DOCUMENTATION

- A. Provide the following information to the CxA for inclusion in the commissioning plan:
 - 1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
 - 2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
 - 3. Process and schedule for completing construction checklists and manufacturer's pre-start and startup checklists for electrical systems, assemblies, equipment, and components to be verified and tested.
 - 4. Certificate of completion certifying that installation, pre-start checks, and startup procedures have been completed.
 - 5. Certificate of readiness certifying that electrical systems, subsystems, equipment, and associated controls are ready for testing.
 - 6. Test and inspection reports and certificates.
 - 7. Corrective action documents.

1.6 SUBMITTALS

- A. Certificates of readiness.
- B. Certificates of completion of installation, pre-start, and startup activities.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 GENERAL

- A. Refer to section 016500 - GENERAL COMMISSIONING REQUIREMENTS.

3.2 PRE-FUNCTIONAL CHECKLISTS

- A. Contractor shall conduct Pre-functional Testing to document compliance with installation and start-up checklists prepared by Commissioning Authority for the Division-26 items.
- B. Request verification of Pre-functional checklists by CxA prior to proceeding with system start-up and Functional Testing of systems.
- C. Refer to Section 016500 - GENERAL COMMISSIONING REQUIREMENTS for issues relating to pre-functional checklists and testing, including list of systems to be commissioned, description of process, details on non-conformance issues relating to pre-functional checklists and test.
- D. Contractor shall participate in Pre-Functional testing activities to document electrical work associated with mechanical and plumbing systems.

3.3 SYSTEM START-UP, TESTS & INSPECTIONS

- A. Contractor is solely responsible for system start-up. CxA may, at his discretion, witness start up procedures, but will not perform any Functional Testing of systems until General Contractor has completed start-up and resolved all operating deficiencies.

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- B. Contractor is solely responsible for all tests and inspections required by the Authority Having Jurisdiction (AHJ). All test reports and certificates required by the AHJ shall be submitted prior to Functional Testing.
- C. Contractor shall provide no less than 48 hours' notice prior to conducting tests specified in other sections of the specifications, including:
 - 1. Generator and transfer switch testing
 - 2. Grounding tests

3.4 FUNCTIONAL TESTING PREPARATION

- A. Certify that electrical systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
- B. Certify that instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.
- C. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
- D. Inspect and verify the position of each device and interlock identified on checklists.
- E. Check all notification and initiation devices and interlocks with associated systems during each mode of operation.
- F. Testing Instrumentation: Provide instrumentation and personnel as required to conduct tests.

3.5 FUNCTIONAL TESTING PROCEDURES OF SYSTEMS TO BE COMMISSIONED

- A. Lighting Systems:
 - 1. Light Fixtures: Verify all lamps work without flicker.
 - 2. Light Switches: Verify switches control lights per design
 - 3. Lighting Controls:
 - a. Verify sensors pick up motion and turn on lights immediately.
 - b. Verify that lights turn off after specified time.
 - c. Verify sensor coverage includes entire room area being sensed.
 - d. Verify sensor does not pick up occupancy outside the area sensed.
 - e. For ceiling mounted occupancy switches, verify light switches still function in circuit.
- B. All Electrical and Electrically Powered Equipment
 - 1. Inspect electrical wiring and grounding for proper connections, color coding, and quality of installation.
 - 2. Verify supply voltage, all hot legs.
 - 3. Verify amperage is within allowable limits.
 - 4. Inspect for physical damage, proper installation, anchorage.
 - 5. Verify equipment runs smoothly and quietly.
 - 6. Verify operation of safeties.
 - 7. Verify all required means of disconnect are in place.
 - 8. Verify maintenance and NEC clearances are maintained.

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- C. Service Grounding Test:
 - 1. CxA will witness ground tests to be conducted by Contractor in accordance with specifications. Contractor will provide CxA a minimum 48 hours advance notice of test so that CxA may be witness, or he shall re-test in CxA's presence. Ground resistance testing is to include lightning protection system as well as electrical power systems.
 - 2. Provide ground test report for review by CxA.
- D. Electrical Distribution System
 - 1. Switchboards and Panelboards.
 - a. Wiring:
 - 1) Verify wiring connections are secure.
 - 2) Verify ground wires properly terminated, panels are grounded.
 - 3) Verify wiring color coding is proper.
 - b. Verify panel is properly identified.
 - c. Verify load indicated in circuit directory is actual load served in space (by opening circuit breaker and observing response in space).
 - d. Verify load identification is adequately descriptive of load.
 - e. Verify phase rotation
 - f. Verify phase to phase and phase to neutral volts.
 - g. Document phase balance.
 - 2. Receptacle and Device Test:
 - a. Test receptacles with a receptacle circuit tester for proper polarity.
 - b. Test each receptacle or branch circuit breaker having ground-fault circuit protection.
- E. Transformers
 - 1. Verify primary and secondary voltages are within acceptable range and secondary voltage taps (where applicable) are appropriate.
 - 2. Document phase to phase and phase to neutral voltages.
 - 3. Document ground resistance
 - 4. Verify transformers operate without "hum".
- F. Emergency Generator Systems and Transfer Switches
 - 1. Verify phase rotation and consistency.
 - 2. Notify CxA to witness manufacturer's start-up procedure to include:
 - a. No-load test
 - b. Load-bank test
 - c. Building-load test (witness activation of transfer switch and generators upon a real building power loss)
 - d. Other tests as specified
 - e. Provide copy of manufacturer's start-up report.
 - 3. Document response of building systems upon a real building power-loss, activation of generator, and return of normal power.
 - 4. Provide infrared scanning report.

3.6 TRAINING

- A. Refer to sections 016500 - GENERAL COMMISSIONING REQUIREMENTS.

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3.7 O&M MANUALS

A. Refer to sections 016500 - GENERAL COMMISSIONING REQUIREMENTS

END OF SECTION

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SECTION 260105

ELECTRICAL OPERATING AND MAINTENANCE MANUALS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Compile electrical product data and related information appropriate for Owner's operation and maintenance of products furnished under Contract. Prepare electrical operating and maintenance data as specified in this Section and as referenced in other sections of specifications.
- B. Instruct Owner's personnel in operation and maintenance of equipment and systems.
- C. Submit 3 copies of complete manual in final form.

1.2 ELECTRICAL OPERATING AND MAINTENANCE MANUAL SUBMITTAL SCHEDULE

- A. Thirty (30) days after receipt of reviewed submittals bearing the Architect / Engineer's stamp of acceptance (including re-submittals), submit for review 1 copy of the first draft of the Electrical Operating and Maintenance Manual. This copy shall contain as a minimum:
 - 1. Table of Contents for each element
 - 2. Contractor information
 - 3. All shop drawings, coordination drawings and product data, bearing the Architect / Engineer's stamp of acceptance.
 - 4. All parts and maintenance manuals for items of equipment
 - 5. Warranties (without starting dates)
 - 6. Certifications that have been completed; submit forms and outlines of certifications that have not been completed
 - 7. Operating and maintenance procedures.
 - 8. Form of Owner's Training Program Syllabus (including times and dates)
 - 9. Control operations / equipment wiring diagrams
 - 10. Coordination Drawings
 - 11. Schedule of Lamps, Light Engines
 - 12. Schedule of Ballasts and Drivers
 - 13. Schedule of Fuses
 - 14. Other required operating and maintenance information that are complete.
- B. Copy will be returned to the Contractor within 15 days with comments for corrections.
- C. Submit two completed manuals in final electronic form to the Architect/Engineer one day after substantial completion, and prior to Owner's instructions.
 - 1. Prior to substantial completion for Owner's use after the Owner accepts facility maintenance.
 - 2. Include all specified data, test reports, drawings, dated warranties, certificates, along with other materials and information.
- D. The Architect / Engineer shall review the manuals for completeness within 15 days.
- E. The Contractor shall be notified of any missing or omitted materials. The Manuals shall be reworked by the Contractor, as required, in the office of the Architect / Engineer. The manuals will not be retransmitted.
- F. Two electronic copies of completed manual shall be delivered to the Owner.

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PART 2 - PRODUCTS

2.1 BINDERS

- A. Commercial quality black, 3-ring binders with clear, durable, cleanable plastic covers.
- B. Minimum ring size: 1"; Maximum ring size: 3".
- C. When multiple binders are used, correlate the data into related groupings.
- D. Label contents on spine and face of binder with full size insert. Label under plastic cover.

PART 3 - EXECUTION

3.1 ELECTRICAL OPERATION AND MAINTENANCE MANUAL

- A. Form for Manuals:
 - 1. Prepare data in form of an instructional manual for use by Owner's personnel.
 - 2. Format:
 - a. Size: 8-1/2" x 11"
 - b. Text: Manufacturer's printed data or neatly typewritten.
 - 3. Drawings:
 - a. Provide reinforced punched binder tab and bind in text.
 - b. Fold larger drawings to size of text pages.
 - 4. Provide flyleaf indexed tabs for each separate product or each piece of operating equipment.
 - 5. Cover: Identify each volume with typed or printed title "Operating and Maintenance Instructions". List:
 - a. Title of Project
 - b. Identity of separate structures as applicable
 - c. Identity of general subject matter covered in the manual.
 - 6. Binder as specified
- B. Content of Manual:
 - 1. Neatly typewritten Table of Contents for each volume arranged in systematic order as outlined in the specifications.
 - a. Contractor, name of responsible principal, address and telephone number
 - b. A list of each product required to be included, indexed to content of the volume.
 - c. List with each product, name, address and telephone number of:
 - 1) Subcontractor or installer
 - 2) Maintenance contractor as appropriate
 - 3) Identify area of responsibility of each.
 - 4) Local source of supply for parts and replacement
 - d. Identify each product-by-product name and other identifying symbols as set forth in Contract Documents.
 - 2. Product Data:
 - a. Include those sheets pertinent to the specific product.
 - b. Annotate each sheet to:
 - 1) Identify specific product or part installed.
 - 2) Identify data applicable to installation.
 - 3) Delete references to inapplicable information.

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3. Drawings:
 - a. Supplement product data with drawings as necessary to illustrate:
 - 1) Relations of component parts of equipment and systems
 - 2) Control and flow diagrams
 - b. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
 - c. Do not use Project Record Documents as maintenance drawings.
 4. Written text as required to supplement product data for the particular installation:
 - a. Organize in consistent format under separate headings for different procedures.
 - b. Provide logical sequence of instructions for each procedure.
 5. Copy of each warranty, bond and service contract issued
 - a. Provide information sheet for Owner's personnel, giving:
 - 1) Proper procedures in event of failure
 - 2) Instances that might affect validity of warranties or bonds
 6. Shop drawings, coordination drawings and product data as specified.
- C. Sections for Equipment and Systems
1. Content for each unit of equipment and system as appropriate:
 - a. Description of unit and component parts:
 - 1) Function, normal operating characteristics, and limiting conditions.
 - 2) Performance curves, engineering data and tests.
 - 3) Complete nomenclature and commercial number of replaceable parts.
 - b. Operating procedures:
 - 1) Start up, break-in, routine / normal operating instructions
 - 2) Regulation, control, stopping, shut down and emergency instructions
 - 3) Summer and winter operating instructions
 - 4) Special operating instructions
 - c. Maintenance procedures:
 - 1) Routine operations
 - 2) Guide to trouble-shooting
 - 3) Disassembly, repair and reassembly
 - 4) Alignment, adjusting and checking
 - 5) Routine service based on operating hours
 - d. Servicing and lubrication schedule
 - 1) List of lubricants required
 - e. Manufacturer's printed operating and maintenance instructions.
 - f. Copies of typed circuit directories of panel board to reflect actual room graphics numbers and room names (not architectural room numbers from the drawings).
 - 1) Electrical
 - 2) Controls
 - 3) Communications
 - g. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
 - 1) Predicted life of part subject to wear
 - 2) Items recommended to be stocked as spare parts
 - h. Schedule of fuses
 - i. Complete equipment field accessible internal wiring diagrams
 - j. Schedule of lamps

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- k. Schedule of ballasts
 - l. Each Contractor's coordination drawings
 - m. List of original manufacturer's spare parts and recommended quantities to be maintained in storage
 - n. Other data as required under pertinent sections of the specifications
- 2. Prepare and include additional data when the need for such data becomes apparent during instruction of Owner's personnel.
 - 3. Additional requirements for operating and maintenance data as outlined in respective sections of specifications
 - 4. Provide complete information for products specified in Division 26.
 - 5. Provide certificates of compliance as specified in each related section.
 - 6. Provide start up reports as specified in each related section.
 - 7. Provide signed receipts for spare parts and material.
 - 8. Provide training report and certificates.

END OF SECTION

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SECTION 260500

ELECTRICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Except as modified in this Section, General Conditions, and Supplementary Conditions, applicable provisions of Division 1 General Requirements, and other provisions and requirements of the Contract Documents apply to work of Division 26 Electrical.
- B. Applicable provisions of this section apply to all sections of Division 26, Electrical.

1.2 CODE REQUIREMENTS AND FEES

- A. Perform work in accordance with applicable statutes, ordinances, codes and regulations of governmental authorities having jurisdiction.
- B. Electrical work shall comply with applicable inspection services:
 - 1. Underwriters Laboratories
 - 2. National Fire Protection Association
 - 3. State Health Department
 - 4. Local Municipal Building Inspection Department adopted codes with amendments
 - 5. National Electrical Code with local amendments
 - 6. State Regulatory Agencies
 - 7. Where the project is located outside a municipal jurisdiction, and has no municipal inspection services, the National Electrical Code with amendments of the municipality with extraterritorial jurisdiction shall govern.
 - 8. Where the project is located outside any municipal jurisdiction, including extraterritorial jurisdictions, the National Electrical Code with local adopted amendments of the largest municipality located in the same county or parish shall govern.
 - 9. International Energy Conservation Code
 - 10. National Electrical Safety Code
- C. Resolve any code violations discovered in contract documents with the Engineer prior to award of the contract. After Contract award, any correction or additions necessary for compliance with applicable codes shall be made at no additional cost to the Owner.
- D. This Contractor shall be responsible for being aware of and complying with asbestos NESHAP regulations, as well as all other applicable codes, laws and regulations.
- E. Obtain all permits required.

1.3 CONTRACTOR'S QUALIFICATIONS

- A. An approved contractor for the work under this division shall be:
 - 1. A specialist in this field and have the personnel, experience, training, and skill, and the organization to provide a practical working system.
 - 2. Able to furnish evidence of having contracted for and installed not less than 3 systems of comparable size and type that has served their Owners satisfactorily for not less than 3 years.

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1.4 REFERENCE SPECIFICATIONS AND STANDARDS

- A. Materials which are specified by reference to Federal Specifications; ASTM, ASME, ANSI, APWA, or AWWA Specifications; Federal Standards; or other standard specifications must comply with latest editions, revisions, amendments or supplements in effect on date proposals are received. Referenced specifications and standards are minimum requirements for all equipment, material and work. In instances where specified capacities, size or other features of equipment, devices or materials exceed these minimums, meet specified capacities.
- B. Use electrical materials and equipment that is constructed and tested in accordance with the standards of NEMA, ANSI, ASTM, or other recognized commercial standard. If materials and equipment is labeled, listed, or recognized by any Nationally-Recognized Testing Laboratory (NRTL) acceptable to the Occupational Safety and Health Administration (OSHA), then provide NRTL-labeled, listed, or recognized material and equipment. Acceptable NRTLs include but are not limited to:
 - 1. Underwriters Laboratories, Inc. (UL)
 - 2. Factory Mutual Research Corp. (FMRC) (also referred to as "Factory Mutual Global," or "FM Global")
 - 3. Intertek Testing Services NA, Inc. (ITSNA, formerly ETL)
 - 4. Canadian Standards Association (CSA)
 - 5. A complete listing of acceptable NRTLs is published on the OSHA website at <http://www.osha.gov/dts/otpc/nrtl/>.
- C. Where material and equipment is not labeled, listed, or recognized by any NRTL, provide a manufacturer's Certificate of Compliance indicating complete compliance of each item with applicable standards of NEMA, ANSI, ASTM, or other recognized commercial standard.
- D. Do not install or use electrical material or equipment for any use other than that for which it was designed, labeled, listed, or identified unless formally approved for such use by the Owner's AHJ. This *National Electrical Code*® requirement is re-stated for emphasis.
- E. Codes and Standards applicable to this Division:
 - 1. ANSI – American National Standards Institute
 - a. ANSI Z535.1, Safety Colors
 - b. ANSI Z535.2, Environmental and Facility Safety Signs
 - c. ANSI Z535.3, Criteria for Safety Symbols
 - d. ANSI Z535.4, Product Safety Signs and Labels
 - 2. ASHRAE – American Society of Heating, Refrigeration, and Air Conditioning Engineers:
 - a. ASHRAE Standard 90.1, *Energy Standards for Buildings Except for Low Rise Residential Buildings* [ANSI, IESNA]
 - 3. ASTM – American Society for Testing and Materials
 - 4. CBM – Certified Ballast Manufacturers
 - 5. ICC – International Code Council
 - a. International Building Code® (IBC)
 - b. International Existing Building Code® (IEBC)
 - 6. ICEA – Insulated Cable Engineers Association
 - a. ICEA S-93-639, *Shielded Power Cables 5-46kV* (NEMA WC-74)
 - 7. IEEE® - Institute of Electronics and Electrical Engineers
 - a. IEEE C2™, *National Electrical Safety Code* (NESC) [ANSI]
 - b. IEEE Std 141™, *Recommended Practice for Electric Power Distribution for Industrial Plants* ("Red Book")

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- c. IEEE Std 143™, *Recommended Practice for Grounding of Industrial and Commercial Power Systems* ("Green Book")
- d. IEEE Std 241™, *Recommended Practice for Electric Power Systems in Commercial Buildings* ("Gray Book")
- e. IEEE Std 242™, *Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems* ("Buff Book")
- f. IEEE Std 315™, *Graphic Symbols for Electrical and Electronics Diagrams*
- g. IEEE Std 399™, *Recommended Practice for Power Systems Analysis* ("Brown Book")
- h. IEEE Std 446™, *Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications* ("Orange Book")
- i. IEEE Std 493™, *Recommended Practice for the Design of Reliable Industrial and Commercial Power Systems* ("Gold Book")
- j. IEEE Std 519™, *Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems*
- k. IEEE Std 739™, *Recommended Practice for Energy Management in Industrial and Commercial Facilities* ("Bronze Book")
- l. IEEE Std 902™, *Guide for Maintenance, Operation, and Safety of Industrial and Commercial Power Systems* ("Yellow Book")
- m. IEEE Std 1015™, *Recommended Practice Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems* ("Blue Book")
- n. IEEE Std 1100™, *Recommended Practice for Powering and Grounding Electronic Equipment* ("Emerald Book")
- o. IEEE Std 1584™, *Guide for Performing Arc-Flash Hazard Calculations*
- 8. IESNA – Illuminating Engineering Society of North America
 - a. IESNA *Lighting Handbook*, Ninth Edition
 - b. IESNA RP-1, *American National Standard Practice for Office Lighting*
 - c. IESNA RP-7, *American National Standard Practice for Lighting Industrial Facilities*
- 9. NECA – National Electrical Contractors Association:
 - a. NECA 1, *Good Workmanship in Electrical Construction* [ANSI]
 - b. NECA 90, *Recommended Practice for Commissioning Building Electrical Systems* [ANSI]
 - c. NECA 100, *Symbols for Electrical Construction Drawings* [ANSI]
 - d. NECA 101, *Standard for Installing Steel Conduits (Rigid, IMC, EMT)* [ANSI]
 - e. NECA 104, *Recommended Practice for Installing Aluminum Building Wire and Cable* [ANSI]
 - f. NECA / NEMA 105, *Recommended Practice for Installing Metal Cable Tray Systems* [ANSI]
 - g. NECA 111, *Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC)* [ANSI]
 - h. NECA / NACNA 120, *Standard for Installing Armored Cable (Type AC) and Metal-Clad Cable (Type MC)* [ANSI]
 - i. NECA 202, *Recommended Practice for Installing and Maintaining Industrial Heat Tracing Systems* [ANSI]
 - j. NECA 230, *Standard for Selecting, Installing and Maintaining Electric Motors and Motor Controllers* [ANSI]
 - k. NECA 331, *Standard for Building and Service Entrance Grounding and Bonding*
 - l. NECA 400, *Standard for Installing and Maintaining Switchboards* [ANSI]
 - m. NECA 402, *Standard for Installing and Maintaining Motor Control Centers* [ANSI]

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- n. NECA / EGSA 404, *Standard for Installing Generator Sets* [ANSI]
- o. NECA 407, *Recommended Practice for Installing and Maintaining Panelboards* [ANSI]
- p. NECA 408, *Recommended Practice for Installing and Maintaining Busways* [ANSI]
- q. NECA 409, *Recommended Practice for Installing and Maintaining Dry-Type Transformers* [ANSI]
- r. NECA 410, *Recommended Practice for Installing and Maintaining Liquid-Filled Transformers* [ANSI]
- s. NECA 411, *Recommended Practice for Installing and Maintaining Uninterruptible Power Supplied (UPS)* (ANSI)
- t. NECA 420, *Standard for Fuse Applications* [ANSI]
- u. NECA 430, *Standard for Installing Medium-Voltage Metal-Clad Switchgear* [ANSI]
- v. NECA / IESNA 500, *Recommended Practice for Installing Indoor Lighting Systems* [ANSI]
- w. NECA / IESNA 501, *Recommended Practice for Installing Exterior Lighting Systems* [ANSI]
- x. NECA / IESNA 502, *Recommended Practice for Installing Industrial Lighting Systems* [ANSI]
- y. NECA / MACSCB 600, *Recommended Practice for Installing and Maintaining Medium-Voltage Cable* [ANSI]
- z. NECA / NEMA 605, *Installing Underground Nonmetallic Utility Duct* [ANSI]
- 10. NEMA – National Electrical Manufacturers Association
- 11. NETA – International Electrical Testing Association, Inc.:
 - a. NETA ATS, *Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems*
 - b. NETA MTS, *Maintenance Testing Specifications for Electrical Power Distribution Equipment and Systems*
 - c. NETA ETT, *Standard for Certification of Electrical Testing Technicians* [ANSI]
- 12. NFPA – National Fire Protection Association:
 - a. NFPA 20®, *Standard for the Installation of Stationary Pumps for Fire Protection*®
 - b. NFPA 70™, *National Electrical Code*® (NEC®)
 - c. NFPA 70E, *Standard for Electrical Safety in the Workplace*.
 - d. NFPA 101®, *Life Safety Code*®
 - e. NFPA 110, *Standard for Emergency and Standby Power Systems*
 - f. NFPA 111, *Standard on Stored Electrical Energy Emergency and Standby Power Systems*
 - g. NFPA 780, *Standard for the Installation of Lightning Protection Systems*
 - h. All other NFPA codes and standards except NFPA 5000
- 13. OSHA – Occupational Safety and Health Administration
- 14. IECC – International Energy Conservation Code
- 15. ISO – International Organization for Standardization
- 16. State and Local Energy Conservation Code
- 17. Applicable County and Municipal Codes

1.5 CONTRACT DRAWINGS

- A. Contract drawings are diagrammatic only and do not give fully dimensioned locations of various elements of work. Determine exact locations from field measurements.

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- B. Every effort has been made by the Engineer to indicate wiring of all receptacles, light fixtures, switches, telephone outlets, HVAC equipment, other equipment, elevator equipment, and all other devices / appliances requiring electrical power. It is the intent of the Engineer that all light fixtures be powered and controlled unless specifically noted on the plans; that all wiring devices (receptacles and direct connected equipment) be circuited to a power source of the correct voltage and that all HVAC, elevator equipment and other equipment be properly wired to the correct voltage power source; that all communications and security systems devices and equipment and all fire alarm system devices and equipment are installed, wired and systems are fully operational.
- C. It is the responsibility of the Contractor to review the construction drawings (reflected ceiling plans) for light fixtures, casework elevation details for electrical devices which are not indicated on the electrical drawings; to review the mechanical and plumbing documents and all other drawings to determine the electrical rough-ins for all equipment requiring power connections, and to include in their proposals the correct and complete electrical rough-ins for all of these items which were inadvertently not indicated on the electrical drawings, OR the Contractor shall specifically enumerate each item requiring electrical rough-in which is not specifically shown on the electrical drawings, and indicate the electrical provisions of these items as specifically excluded from his proposal.
- D. It is the responsibility of the Contractor to compare the scale of all electrical drawings with the scale of the architectural drawings and make adjustments to all electrical drawings which have the incorrect drawing scale so that his material takeoffs are not in error due to an incorrectly labeled drawing scale and his proposal is complete.
- E. No proposal shall be accepted which specifically excludes any of the provisions of paragraphs B, C, or D above.

1.6 PROJECT RECORD DOCUMENTS

- A. Maintain at the job site a separate set of white prints (black line) of the contract drawings for the sole purpose of recording the "as-built" changes and diagrams of those portions of work in which actual construction is significantly at variance with the contract drawings. Mark the drawings with a colored pencil. Prepare, as the work progresses and upon completion of work, reproducible drawings clearly indicating locations of various major and minor feeders, equipment, and other pertinent items, as installed. Record underground and under slab service and feeders installed, dimensioning exact location and elevation of such installations.
- B. At conclusion of project, obtain without cost to the Owner, electronic PDF and AutoCAD 2014 and / or Revit CAD files of the original drawings and transfer as-built changes to these. Provide the following as-built documents including all contract drawings regardless of whether corrections were necessary and include in the transmittal: "2 sets of CDs and prints for Owner's use, one set of CDs, prints, and mylars for Architect / Engineers Records". Delivery of these as-built electronic, reproducible and prints is a condition of final acceptance.
 - 1. 3 sets of electronic AutoCAD (2014 dwg) and / or Revit CAD drawing files, on CD-ROM media, of each contract as-built drawing.
 - 2. One reproducible Dayrex Mylar film positive of each contract as-built drawing.
 - 3. Three sets of blue-line prints of each contract as-built drawing.
 - 4. Three sets of pdf prints of each contract as-built drawing on CD.

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- C. As-Built Drawings should indicate the following information as a minimum:
1. Indicate all addendum changes to documents.
 2. Remove Engineer's Seal, name, address, and logo from drawings.
 3. Mark documents RECORD DRAWINGS.
 4. Clearly indicate: DOCUMENT PRODUCED BY:
 5. Indicate all changes to construction during construction. Indicate actual routing of all conduits, etc. that was deviated from construction drawings.
 6. Indicate exact location of all underground electrical raceways, and elevations.
 7. Correct schedules to reflect (actual) equipment furnished and manufacturer.
 8. During the execution of work, maintain a complete set of Drawings and specifications upon which all locations of equipment, devices, and all deviations and changes from the construction documents in the work shall be recorded.
 9. Exact location of all electrical equipment in building. Label panel schedules to indicate actual location.
 10. Exact location of all electrical equipment in and outside of the building.
 11. Exact location of all outdoor lighting poles and equipment.
 12. Location, size and routing of all feeder conduits, equipment, etc. shall be accurately and neatly shown to dimension.
 13. Exact location of all roof mounted equipment, wall, roof and floor penetrations.
 14. Cloud all changes.
 15. Update all panel schedules with all additional circuits added or deleted through construction. Identify each circuit to include all information specified for directory cards for circuit identification in panelboards.

1.7 SPACE REQUIREMENTS

- A. Consider space limitations imposed by contiguous work in selection and location of equipment and material. Do not provide equipment or material that is not suitable in this respect.

1.8 RELATION WITH OTHER TRADES

- A. Carefully study all matters and conditions concerning the project. Submit notification of conflict in ample time to prevent unwarranted changes in any work. Review other Divisions of these specifications to determine their requirements. Extend electrical services and final connections to all items requiring same.
- B. Because of the complicated relationship of this work to the total project, conscientiously study the relation and cooperate as necessary to accomplish the full intent of the documents.
- C. Provide sleeves and inserts in forms as required for the work. Stub up and protect open ends of pipe before any concrete is placed. Furnish sizes of required equipment pads. Furnish and locate bolts and fittings required to be cast in them.
- D. Locate and size openings required for installation of work specified in this Division in sufficient time to prevent delay in the work.
- E. Refer to other Divisions of the specifications for the scope of required connections to equipment furnished under other Division. Determine from the General Contractor / Construction Manager for the various trades, the Owner, and by direction from the Architect / Engineer, the exact location of all items. The construction trades involved shall furnish all roughing-in drawings and wiring diagrams required for proper installation of the electrical work.

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1. Make final electrical connections to all electrically operated equipment indicated on the drawings, except as noted.
2. The responsibility for alignment of motor and driven equipment is specified in the related division.

F. Request all Shop Drawings required in ample time to permit proper installation of all electrical provisions.

G. Extend services as indicated to the various items of equipment furnished by others. Rough-in for the various items and make final connections ready for operation upon placing of the equipment.

1.9 CONCEALED AND EXPOSED WORK

A. When the word "concealed" is defined as hidden from sight as in chases, furred spaces or above ceilings. "Exposed" is defined as open to view, in plain sight.

1.10 GUARANTEE

A. Guarantee work for 1 year from the date of substantial completion of the project. During that period make good any faults or imperfections that may arise due to defects or omissions in material, equipment or workmanship. Replacement of failed parts or equipment shall be provided.

1.11 MATERIAL AND EQUIPMENT

A. Furnish new and unused materials and equipment meeting the requirements of the paragraph specifying acceptable manufacturers. Where two or more units of the same type or class of equipment are required, provide units of a single manufacturer.

1.12 NOISE AND VIBRATION

A. Select equipment to operate with minimum noise and vibration. If noise or vibration is produced or transmitted to or through the building structure by equipment, piping, ducts or other parts of work, and judged objectionable by the Owner, Architect, or Engineer, rectify such conditions at no additional cost to the Owner. If the item of equipment is judged to produce objectionable noise or vibration, demonstrate at no additional cost that equipment performs within designated limits on a vibration chart.

1.13 ACCEPTABLE MANUFACTURERS

A. Manufacturers names and catalog number specified under sections of Division 26 are used to establish standards of design, performance, quality and serviceability and not to limit competition. Equipment of similar design, materials, energy efficiency characteristics (where applicable) and lighting performance characteristics (where applicable) equal to that specified, manufactured by a named manufacturer shall be acceptable on approval. A request for prior approval of equipment not listed must be submitted ten (10) days before proposal due date. Submit a marked-up set of the relevant specification section indicating all variances, a comparison to the specified product, and of construction and performance criteria, complete design and performance data for the specified product and the proposed substitution for comparison to the Engineer. The Architect issues approvals of acceptable manufacturers as addenda to the Construction Proposal Documents.

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1.14 UTILITIES, LOCATIONS AND ELEVATIONS

- A. Locations and elevations of the various utilities included within the scope of this work:
 - 1. Obtained from utility maps and other substantially reliable sources.
 - 2. Are offered separate from the Contract Documents as a general guide only without guarantees to accuracy.
- B. Examine the site and verify the location and elevation of all utilities and of their relation to the work. Existing utilities indicated on the site plans are for reference only and shall be field verified by the Contractor with the respective public or private utility.

1.15 OPERATING TESTS

- A. After all electrical systems have been completed and put into operation, subject each system to an operating test under design conditions to ensure proper sequencing and operation throughout the range of operation. Tests shall be made in the presence of the Architect / Engineer and Owner. Provide minimum 24-hour advance notice of scheduling of all tests. Make adjustments as required to ensure proper functioning of all systems. Special tests on individual systems are specified under individual sections. Submit 3 copies of all certifications and test reports adequately in advance of completion of the work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

1.16 WARRANTIES

- A. All normal and extended warranties shall include parts, labor, miscellaneous materials, travel time, incidental expenses, normal freight / shipping, refrigerant, oils, lubricants, belts, filters and any expenses related to service calls required to diagnose and correct warranty problems.
- B. Manufacturer's warranty shall be from one year from date of substantial completion. Contractor shall be responsible for extending the warranties regardless of date of installation or commissioning.
- C. Submit 3 copies of all warranties and guarantees for systems, equipment, devices and materials. These shall be included in the Operating and Maintenance Manuals.

1.17 BUILDING CONSTRUCTION

- A. It shall be the responsibility of the sub-contractor to consult the Contract Drawings, details and specifications and thoroughly familiarize himself as to the construction and all job related requirements. All construction trades shall cooperate with the General Contractor / Construction Manager Job site superintendent and lay out work so that all raceways and other items are placed in the walls, furred spaces, chases, etc., so that there shall be no delay in the job.

1.18 TEMPORARY FACILITIES

- A. General: Refer to Division 1 for general requirements on temporary facilities.
- B. Temporary Wiring: Temporary power and lighting for construction purposes shall be provided under this Division. Installation of temporary power shall be in accordance with NEC Article 527.

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- C. Temporary facilities, wire, lights and devices are the property of this Contractor and shall be removed by this Contractor at the completion of the Contract.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 IDENTIFICATION OF EQUIPMENT

A. Identification of Equipment:

1. All major equipment shall have a manufacturer's label identifying the manufacturer's address, equipment model and serial numbers, equipment size, and other pertinent data. Take care not to obliterate this nameplate. The legend on all nameplates or tags shall correspond to the identification shown on the Operating Instructions. All panels, cabinets, or equipment requiring 120 volt or higher power shall be labeled as required which includes circuit designation and circuit panelboard location, regardless of which discipline installs the equipment.
2. Three layer laminated plastic engraved identifying nameplate shall be permanently secured to each switchboard, distribution panel, motor control center, transformer, panelboard, safety disconnect switch, enclosed circuit breaker, transfer switches, remote generator transfer devices not installed inside light fixtures, wireway, busduct plug, terminal cabinet, surge protective device, capacitor, individual motor controller, contactor, fire alarm panels (main and remote booster), and communications (voice, data, video) cabinet or rack, security panels, time clocks, BMCS cabinets, sound reinforcement cabinets and racks, miscellaneous control cabinets, equipment integral disconnect switches, toggle or motor switches, disconnects for equipment, exterior junction boxes, exterior pull boxes, exterior wireways and gutters, and rooftop equipment (i.e.: supply and exhaust fans, rooftop HVAC equipment) with stainless steel screws.
 - a. Utility Power: White letters on black background
Generator Power (White letters on red background
UPS Power: White letters on blue background
Load Bank Circuits: White letters on green background
Solar or Wind Power Generation: White on orange background
 - b. Identifying nameplates shall have 1/2-inch high, engraved letters for equipment designation and 1/4-inch letters indicating source circuit designation, (i.e.: "PANEL HA –fed from MDP-6 located in Mech. Rm. 100"). The words "fed from" and "located" shall be included in the labeling.
 - c. Each switchboard, distribution panel, transfer switch, generator transfer device (GTD) for emergency lighting, and motor control center feeder or branch circuit device shall have a nameplate showing the load and location of load served in 1/4-inch high, engraved letters. Circuit breaker name and kirk key designation if applicable
 - d. Each section of multiple section panelboards shall also indicate panelboard section number (i.e.: Panel "HA-Section 2 – fed from MDP-6 located in Mech. Rm. 100")
 - e. Motor Controllers, starters, and contactors: Provide neatly typed label inside each motor controller and contactor enclosure door identifying motor or load served, nameplate horsepower, full load amperes, code letter, service factor, and voltage / phase rating.

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- f. Individual motor controller and contactor nameplates shall include load served, location of load served, panel and circuit numbers serving load, location of panel serving load, panel and circuit number serving control circuit, location of panel serving control circuit (if different from panel serving load), description and location (if applicable) of control controlling contactor (i.e. Controlled: Switch in RM 100, and Controlled: BMCS). Contactor nameplate is to include whether it is a lighting or receptacle contactor and name of contactor. i.e. C-1.

Lighting Contactor Example	Receptacle Contactor Example
Lighting Contactor C1 West Parking Lot Pole Lights Fed From Panel HA-2,4,6 Located Main Elec. Rm. 100 Control Circuit-Panel LA 42 Located Main Elec. Rm. 100 Controlled-BMCS	Receptacle Contactor C2 Table Recpts Lab Rm 100 Fed From Panel LA-2,4,6,8 Located Mech. Rm. 110 Control Circuit-Panel LA-42 Controlled-Emer Shut Off Mushroom Switch Rm 101

- g. Exterior J-boxes, pull boxes, and gutters shall have panel identification, circuit numbers, and location of panel listed on name plate. Low voltage shall be identified per contents, examples: DATA, BMCS, F/A
- h. Name plates on equipment served from switchboards, distribution panels, I-Line panels, and motor control centers are not to include circuit numbers shown on drawings as the circuit numbers are for construction drawing purposes only.
- i. Panel names for 277/480v shall start with the letter "H" and 120/208v, 120/240v shall start with the letter "L". No panel shall be named to include a number other than multi sectional panels, example HA-section 2. New panels installed in renovation or site additions shall have names approved or designated by Owner's electrical representative. Panel names shall not include the letter "I". Transformer names shall start with the letter "T" followed by the panel name it serves, i.e. TLA.
- j. Main service ATS label shall include equipment name, emergency source and location, normal power source and location, panel served and location. Wall mounted ATS serving lighting loads shall include type of lighting and location, emergency panel and circuit ID and location of panel, normal panel and circuit ID and location of panel.
- | Main Service ATS Example | Wall Mounted Lighting ATS Example |
|---------------------------|-----------------------------------|
| ATS-1 | ATS |
| Emer Power-Emer Generator | Exterior Wall Packs/Soffit Lights |
| Located Chiller Yard | North/West Metal Canopy Lights |
| Normal Power-MSB | Fed from EHA-2 |
| Located-Mech Rm 100 | Located Mech Rm 200 |
| Serves Panel EHA | Fed From HB-4 |
| Located-Mech Rm 100 | Located Mech Rm 150 |
- k. Name plates shall include rated bus amperage, voltage, number of phases, number of wires and type of essential electrical system as applicable.
- l. Service equipment available fault current labeling: Provide a 2x3 inch label with blue lettering on contrasting background permanently affixed to the service disconnect/equipment prior to energizing the service equipment. The label shall include the date of installation and the date of calculation. The date of calculation shall be the date indicated by the Engineer of Record's Seal on the Construction Document Electrical One-Line Diagram / Riser Drawing. Example:

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SERVICE EQUIPMENT AVAILABLE FAULT CURRENT: ##, ### AMPS
DATE OF INSTALLATION: MM/DD/YY
DATE OF CALCULATION: MM/DD/YY

3. Cardholders and directory cards shall be furnished for circuit identification in panelboards. Cardholder shall be located on inside of panel door and shall be in a metal frame with clear plastic front. Circuit lists shall be typewritten. Circuit descriptions shall include explicit description and identification of items controlled by each individual breaker, including final graphics room number or name designation and name of each item served. If no building appointed room number or name is given, list locations per the following examples – A. Storage in Rm 100 – B. Office in Rm 100 – C. Storage west of Rm. 100. List corridors as “corridors”. Identify circuits controlled by contactors using a separate notation for each contactor used. List notation at bottom of schedule stating the circuits are controlled by a contactor, list exact location of contactor, and how switched. Do not use architectural room number designation shown on plans. Obtain final graphics room number identification from Architect’s final room number graphics plan. All locations served by breakers shall be listed on schedule. Panel schedule shall be large enough to contain all information required. Also refer to Section 26 24 16.
 4. Permanent, waterproof, black markers shall be used to identify each lighting and power grid junction box, gutter and wireway. Clearly indicate the panel and branch circuit numbers available at that junction box, gutter or wireway. Where low voltage relay panels are used for lighting control, identify the low voltage relay panel and number in addition to the branch circuit panel and number.
 5. Pull Boxes, Transformers, Disconnect Switches, etc.: Field work each with a name plate showing identity, voltage and phase and identifying equipment connected to it. The transformer rating shall be shown on the panels or enclosures. For an enclosure containing a motor starter, the nameplate shall include the Owner’s motor number, motor voltage, number of motor phases, motor load being serviced, motor horsepower, and motor full load current. Nameplates shall also indicate where panel is fed from.
- B. Prohibited Markings: Markings intended to identify the manufacturer, vendor, or other source from whom the material has been obtained are prohibited for installation in public, tenant, or common areas within the project. Also prohibited are materials or devices that bear evidence that markings or insignias have been removed. Certification, testing (example, Underwriters Laboratories), and approval labels are exceptions to this requirement.
- C. Warning Signs: Provide warning signs where there is hazardous exposure associated with access to or operation of electrical facilities. Provide text of sufficient size to convey adequate information at each location; mount permanently in an appropriate and effective location. Comply with industry standards for color and design.
- D. Wire and Cable Markers: Provide vinyl cloth markers with split sleeve or tubing type, except in manholes provide stainless steel with plastic ties.
- E. Wire and Cable Labeling: Provide wire markers on each conductor in all boxes, pull boxes, gutters, wireways, contactors, and motor controllers and load connection. Identify with panelboard / switchboard branch circuit or feeder number for power and lighting circuits, and with control wire number as indicated on equipment manufacturer’s shop drawings for control wiring.

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- F. Underground Warning Tape: Thomas and Betts or approved equal. Six-inch wide plastic tape, colored red for 50 volts or above electrical, or orange for communications and control with suitable warning legend describing buried electrical lines; telephone lines and data lines per APWA recommendations. All underground electrical conduits shall be so identified. Tape shall be buried at a depth of 6-inches below grade and directly above conduits or ductbanks. Provide magnetic marking tape below all underground electrical conduits.
- G. Lighting Controls and Equipment: Provide self-adhesive machine typed tape labels with ¼" high white letters on ½" tall black background for digital lighting modules as "DLM". Modules or relays located above ceiling: adhere label to bottom of ceiling T-grid below relay location. Modules or relays located in mechanical or electrical rooms or other areas other than above ceiling: Adhere label to the cover of the module or relay and identify the area they control as "MAIN GYM", "BAND HALL", or "CORRIDOR 100", etc. Remote lighting control switches or push button stations located remotely from the area they control: Adhere label to device face plate, not obstructing screw fasteners, and intuitively identify function such as "GYM LTG LOW-HIGH" or "CAFE LTG DIM", etc.

3.2 CUTTING AND PATCHING

- A. General: Comply with the requirements of Division 1 for the cutting and patching of other work to accommodate the installation of electrical work. Except as authorized by the Architect / Engineer, cutting and patching of electrical work to accommodate the installation of other work is not permitted.

3.3 INSTRUCTION OF OWNER'S PERSONNEL

- A. Prior to substantial completion, conduct an on-site training program to instruct Owner's operating personnel in the operation and maintenance of the electrical systems.
 - 1. Provide the training during regular working day.
 - 2. The Instructors shall be experienced in their phase of operation and maintenance of the electrical systems and with the project.
 - 3. Refer to other specification sections for additional training and commissioning requirements.
- B. Time to be allocated for instructions.
 - 1. Minimum of 20 hours dedicated instructor time
 - 2. 4 hours on each of 5 days
 - 3. Additional instruction time for specific systems as specified in other Sections.
- C. Before on-site training, submit the program syllabus; proposed time and dates; for review and approval, minimum 48 hours prior to proposed training time and date.
 - 1. One copy to the Owner
 - 2. One copy to the Architect / Engineer
- D. The Owner shall provide a list of personnel to receive instructions, and shall coordinate their attendance at the agreed upon times.
- E. Use operation and maintenance manuals as the basis of instruction. Review manual with personnel in detail. Explain all aspects of operation and maintenance.
- F. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shut down of each item of equipment.

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- G. Demonstrate equipment functions (both individually and as part of the total integrated system).
- H. Prepare and insert additional data in the operating and maintenance manuals when the need for additional data becomes apparent during instructions.
- I. Submit a report within one week after completion of training. List time and date of each demonstration, hours devoted to the demonstration, and a list of people present, with their respective signatures.
- J. At the conclusion of the on-site training program, have the person designated by the Owner sign a certificate to certify that he / she has a proper understanding of the system, that the demonstrations and instructions have been satisfactorily completed, and the scope and content of the operating and maintenance manuals used for the training program are satisfactory.
- K. Provide a copy of the report and the certificate in an appropriately tabbed section of each Operating and Maintenance Manual.

3.4 OPENINGS

- A. Framed, cast or masonry openings for boxes, equipment or conduits are specified under other divisions. Drawings and layout work for exact size and location of all openings are included under this division.

3.5 HOUSEKEEPING PADS

- A. Provide concrete equipment housekeeping pads under all floor and outdoor mounted electrical equipment.
- B. Concrete and reinforcing steel shall be as specified in Division 3, or as indicated or noted.
- C. Concrete pads:
 - 1. 6-inches thick minimum indoors; 8-inches thick minimum outdoors, or match existing if indicated on the drawings to extend existing pads, or in other sections of the specifications.
 - 2. Chamfer strips at edges and corner of forms.
 - 3. Smooth steel trowel finish.
 - 4. Extend 3-inches minimum indoors beyond perimeter of equipment unless otherwise shown.
 - 5. 6-inch x 6-inch #8 wire reinforcement mesh.

3.6 OBSTRUCTIONS

- A. The drawings indicate certain information pertaining to surface and subsurface obstructions, which has been taken from available drawings. Such information is not guaranteed, however, as to accuracy of location or complete information.
 - 1. Before any cutting or trenching operations are begun, verify with Owner's representative, utility companies, municipalities, and other interested parties that all available information has been provided.
 - 2. Should obstruction be encountered, whether shown or not, alter routing of new work, reroute existing lines, remove obstruction where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of the new work and leave existing services and structures in a satisfactory and serviceable condition.

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- B. Assume total responsibility for and repair any damage to existing utilities or construction, whether or not such existing facilities are shown.

3.7 VANDAL RESISTANT DEVICES

- A. Where vandal resistant screws or bolts are employed on the project, deliver to the Owner 2 suitable tools for use with each type of fastener used, and 25 percent spare fasteners.
- B. Proof of delivery of these items to the Owner shall be included in the Operating and Maintenance Manuals.

3.8 PROTECTION

- A. Protect work, equipment, fixtures, and materials. At work completion, work must be clean and in original manufacturer's condition.
- B. Do not deliver equipment to this project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather shall be rejected, and the contractor is obligated to furnish new equipment of a like kind at no additional cost to the Owner.

3.9 COORDINATION OF BRANCH CIRCUIT OVERCURRENT AND PROTECTION DEVICES

- A. Review with equipment specified which requires electrical connections. Review equipment shop drawings and manufacturer's nameplate data and coordinate exact branch circuit overcurrent protective device and conductors with equipment provided.
 - 1. Provide equipment manufacturer's recommended overcurrent protective device indicated on nameplate at no additional cost to the Owner.
 - 2. If branch circuit conductors and / or conduit sizing is less than the minimum required by equipment manufacturer, notify the Architect / Engineer immediately, prior to rough-in.
 - 3. If equipment manufacturer is a substitution to the specified equipment manufacturer, provide the greater of the conductors specified or those required for the installed equipment manufacturer's minimum circuit conductors, at no additional cost to the Owner.
 - 4. If conductors indicated on plans are in excess of that permitted by equipment manufacturer, notify Architect / Engineer immediately, prior to rough-in.
 - 5. If conductors indicated on plans are in excess of that permitted by the equipment manufacturer, provide the maximum conductors permitted by the equipment manufacturer based on NEC ampacity tables, either in a single set, or as a set of parallel conductors as permitted by the NEC. Conductor size and quantity entering the equipment enclosures shall not exceed the equipment manufacturer's maximum recommendations.

3.10 FAULT CURRENT AND ARC FLASH STUDY FOR OVERCURRENT DEVICE COORDINATION

- A. Contractor shall provide a coordination study, fault current analysis, and Arc-Flash study report for new electrical distribution equipment downstream to the last new overcurrent device in each feeder or branch circuit, conducted and prepared by the switchgear manufacturer. The coordination study and fault current analysis shall include the manufacturer's recommendations for all adjustable overcurrent devices specified or provided. Study does not require inclusion of existing switchgear, except it shall include

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existing or new overcurrent devices in existing switchgear serving new switchgear. Contractor shall submit the report results prior to submitting switchgear submittals to allow changes or modifications to equipment selection.

- B. Contractor shall adjust all overcurrent device settings based on manufacturer's recommendations, or as directed by Owner / Architect at no additional cost to Owner. Settings for GFI shall be set at maximum as permitted by the NEC.
- C. Arc-Flash & Shock-Hazard Warning Labels: Provide arc-flash and shock hazard-warning labels that comply with ANSI Z535.4 on switchgear, switchboards, transformers, motor control centers, panelboards, motor controllers, safety switches, industrial control panels and other equipment that is likely to require examination, adjustment, servicing, or maintenance while energized. Locate the marking to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment. On renovation projects, install arc-flash warning labels on existing equipment where lock-out / tag-out will be required for the renovation work. Provide the information listed below on each label. Specify that arc-flash warning label information be produced by the electrical equipment manufacturer or supplier as a part of the final power system studies to be submitted by the Contractor in accordance with the electrical acceptance testing.
 - 1. Note: In addition to the final arc-flash analysis, the final power system studies include load flow and fault-current calculations, and an overcurrent protective device (OCPD) coordination study based on the actual equipment to be installed for the project.
- D. Information to be determined and applied to electrical equipment:
 - 1. Arc-Flash Protection Boundary
 - 2. Arc-Flash incident energy calculated in accordance with IEEE Std 15841 TM
 - 3. Working distance calculated in accordance with IEEE Std 1584a TM
 - 4. NFPA 70E Hazard / Risk Category Number or the appropriate personal protective equipment (PPE) for operations with doors closed and covers on.
 - a. Typical operations include operating circuit breakers, fused switches, and meter selector switches.
 - 5. System phase-to-phase voltage
 - 6. Condition(s) when a shock hazard exists (e.g. "With cover off")
 - 7. Limited Approach Boundary as determined from NFPA 70E, Table 130.2(C)
 - 8. Restricted Approach Boundary as determined from NFPA 70E, Table 130.2(C)
 - 9. Prohibited Approach Boundary as determined from NFPA 70E, Table 130.2(C)
 - 10. Unique equipment designation or code (described under "Component Identification")
 - 11. Class for insulating gloves based on system voltage (e.g., Class 00 up to 500V)
 - 12. Voltage rating for insulated or insulating tools based on system voltage (e.g., 1000V)
 - 13. Date that the hazard analysis was performed.
 - 14. "Served from" circuit directory information including the serving equipment designation, location (e.g., room number), circuit number, and circuit voltage / number of phases / number of wires.
 - 15. If applicable, the "serves" circuit directory information including the served equipment designation, location (e.g., room number), circuit number, and circuit voltage / number of phases / number of wires.
 - 16. An abbreviated warning label may be used where it has been determined that no dangerous arc-flash hazard exists in accordance with IEEE 1584a TM, paragraph 9.2.3.
 - 17. Use a "DANGER" label where the calculated arc-flash incident energy exceeds 40 cal/cm.

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- E. Submittals: Submit four copies of coordination study and certified fault current study results to the Architect for review.

3.11 EQUIPMENT BACKBOARDS

- A. Backboards: ¾ inch, fire retardant, exterior grade plywood, painted gray, both sides.
1. Provide minimum of two 4-ft. by 8-ft. sheets of plywood for each new telephone equipment terminal location.
 2. Provide minimum of two 4-ft. by 4-ft. sheets of plywood for each new data / voice / video / communications equipment location / cable TV head end equipment, or security equipment location.

3.12 TESTING

- A. The contractors for the various sub-systems shall submit proposed testing procedures for their systems, subject to review and approval and Owner acceptance. The contract will not be declared to be substantially complete until the functional operation of the subsystems have been demonstrated and verified and reports have been provided, reviewed and accepted.
- B. The project will not be declared substantially complete until the following has taken place.
1. The "As-Built" drawings have been submitted, reviewed and accepted by the Architect / Owner / Owner's Construction Representative.
 2. The building emergency lighting system and other systems including but not limited to those listed below have been tested, completed factory start-up and programming and adjusting as required for a complete and fully operational system acceptable to the Architect and Owner.
 - a. Occupancy Sensor and Lighting Controls
 - b. Surge protective device equipment
 - c. Overcurrent devices
 - d. Motor Controllers
 - e. Emergency Lighting
 - f. Building Fire Alarm System
 - g. Clock System
 - h. Television Distribution System
 - i. Building Data / Voice Cabling System
 - j. Surveillance and Security System
 - k. Intercom / Telephone
 - l. Sound Reinforcement Systems
 - m. Building Lightning Protection System

3.13 LOAD BALANCING

- A. Balance the loads on each low-voltage feeder so that the voltage on each phase is within +/- 1.0% of the average voltage of the three phases. Refer to the DOE Office of Industrial Technologies, "Motor Tip Sheet #7" dated September 2005 available for download to PDF format at no charge at:
http://www1.eere.energy.gov/industry/bestpractices/pdfs/eliminate_voltage_un_balanced_motor-systems7.pdf

END OF SECTION

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SECTION 260505

ELECTRICAL ALTERATIONS PROJECT PROCEDURES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Inspection and service of existing equipment and materials to remain or be reused.
- B. Handling of equipment and materials to be abandoned.
- C. Handling of equipment and materials to be removed.

1.2 QUALITY ASSURANCE

- A. Coordination with the Contractor prior to the disconnection or shutdown of existing equipment, or to the modification of existing operational systems.

1.3 CONTRACT DRAWINGS

- A. There is the possibility that there exist conditions and devices that are affected by the work indicated on the drawings and called for in the specifications (project manual) that do not appear on the drawings. It is the Contractors responsibility to visit the site and determine all of the existing conditions and to consider these existing conditions when making and presenting a proposal, to have a complete proposal.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Material used to upgrade and repair existing equipment shall conform to that specified.
- B. Material used to upgrade and repair existing equipment shall not void existing warranties or listings of the equipment to be upgraded or repaired.
- C. Material used to upgrade and repair existing equipment shall be new and shall be of the same manufacturer of the existing equipment, shall be acquired through the existing original equipment manufacturer's approved distribution channels, shall have manufacturer's warranties for the new material being used, and shall be listed for the use intended.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Existing materials and equipment indicated on the drawings or in the specifications to be reused shall be inspected for damaged or missing parts. Notify the Architect / Engineer, in writing, accordingly.
- B. If using materials specified or shown on the drawing voids or diminishes the warranty or operation of remaining equipment or systems, the Contractor shall notify the Architect / Engineer, in writing.

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- C. Verify field measurements and circuiting arrangements.
- D. Verify that abandoned wiring, panelboards, and switchboards, disconnect switches, and equipment serve only abandoned facilities. Where abandoned wiring, panelboards, switchboards, and equipment which serve existing facilities are to remain, Contractor shall provide means and methods to ensure existing facilities remain energized with the correct voltage, overcurrent protection, conductors, and circuit ampacity required by the existing facilities to remain.
- E. Demolition Drawings are based on casual field observation, and when available, existing record documents. Report discrepancies to Architect before disturbing existing installation, and immediately after such discrepancies are discovered.

3.2 APPLICATION

- A. Existing materials and equipment indicated on the drawings or in the specification to be reused shall be cleaned and reconditioned, including tightening of feeder and bus bar lugs prior to installation and reuse in the modified system.
- B. Remove existing luminaries for alterations/renovations. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. For each luminaire that is taken down for alteration and then reinstalled, replace damaged parts, provide new lamps and, with matching paint, touch-up scratched or abraded areas, and replace cracked, broken or missing lenses or diffusers. Replace unrepairable fixtures with new fixtures
- C. Material and equipment removed that is not to be salvaged for Owner's use or for reuse on the project shall become the property of the Contractor and shall be removed from the site.
- D. Prior to start of construction, Contractor shall walk areas to be renovated with Owner to identify and document items to be salvaged for Owner's use.
- E. Material or equipment salvaged for Owner's use shall be carefully handled and stored where directed by the Owner.
- F. Materials and equipment not indicated to be removed or abandoned shall be reconnected to the new system.
- G. Clean and repair existing materials and equipment that remain or are to be reused.
- H. Panelboards Reused and Modified for Renovation: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

3.3 SEQUENCING AND SCHEDULING

- A. Coordinate utility service outages with Utility Company, Architect and Owner.
- B. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits use personnel experienced in such operations.

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- C. Existing Electrical Service: Refer to drawings for work in remodeled areas. Where facilities in these areas are to remain in service, any related work to keep the facilities in operation is specified in this Division. Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Obtain written permission from Owner at least 10 business days before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area. Disclose the extent, exact time and expected duration of the outage in a written request to the Owner.
- D. Remove and replace existing conduit, wiring, outlets, devices, lighting fixtures, panels and appurtenances as occasioned by new or remodeled construction. Re-establish service to lights, switches and devices that may be interrupted by remodeled construction.
- E. Disconnect electrical systems in walls, floors and ceilings scheduled for removal. When outlets are removed, wire shall be pulled out of the conduit back to the nearest remaining box or cabinet.
 - 1. Remove exposed conduit that has been abandoned.
 - 2. Cap conduit beyond the finish line.
 - 3. Provide unswitched circuit leg for emergency battery powered equipment; circuit from same branch circuit breaker as switched normal lighting circuit.
- F. Where new/existing luminaries or devices are shown being connected to existing circuits:
 - 1. Field verify existing system voltage
 - 2. Provide ballast / device to match system voltage
- G. Verify the loading of each circuit affected by remodeling work. The maximum load of any branch circuit shall not exceed 80% of its rating.
- H. Remove equipment, systems, conductors, wiring, raceways, etc. abandoned or not required for existing or new systems. Coordinate with Architect / Owner for salvage by Owner. Remove abandoned / not required raceways and wiring back to nearest box serving load to remain, or back to panel if not serving remaining load.
- I. Existing Power, and Lighting and Appliance Branch Circuit Distribution System: Maintain existing system in service unless as noted or specified otherwise. Disable system only to make switchovers and connections. Notify Owner at least 72 hours before partially or completely disabling system. Minimize outage duration. Make connections to maintain service in areas adjacent to work area.
- J. Existing Lighting System: Maintain existing system in service unless as noted or specified otherwise. Disable system only to make switchovers and connections. Notify Owner at least 72 hours before partially or completely disabling system. Minimize outage duration. Make connections to maintain service in areas adjacent to work area.
- K. Existing Fire Alarm System: Maintain existing system in service. Disable system only to make switchovers and connections. Notify Owner and local fire service at least 72 hours before partially or completely disabling system. Minimize outage duration. Make connections to maintain service in areas adjacent to work area.
- L. Existing Telephone System: Maintain existing system in service. Disable system only to make switchovers and connections. Notify Owner and Telephone Company at least 72 hours before partially or completely disabling system. Minimize outage duration. Make connections to maintain service in areas adjacent to work area.

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- M. Existing Paging and Sound Reinforcement Systems: Maintain existing system in service. Disable system only to make switchovers and connections. Notify the Owner at least 72 hours before partially or completely disabling system. Minimize outage duration. Make connections to maintain service in areas adjacent to work area.
- N. Existing Data Network: Maintain existing system in service. Disable system only to make switchovers and connections. Notify the Owner at least 72 hours before partially or completely disabling system. Minimize outage duration. Make connections to maintain service in areas adjacent to work area.
- O. Existing Video Distribution System: Maintain existing system in service. Disable system only to make switchovers and connections. Notify the Owner at least 72 hours before partially or completely disabling system. Minimize outage duration. Make connections to maintain service in areas adjacent to work area.
- P. Existing Security System: Maintain existing system in service. Disable system only to make switchovers and connections. Notify the Owner at least 72 hours before partially or completely disabling system. Minimize outage duration. Make connections to maintain service in areas adjacent to work area.
- Q. Existing Video Surveillance System: Maintain existing system in service. Disable system only to make switchovers and connections. Notify the Owner at least 72 hours before partially or completely disabling system. Minimize outage duration. Make connections to maintain service in areas adjacent to work area.
- R. Prior to shutdown of existing power for any single extended period of time greater than 18 hours, provide at minimum 120/240 volt, 1-phase, 3-wire electrical service to provide temporary power to all critical loads as identified by Owner including but not limited to all security systems, fire alarm panel and associated remote power supplies. Contractor shall provide continuous operation temporary generator power or coordinate directly with local utility regarding temporary power service and metering and provide all necessary permits and fees at no cost to the Owner.
- S. Provide a minimum 30 space panelboard with required branch circuit breakers as required and all associated temporary wiring as required. Remove all temporary power prior to substantial completion.

3.4 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. The Contractor shall modify, remove, and/or relocate all materials and items so indicated on the drawings or required by the installation of new facilities. All removals and/or dismantling shall be conducted in a manner as to produce maximum salvage. Salvage materials shall remain the property of the Owner, and shall be delivered to such destination as directed by the Owner's representative unless they are not wanted, then it will be the responsibility of this Contractor to remove such items and properly dispose of them. Materials and/or items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to good operative condition. The Contractor may, at his discretion, and upon approval of the Owner's representative substitute new materials and/or items of like design and quality in lieu of materials and/or items to be relocated.
 - 1. Remove abandoned electrical distribution equipment, utilization equipment, outlets and accessible portions of wiring, raceway systems, and cables back to the source panelboard, switchboard, switchgear, communications closet, or cabinet. Abandoned wiring and raceways can result from actions that include the following:

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- a. Equipment is removed or relocated
 - b. Fixtures are removed or relocated
 - c. System is no longer used
 - d. There is no demonstrable near term future use for the existing circuit or raceway system.
 2. Leave abandoned electrical equipment, conductors, and material in place only if one or more of the following conditions exist:
 - a. The removal requires the demolition of other structures, finishes, or equipment that is still in use. An example is abandoned conduit above an existing plaster ceiling.
 - b. Removal is not feasible due to hazards, construction methods, or restricted access.
 - c. Removal of abandoned conductors may damage conductors that must remain operational.
 3. Remove conduits, including those above accessible ceilings, to the point that building construction, earth, or paving covers them. Cut conduit beneath or flush with building construction or paving. Plug, cap, or seal the remaining unused conduits. Install blank covers for abandoned boxes and enclosures not removed.
 4. Extend existing equipment connections using material and methods compatible with the existing electrical installation and this division.
 5. Restore the original fire rating of floors, walls, and ceilings after electrical demolition.
 6. Use approved lock-out / tag-out procedures to control hazardous energy sources. Assure that an electrically safe work condition exists in the demolition area before beginning demolition. Where possible, disconnect the building from all sources of electrical power before beginning demolition.
- B. All items to be relocated shall be carefully removed in reverse to original assembly or placement and protected until relocated. The Contractor shall clean, repair, and provide all new materials, fittings, and appurtenances required to complete the relocations and to restore them to good operative order. All relocations shall be performed by workmen skilled in the work and in accordance with standard practice of the trades involved.
- C. When items scheduled for relocation and/or reuse are found to be in damaged condition before work has been started on dismantling, the Contractor shall call the attention of the Owner's representative to such items and receive further instructions before removal. Items damaged in repositioning operations are the contractor's responsibility and shall be repaired or replaced by the contractor as approved by the owner's representative, at no additional cost to the Owner.
- D. Conduit and wiring to items to be removed, salvaged, or relocated shall be removed to points indicated on the drawings, specified, or acceptable to the Owner's representative. Conduit and wiring not scheduled for reuse shall be removed to the points at which reuse is to be continued or service is to remain. Such services shall be sealed, capped, or otherwise tied-off or disconnected in a safe manner acceptable to the Construction Inspector. All disconnections or connections into the existing facilities shall be done in such a manner as to result in minimum interruption of services to adjacent occupied areas. Services to existing areas or facilities that must remain in operation during the construction period shall not be interrupted without prior specific approval of the Owner's representative herein before specified.

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- E. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed. Replace existing wiring devices and cover plates with new wiring devices and new cover plates in renovated areas. Any corridor, room, or area indicated to have any new wiring devices installed shall have all of the existing wiring devices and cover plates replaced with new wiring devices and new cover plates.
- F. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
- G. Disconnect and remove abandoned luminaries. Remove brackets, stems, hangers, and other accessories.
- H. Repair adjacent construction and finishes damaged during demolition and extension work.
- I. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.
- J. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.
- K. Existing conduit raceway found to need additional hangers installed and/or junction box covers shall be added at no additional cost to the Owner.
- L. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

3.5 PROTECTION OF THE WORK

- A. Provide adequate temporary support and auxiliary structure as necessary to ensure structural value or integrity of affected portion of work.
- B. Provide devices and methods to protect other portions of work from damage.
- C. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances and finishes.

3.6 IDENTIFICATION OF EQUIPMENT IN RENOVATED AREAS

- A. Identification of Equipment: Provide new, typed panel directory cards (and card holders if needed) for existing panelboards located within the renovated areas. Ring out all new and existing circuits within these panelboards as specified in Section 26 05 00 Electrical General Provisions. Do not include the description "existing". Provide new nameplates for all existing electrical equipment in renovated areas as specified in Section 26 05 00 Electrical General Provisions.

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3.7 TESTING AND CORRECTIVE MEASURES FOR DAMAGE DURING CONSTRUCTION IN EXISTING LOW VOLTAGE SYSTEMS

- A. Pre-construction testing of existing low voltage systems:
 - 1. Provide a complete operational test of the following systems prior to demolition and renovation. Verify operation of each circuit, device, panel, console, distribution equipment, and associated accessories. Test shall be performed by a contractor and technicians, each certified by the respective manufacturer of the existing special system to perform test, programming, and repairs to the respective manufacturer's system. Testing of the existing system shall include all areas served by the existing system including but not limited to the main campus, remote buildings, and temporary buildings:
 - a. Paging System
 - b. Telephone System
 - c. Fire Alarm System
 - d. Data Network Communications System
 - e. Video Distribution System
 - f. Security Access Control System
 - g. Video Surveillance System
 - h. Sound Reinforcement System
 - 2. Provide a complete written report to the Architect, indicating any deficiencies of the existing system in relation to each component's intended function. Include in the written report evidence of current certification by the respective manufacturer for the contractor and individuals performing the tests. Provide the written report within 14 days of notice to proceed and prior to any demolition or renovation work.
- B. Substantial completion testing of existing low voltage systems:
 - 1. Provide complete operational tests of the following systems within 14-days prior to estimated date of substantial completion. Verify operation of each circuit, device, panel, console, distribution equipment, and associated accessories. Test shall be performed by a contractor and technicians each certified by the respective manufacturer of the existing system to perform test, programming, and repairs to the respective manufacturer's system. Testing of the existing system shall include all areas served by the existing system including but not limited to the main campus, remote buildings, and temporary buildings:
 - a. Paging System
 - b. Telephone System
 - c. Fire Alarm System
 - d. Data Network Communications System
 - e. Video Distribution System
 - f. Security Access Control System
 - g. Video Surveillance System
 - h. Sound Reinforcement System
 - 2. Provide a complete written report to the Architect, indicating any deficiencies of the existing system in relation to each component's intended function. Include in the written report evidence of current certification by the respective manufacturer for the contractor and each individual performing the tests. Provide the written report within 14 days of expected date for substantial completion.
- C. Repairs, equipment replacements, and corrections to low voltage systems due to damage caused by contractor:
 - 1. Notify the Owner immediately of any disruption or damage to any low voltage system.

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2. Any disruption or damage to the existing access control system or fire alarm system shall be corrected the same day as the disruption or damage occurred. The access control system and fire alarm system shall be tested daily in the presence of the owner prior to the Contractor leaving the job site each day.
3. For each low voltage system other than access control or fire alarm system, a manufacturer certified contractor and certified technicians shall perform corrective measures to each system component that was functional prior to demolition and renovation and found defective or non-functional within 14-days prior to estimated date of substantial completion.
4. Corrective measures to all low voltage systems to correct components of the low voltage systems found damaged by the contractor shall be completed to the satisfaction of the Owner and Architect / Engineer prior to acceptance of substantial completion at no additional cost to the Owner.

END OF SECTION

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SECTION 260510

CONTRACT QUALITY CONTROL

PART 1- GENERAL

1.1 WORK INCLUDED

- A. General: Electrical service shall be provided by local utility company. Provide infrastructure, conduit, ductbanks and pathways from public street right-of-way to building for telecommunications and cable service.
- B. Power Company Data: Obtain from utility company information and installation standards for electrical, telecommunication, and cable service installation.
- C. Responsibilities: Determine what equipment and labor is provided by utility company and what equipment and labor is required of this Contractor.

PART 2 – PRODUCTS

2.1 GENERAL

- A. Service Data: Ensure that utility company service data is accurate and verified.

2.2 PRIMARY SERVICE

- A. General: Division 26 shall provide primary service conduit, manholes, and pull boxes as required and as specified for electrical service. Division 26 shall provide grounding rods, grounding conductors, sleeves, conduits, pull boxes and manholes as required by telecommunications and cable service providers.
- B. Electric utility company shall provide primary cables, splices, terminations, and primary underground and overhead service conductors. Telecommunications and cable service utility companies shall provide cabling and connections to the Owner's demarcation point of service.

2.3 SECONDARY SERVICE CABLE TAP BOXES

- A. General: Division 26 shall provide secondary service cable tap boxes as approved by the utility company. Where required or specified, enclosure shall be constructed of NEMA 3R construction.

2.4 SECONDARY SERVICE CONDUCTORS

- A. General: Division 26 shall provide secondary service entrance conductors and conduit.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Standards: The installation of the service entrance provisions shall comply with the published standards and requirements of the utility company, the utility company's specific construction requirements for this project, and with requirements of this Division.

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- B. Correction: Any failure to meet the standards and requirements shall be corrected to the satisfaction of the utility company and Owner without any additional cost to the Owner.
- C. Contractor shall provide all construction materials and labor that the utility company determines to be the responsibility of the customer, at no additional cost to the Owner.
- D. The materials and labor required by the for a complete installation shall be provided by the contractor and includes but is not limited to permanent or removable / lockable vehicular barriers, grounding rods, grounding conductors, sleeves, concrete pads, conduits, metering racks and metering enclosures.
- E. Primary distribution poles and service entrance ductbank locations shall be staked and surveyed prior to pole installation by the Contractor to verify their proper placement is within the Owner's property and respective utility easements. Contractor shall verify by survey that the pole and service entrance ductbank location and easements do not interfere with existing easements, rights-of-way, or other restricted properties. Conflicts with existing easements and restrictions shall be brought to the attention of the Architect prior to construction.
- F. Contractor shall initiate contact with the utility providers and Owner within 14 days of Notice to Proceed to ensure permanent power will be available to the site. Any delays resulting from lack of this coordination shall be the responsibility of the Contractor.

END OF SECTION

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SECTION 260512

ELECTRICAL SHOP DRAWINGS, COORDINATION DRAWINGS & PRODUCT DATA

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Prepare submittals as required by Division 01 and as outlined below.
- B. Provide individual submittals based on the project specification section number and description and only items specified or required in that specific project specification section.
- C. Submit product data shop drawings only for the following items indicated below when included as part of the project specifications, and for items specifically requested elsewhere in the Contract Drawings and Specifications. Architect / Engineer reserves the right to refuse shop drawings not requested for review, typically for basic materials and commodity off-the-shelf materials, and/or to imply that materials shall be provided as specified without exception.
- D. The term submittal, as used herein, refers to all:
 - 1. Shop Drawings
 - 2. Coordination Drawings
 - 3. Product data
- E. Submittals shall be prepared and produced for:
 - 1. Distribution as specified
 - 2. Inclusion in the Operating and Maintenance Manual, in the related O&M manual section.

1.2 ARCHITECT / ENGINEER REVIEW OF SUBMITTALS

- A. The Architect / Engineer will:
 - 1. Review requested submittals with reasonable promptness. Specific equipment submittal within a materials specification section that may be required to be expedited shall be submitted separately without other submittal items not requiring the same prompt attention.
 - 2. Affix stamp and initials or signature and indicate requirements for resubmittal or exceptions to submittal as submitted.
 - 3. Return submittals to Contractor for distribution or for resubmission.
- B. Review of submittals will not extend to design data reflected in submittals that is peculiarly within the special expertise of the Contractor or any party dealing directly with the Contractor.
- C. Architect / Engineer's review is only for conformance with the design concept of the project and for compliance with the information given in the contract.
 - 1. The review shall not extend to means, methods, sequences, techniques or procedures of construction or to safety precautions or programs incident thereto.
 - 2. The review shall not extend to review of quantities, dimensions, weights or gauges, fabrication processes, or coordination with the work of other trades.
- D. The review of a separate item as such will not indicate approval of the assembly in which the item functions.

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1.3 SUBSTITUTIONS

- A. Do not make requests for product or material substitution employing the procedures of this Section. The procedure for making a formal request for substitution is specified in Division 01.

PART 2 - PRODUCTS

- A. Each individual submittal shall be an individual specific electronic data file with the file name resembling the product specification section number and title. Refer to Division 01 for additional data file format and media requirements.

PART 3 - EXECUTION

3.1 SPECIFICATION COMPLIANCE REVIEW

- A. Do not submit an outline form of compliance, submit a complete copy with the product data.
- B. Mark up a complete copy of the complete specification section for the product to indicate a) acknowledgement of the specification requirement (Comply), or b) acknowledgement that the particular specification requirement does not apply to this specific project (Not Applicable) or, c) acknowledgement that the specification requirement cannot be made or that a variance is being submitted for review to the Architect / Engineer / Owner (Does Not Comply, Explanation:).
- C. Variances for product or materials typically include updated model numbers or updated versions of the specified product from the same manufacture or an equal or better product from the approved manufactures list. Substitutions from manufacture's not on the approved manufacture's will not be reviewed unless prior approval using one of the procedures for substitutions or changes in the contract documents are followed as required in Division 01.

3.2 COMPOSITE COORDINATION DRAWINGS

- A. Produce a set of composite coordination drawings for above ceiling, below ceiling, and below floor of electrical, mechanical, and technology equipment rooms and equipment yards for review and comment within four (4) weeks of receipt of Owner's official Notice to Proceed. Show coordination of items including but not limited to structural and architectural elements, all mechanical and plumbing piping, ductwork, equipment, electrical conduit, low voltage communications and safety/security systems cabling, cable trays, lighting, electrical switchgear, generators and UPSs, and any public or private building utility services.
 - 1. Prepare the composite plans at one-quarter inch (1/4") equals one-foot scale. Include larger scale sections with vertical elevations of elements as required to confirm coordinate of all elements.
 - 2. For each room containing major electrical switchgear and each outside equipment area with major electrical switchgear and other equipment also include NEC working space, NEC equipment space, and NEC access to NEC working space, and housekeeping pad location and dimensions.
 - 3. Prepare coordination drawings to coordinate installations for efficient use of available space allowing for future additional equipment wherever possible, for proper sequence of installation, and to resolve conflicts. Coordinate with work specified in other sections and other divisions of the specifications.
 - 4. Identify field dimensions. Show relation to adjacent or critical features of work or products.

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- B. Submit composite coordination shop drawings in plan, elevation and sections, showing receptacles, outlets, electrical and telecommunication devices in casework, cabinetwork and built-in furniture.
 - 1. Verify location of wiring devices and outlets, communication devices and outlets, safety and security devices, and other work specified in this Division.
 - 2. Coordinate with drawing details, site conditions, composite coordination drawings, and millwork other equipment shop drawings prior to installation.
 - 3. Submit coordination and shop drawings prior to rough-in and fabrication.

3.3 EQUIPMENT SHOP DRAWINGS AND PRODUCT DATA

- A. Submittals shall not be combined or bound together with any other material submittal. Do not submit entire product catalogs, submit only specific data sheets indicating required product information and available product options or accessories.
- B. Submittal Specification Information:
 - 1. Every submittal document shall bear the following information as used in the project manual:
 - a. The related specification section number
 - b. The exact specification section title
 - c. Additional identifiers as required in Division 01.
 - 2. Submittals delivered to the Architect / Engineer without the specified information will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been submitted or delivered.
- C. All product options specified shall be clearly indicated on the product data submittal. All options listed on the standard product printed data not clearly identified as either part of or not part of the product data submitted shall become part of the Contract and shall be assumed to be provided with the product submitted.
- D. Mark each copy of standard manufacture's printed data to identify pertinent products, referenced to specification section and article number.
- E. Show reference standards, performance characteristics and capacities; wiring diagrams and controls; component parts; finishes; dimensions and required clearances.
- F. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete or strike through information not applicable.
- G. Submit drawings in a clear and thorough manner. Identify details by reference to sheet and detail, schedule, or room numbers shown on Contract Drawings.
- H. Show all dimensions of each item of equipment in its to be installed assembled condition with all components assembled. Include a series of drawings of individual components as necessary for reference.
- I. Identify field dimensions; show relation to adjacent or critical features or work or products.
- J. Submit individually bound shop drawings and product data for the following when specified or provided.

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- K. The Fault Current and Overcurrent Device Coordination Analysis shall be submitted prior to other electrical switchgear dependent on the results of the study for specific product selection by the vendor or contractor for compliance with the study.
1. The emergency life safety power system equipment shall be fully coordinated as required by the NEC.
 2. The AIC and WCR ratings of all products meet or exceed the available fault current at that equipment's location.
 3. Electrical systems other than life safety power systems shall be coordinated as much as practicable while reducing arc flash energy as much as practical.
- L. Required submittals when products are indicated or specified:
1. Fault Current and Overcurrent Device Coordination Analysis. Submit this analysis at a minimum of three (3) weeks prior to any overcurrent device submittal to allow review for modifications to overcurrent device product selection submittal based on the manufacture's analysis and recommendations. Manufacture's recommendations for code compliance equipment fault tolerance are a project requirement and shall be provided at no additional cost to the Owner. Manufacture's recommendations for arc flash reduction that result in no additional cost to the Owner shall be provided. Manufacture's recommendations for arc flash reduction which would result in additional cost to the Owner are considered recommendations only and will be reviewed by the Engineer during the submittal review and may or may not result in changes to the specified or submitted equipment.
 2. Enclosed Switches, non-fused, fused, or circuit breaker
 3. Panelboards
 4. Load centers
 5. Wiring devices
 6. Lighting fixtures
 7. Lighting Controls
 8. Surge Protection Devices
 9. Transformers
 10. Electrical Contactors
 11. Enclosed Motor Controllers
 12. Site Lighting Photometrics, Poles, and Fixtures
 13. Switchboards, including renewal components for existing switchboards, and Dwelling Unit Meter Centers.
 14. Elevator Power Module fused switches.
 15. Fuses
 16. Recessed floor boxes and fittings
 17. Metering equipment for building management energy monitoring, usage, IECC compliance
 18. Modular metering equipment for multi-tenant utility electrical services
 19. Emergency/Standby generators
 20. Automatic transfer switches
 21. Manual transfer switches with or without integral generator docking stations
 22. Remote generator docking stations
 23. Emergency lighting inverters
 24. Theatrical Lighting Systems
 25. Architectural Dimming Systems
 26. Electrical cable trays
 27. Sports Lighting Equipment, Photometrics, Fixtures, and Poles
 28. Surface Raceways
 29. Electrical controls and time switches

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- 30. Motor control centers, including renewal components for existing motor control centers
- 31. Busway
- 32. Uninterrupted Power Supply systems
- 33. Power quality improvement filters or capacitors
- 34. Lightning protection system
- 35. Fire Rated Cables and Connectors
- 36. Low Voltage Switchgear
- 37. Medium Voltage Cable and Connectors
- 38. Medium Voltage Switchgear
- 39. Conduits
- 40. Conductors and Connectors

3.4 MANUFACTURERS INSTRUCTIONS

- A. Submit Manufacturer's instructions for storage, preparation, assembly, installation, start-up, adjusting, calibrating, balancing and finishing.

3.5 CONTRACTOR RESPONSIBILITIES

- A. Review, make corrections or annotations for clarification of manufacturer supplied data, stamp and sign submittals prior to transmittal.
- B. Determine and verify:
 - 1. Field measurements
 - 2. Field construction criteria
 - 3. Manufacturer's catalog numbers
 - 4. Conformance with the Contract Documents
- C. Coordinate submittals with requirements of the work and of the Contract Documents.
- D. Notify the Architect / Engineer in writing at time of submission of any deviations in the submittals from requirements of the Contract Documents.
- E. Do not fabricate products, or begin work for which submittals are required, until such submittals have been produced and bear contractor's stamp of acceptance or approval. Do not fabricate products or begin work until return of reviewed submittals with Architect / Engineer's acceptance.
- F. Contractor's responsibility for errors, omissions, or un-approved substitutions in submittals is not relieved whether Architect / Engineer reviews submittals or not.
- G. Contractor's responsibility for deviations in submittals from requirements of Contract Documents is not relieved whether Architect / Engineer reviews submittals or not, unless Architect / Engineer gives written acceptance of the specific deviations identified by the Contractor on reviewed documents.
- H. Submittals shall show sufficient data to indicate complete compliance with Contract Documents:
 - 1. Proper sizes and capacities
 - 2. That the item will fit in the available space in a manner that will allow proper service; manufacturers and code required clearances.
 - 3. Construction methods, materials and finishes

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- I. Schedule submissions at least 15 days before date reviewed submittals will be needed by the Contractor for processing or for making corrections for re-submittal.
- J. General and Electrical Contractor's Stamp of Approval
 - 1. The general contractor and the electrical contractor shall stamp and sign each document certifying to the review of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the work and of Contract Documents.
 - 2. Contractor's stamp of approval on any submittal shall constitute a representation to Owner and Architect / Engineer that Contractor has either determined and verified all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data or assumes full responsibility for doing so, and that Contractor has reviewed or coordinated each submittal with the requirements of the work and the Contract Documents.
 - 3. Do not deliver any submittals to the Architect / Engineer that do not bear the Contractor's stamp of approval and signature.
 - 4. Submittals delivered to the Architect / Engineer without Contractor's stamp of approval and signature will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

3.6 SUBMISSION REQUIREMENTS

- A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the Project or in the work of any other Contractor. Product and equipment related to site work or other trades which require extensive rough-in, foundations, or structural support shall be submitted as soon as possible after given notice to proceed with construction.
- B. Number of submittals required:
 - 1. Coordination Drawings: Submit one electronic data file (pdf) and three opaque reproductions or coordination drawings.
 - 2. Product Data: Submit electronic data PDF files. Refer to Division 01 for specific requirements. PDF files that are 20MB or larger may indicate that a submittal includes information not specifically relevant to the specific product being provided, information not required for the review of the specific product such as a complete product catalog or catalog section. Contractor shall include only the product data required to review the specific products characteristics for compliance with the contract documents.
- C. Accompany submittals with transmittal letter containing:
 - 1. Date
 - 2. Project title and number
 - 3. Contractor's name, address and contact information.
 - 4. The number of each Shop Drawing, Project Datum and Sample submitted
 - 5. Other pertinent data as required in Division 01.
- D. Submittals shall include:
 - 1. The date of submission
 - 2. The project title and number
 - 3. Contract Identification

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4. The names of:
 - a. Contractor
 - b. Subcontractor
 - c. Supplier
 - d. Manufacturer
 5. Identification of the product
 6. Field dimensions, clearly identified as such
 7. Relation to adjacent or critical features of the work or materials
 8. Applicable standards
 9. Identification of deviations from contract documents
 10. Suitable blank space for General Contractor and Architect / Engineer stamps
 11. Contractor's signed and dated Stamp of Approval.
- E. Coordinate submittals into logical groupings to facilitate interrelation of the several items.
1. Finishes which involve Architect / Engineer selection of colors, textures or patterns
 2. Associated items requiring correlation for efficient function or for installation

3.7 RESUBMISSION REQUIREMENTS

- A. Make resubmittals under procedures specified for initial submittals. Re-submittals shall be a complete submittal as if it were the initial submittal unless otherwise instructed in the review comments on the original submittal.
1. Indicate that the document or sample is a resubmittal
 2. Identify changes made since previous submittals
- B. Indicate any additional changes which have been made by the contractor other than those requested by the Architect / Engineer.

END OF SECTION

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SECTION 260519

CONDUCTORS AND CONNECTORS – 600 VOLT

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide electrical conductors, wire and connector work as shown, and specified.
- B. Types: The types of conductors and connectors required for the project include the following:
 - 1. 600V building conductors
 - 2. 600V building conductor connectors
 - 3. 600V 2-hour fire rated power cable
- C. Application: The applications for conductors and connectors required on the project are as follows:
 - 1. Power distribution circuitry
 - 2. Lighting branch circuitry
 - 3. Appliance, receptacle, and equipment branch circuitry
 - 4. Motor branch circuitry
 - 5. Control wiring
 - 6. Line voltage
- D. Refer to other specific specification sections for voice, video, data, alarm and instrumentation cables.

1.2 QUALITY ASSURANCE

- A. UL Label: Conductors and connectors shall be UL labeled.

1.3 REFERENCES

- A. Refer to other specific specification sections regarding specialized wiring and connections.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CONNECTORS

- A. General: Except as indicated, provide conductors and connectors of manufacturer's standard materials, as indicated by published product information, designed and constructed as instructed by the manufacturer, and as required for the installation.
- B. Conductors: Provide factory-fabricated conductors of the size, rating, material, and type as indicated for each use. Conductors shall be soft or annealed copper wires meeting, before stranding, the requirements of ASTM B 3, Standard Specification for Soft or Annealed Copper Wire for Electrical Purposes, latest edition.
 - 1. Conductors for control wiring sized #14 AWG through #10 AWG shall be stranded.
 - 2. Conductors for power and lighting shall be stranded. Stranding shall be Class B meeting the requirements of ASTM B 8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium Hard, or Soft.

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3. Where authorized in writing by the Owner and Architect and not prohibited by local codes or the Authority Having Jurisdiction (AHJ), aluminum alloy compact stranded conductors may be substituted at Contractor's discretion in AWG sizes 3/0 through 750 kcmil (150-358 Amps) for service entrance conductors and feeders exceeding 25-feet in length. Aluminum alloy conductors shall not be used for grounding or for branch circuits or any equipment terminations. Aluminum alloy conductor size shall meet or exceed the equivalent ampacity for the specified copper conductor using 75 C ampacities for both types of conductors.
- C. Insulation for standard building conductors: Insulation shall meet or exceed the requirements of UL 83, Standard for Thermoplastic Insulated Wires.
 1. All wiring inside lighting fixtures shall be temperature rated per NEC.
 2. Insulation for copper conductors shall be UL Type THHN/THWN, 90 degrees C.
 3. Insulation for aluminum conductors shall be UL Type XHHW-2, 90 degrees C.
- D. Insulation for 2-hour fire rated power cables: Insulation shall meet or exceed the requirements of UL 2196 Fire Test for Electrical Circuit Protection Systems, and UL 44, Standards for Fire Resistive Cable.
 1. Insulation for conductors shall be UL Type RHH/RHW, 75 degrees C for wet locations and 90 degrees C for dry locations.
 2. Electrical Circuit Protective Systems (FHIT) – System 27 of the UL Fire Resistance Directory
- E. Cable Lubricant: Fire resistant, nonflammable, water based type for standard building conductors. Provide cable lubricants for fire rated cables as recommended by the cable manufacturer.

2.2 COLOR CODES FOR CONDUCTORS FOR BRANCH CIRCUITS AND FEEDERS

- A. Color coding for conductors as required by NEC 210.5. Color coding for phase and voltage shall be as required by local codes and local standards. Where such standards do not exist, color coding shall be as follows:

Color Code Table	USE CONTINUOUS COLOR-CODED INSULATION THROUGHOUT					
System/Phase	A	B	C	N	G	IG
120/208 3 Ph	Black	Red	Blue	White	Green	Green/Yellow Stripe
120/240 3 Ph	Black	Orange	Blue	White	Green	Green/Yellow Stripe
120/240 1 Ph	Black	N/A	Blue			
277/480	Brown	Purple	Yellow	Gray	Green	Green/Yellow Stripe

Notes to Color Code Table:

1. 120/208, 120/240, and 277/480 Volt Systems shall be routed in separate raceways.
2. Switched legs of phase conductors for lighting and appliance branch circuits shall be of the same color as described above throughout the entire circuit.
3. Conductors shall be the same color from breaker to device or outlet.

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PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install electrical conductors and connectors as shown, in accordance with the manufacturer's written instructions, the requirements of NEC, the NECA Standard of Installation, and industry practices.
- B. Coordination: Coordinate conductor installation work with electrical raceway and equipment installation work, as necessary for interface.
- C. Conductors:
 - 1. Provide a grounded (neutral) conductor for each branch circuit. Do not share grounded (neutral) conductors.
 - 2. No more than six phase conductors shall be installed in a single raceway. Any combination of phase conductors and grounded (neutral) conductors in any raceway shall not exceed nine.
 - 3. When any combination of four or more phase and grounded (neutral) conductors are installed in a raceway, the minimum size for all conductors including equipment ground conductor shall be #10 AWG, and they shall be de-rated accordingly.
 - 4. When more than four (4) conductors are size #10 AWG, they shall be installed in a one-inch conduit.
 - 5. Pull conductors together when more than one is being installed in a raceway. Whenever possible, pull conductors into their respective conduits by hand. Use pulling lubricant when necessary.
 - 6. Before any conductor is pulled into any conduit, thoroughly swab the conduit to remove foreign material and to permit the wire to be pulled into a clean, dry conduit.
 - 7. Run feeders their entire length in continuous section without joints or splices.
 - 8. No wire smaller than #12 AWG shall be permitted for any lighting or power circuit. No wire smaller than #14 AWG shall be used for any control circuit, unless shown otherwise.
 - 9. Provide the same size wire from the panelboard to last outlet on circuit. For 20 amp branch circuits operating at 150V or less, provide #10 AWG wire when the first outlet is over 75-feet from the panelboard. For branch circuits operating at 150 to 600 volts, provide #10 AWG wire when the first outlet is over 150-feet from the panelboard.
 - 10. Branch circuit voltage drop shall not exceed 3% of rated voltage.
 - a. Total voltage drop from the point of service to the last outlet or utilization equipment of the same voltage shall not exceed five percent of rated voltage.
 - b. Total voltage drop from the point of service to transformers with adjustable taps, buck-boost transformers, uninterruptable power supplies (UPS), or voltage regulators shall not exceed five-percent of rated voltage.
 - c. Total voltage drop from a separately derived system, transformer with adjustable taps, buck-boost transformer, uninterruptable power supply (UPS), or voltage regulator to the last outlet or utilization equipment of the same voltage shall not exceed five-percent of rated voltage.
 - d. Total voltage drop from the point of service to distribution equipment of the same voltage shall not exceed two-percent of rated voltage.
 - e. Branch circuit voltage drop from distribution equipment to the last outlet or utilization equipment shall not exceed three-percent of rated voltage.

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- f. Provide the same size branch circuit conductors to last outlet on circuit unless specifically noted or indicated otherwise on the drawings. For 20 amp branch circuits operating at 150-Volts or less, provide #10 AWG wire when the first outlet is over 75-feet from the panelboard. For branch circuits operating above 150-Volts to 600-Volts, provide #10 AWG wire when the first outlet is over 150-feet from the panelboard.
- 11. No tap or splice shall be made in any conductor except in outlet boxes, pull boxes, junction boxes, splice boxes, or other accessible locations. Make taps and splices using an approved compression connector. Insulate taps and splices equal to the adjoining conductor. Make splices or taps only on conductors that are a component part of a single circuit, protected by approved methods. Taps or splices in feed through branch circuits for connection to light switches or receptacles shall be made by pigtail connection to the device.
- 12. Support conductors in vertical raceways, as required by the NEC.
- 13. Do not permit conductors entering or leaving a junction or pull box to deflect to create pressure on the conductor insulation.
- 14. Make joints in branch circuits only where circuits divide. These shall consist of one through circuit to which the branch from the circuit shall be spliced.
- 15. Make connections in conductors up to a maximum of one #6 AWG wire with two #8 AWG wires using twist-on pressure connectors of required size.
- 16. Make connections in conductors or combinations of conductors larger than specified using cable fittings of type and size required for specific duty.
- 17. After a splice is made, insulate entire assembly with UL-approved insulating tape to a value equivalent to the adjacent insulation.
- 18. Make splices and connections in control circuit conductors using UL-approved solderless crimp connectors.
- 19. All conduits shall be installed with an insulated grounding conductor per NEC 250.122. Where green conductor insulation is not available, the ground conductor shall be identified with green phasing tape at all accessible locations.
- 20. Neatly train and lace wiring inside boxes, equipment and panelboards. Provide tie-straps around conductors with their shared neutral conductor where there are more than two neutral conductors in a conduit.
- 21. Clean conductor surfaces before installing lugs and connectors.
- 22. Make splices, taps and terminations to carry full ampacity of conductors with no perceptible temperature rise.
- 23. Provide stranded conductors connected with pressure type connectors / compression fittings and terminal lugs UL listed for the type of conductor used (AL-CU) and correctly sized to the diameter of the bare conductors.
- 24. Run mains and feeders their entire length in continuous pieces without splices or joints.
- 25. Color code conductors.
- 26. Do not install a pull string in conduits containing conductors.
- 27. Conductors shall be the same color from load side of overcurrent protection device to outlet or utilization equipment.
- 28. Spare conductors shall not be installed in any conduit, gutter, raceway, panel or enclosure unless noted otherwise.
- 29. Two-hour fire rated power cable shall be installed per manufacturer's installation instructions in compliance with UL Fire Resistance Directory, Electrical Circuit Protective Systems (FHIT), and System 27.

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30. Two-hour fire rated power cable shall be installed in steel EMT or steel rigid conduit with steel set screw or threaded fittings. UL listed flexible metallic steel conduit may be used in lengths not to exceed 6-feet. Support conduit every 5-feet on concrete or masonry walls or a concrete floor-ceiling assembly. The fire rating of the wall or floor-ceiling assembly must be equal to or greater than the rating of the electrical circuit protective system. Provide j-box at each end of the fire rated cable in the fire rated room to allow splice to standard building cable to the equipment. Provide sealant to the end of the raceway to prevent gases from migrating from the fire rated cable down into the equipment.
- D. Identification: Label each phase conductor in each junction box with corresponding circuit number, using self-adhesive wire markers.
- E. Splices and Joints:
1. In accordance with UL 486A, C, D, E, and NEC.
 2. Aboveground Circuits (No. 10 AWG and smaller):
 - a. Connectors: Solderless, screw-on, reusable pressure cable type, rated 600 V, 220° F, with integral insulation, approved for copper and aluminum conductors.
 - b. The integral insulator shall have a skirt to completely cover the stripped wires.
 - c. The number, size, and combination of conductors, as listed on the manufacturers' packaging, shall be strictly followed.
- F. Aboveground Circuits (No. 8 AWG and larger):
1. Connectors shall be indent, hex screw, or bolt clamp type of high conductivity and corrosion resistant material, listed for use with copper and aluminum conductors.
 2. Provide field-installed compression connectors for cable sizes 250 kcmil and larger with not less than two clamping elements or compression indents per wire.
 3. Insulate splices and joints with materials approved for the particular use, location, voltage, and temperature. Splice and joint insulation level shall be not less than the insulation level of the conductors being joined.
 4. Plastic electrical insulating tape: Per ASTM D2304, flame-retardant, cold and weather resistant.
- G. Underground Branch Circuits and Feeders:
1. Submersible connectors in accordance with UL 486D, rated 600 V, 190°F, with integral insulation.

3.2 TESTING

- A. Pre-Energization Check: Before energizing, check cable and conductors for circuit continuity and short circuits. Correct malfunctions.
- B. Service Entrance and Feeder Insulation Resistance Test: Each main service entrance conductor and each feeder conductor shall have its insulation resistance tested after the installation is complete except for connection at its source and point of termination. Testing shall be performed by qualified technicians who have been trained in testing procedures and in the use of all test equipment.
1. Make tests using a Biddle Megger or equivalent test instrument at a voltage of not less than 1000 VDC; measure resistance from conductor to conductor, conductor to neutral (if present) and from conductor to ground. Insulation resistance shall not be less than the following:

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Wire Size (AWG)	Insulation Resistance (Ohms)
#8	250 K
#6 through #2	100 K
#1 through #4/0	50 K
Larger than #4/0	25 K

2. Conductors that do not meet or exceed the insulation resistance values listed above shall be removed, replaced, and retested.
- C. Submittals: Contractor shall furnish instruments and personnel required for tests. Submit 4 copies of certified test results to Architect for review. Test reports shall include conductor tested, date and time of test, relative humidity, temperature, and weather conditions.
- D. Voltage and Current Values: The voltage and current in each conductor shall be measured and recorded after connections have been made and the conductor is under load.

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SAMPLE DC HIGH VOLTAGE CABLE TEST REPORT
(Specification Paragraph 3.2, C)

Date _____

Contract and Work Location: _____

Contract (Project) No.: _____

Circuit Identification: _____
(Dwg., Title, Number and Ckt. Number)

Test Equipment: _____

(Make, Model, Serial No., Etc.)

Applied Test Voltage _____

Normal Oper. Voltage _____

Cable Installation: New _____ Used _____
(Date) (No. Years)

Cable Size _____ AWG

Cable Length _____ Ft.

Cable Material _____ Cu _____ Al

Temperature _____ Humidity _____

TEST DATA - RESISTANCE IN KILO OHMS

CONDUCTO PER PHASE	A-N	B-N	C-N	A-G	B-G	C-G	A-B	B-C	A-C

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SECTION 260526

ELECTRICAL GROUNDING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Grounding shall conform to the requirements of:
 - 1. National Electrical Code.
 - 2. Governing local codes.
 - 3. All Local Utility Companies
- B. Ground effectively and permanently.
 - 1. Neutral conductor at the main service disconnect and other separately derived systems.
 - 2. All conduit systems.
 - 3. All electrical equipment and related current carrying supports or structures.
 - 4. All metal piping systems.
 - 5. All building structural metal frames.
 - 6. All telephone/voice/video/CATV/data utilities

1.2 REFERENCE STANDARDS

- A. ANSI/IEEE Standard 142 - "Recommended Practice for Grounding of Industrial and Commercial Power Systems."
- B. ANSI/UL 467 - "Safety Standard for Grounding and Bonding Equipment."
- C. Article 250 of the NEC (NFPA 70) for grounding.
- D. NECA – Standard of Installation
- E. NETA ATS – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems
- F. EIA / TIA 607

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Copperweld
- B. nVent ERICO
- C. Burndy
- D. O. Z Gedney
- E. Eaton

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2.2 GROUNDING ELECTRODES

- A. Driven Rod Electrode
 1. 3/4" x 10'-0" copper clad grounding electrode.
 2. UL listed.
 3. Approved thermal fusion connector methods (exothermic).
- B. Metal frame of building or enclosure.
- C. Foundation concrete encased rebar.

2.3 DATA / VOICE COMMUNICATIONS CLOSET GROUND BAR

- A. MDF closets/head end rooms: Erico Cadweld #B544A028 ground bar with 7/16-inch holes.
- B. IDF closets, Erico Cadweld #B542A004 ground bar with 7/16-inch holes.
- C. Heavy-duty, two bolt type, copper alloy or bronze for grounding and bonding applications, in configurations required for particular installation.

2.4 EXOTHERMIC CONNECTIONS

- A. Exothermic type for underground and structural steel; Cadweld
- B. Exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.

2.5 WIRE

- A. Stranded, copper cable
- B. Foundation Electrodes: 4/0 AWG
- C. Grounding Electrode Conductor: Size to meet NFPA 70 requirements

PART 3 - EXECUTION

3.1 GROUNDING AND BONDING

- A. In the service equipment, provide a separate (dedicated) ground bus.
 1. Bond the ground bus with copper bus bar or cable, of equal or greater current carrying capacity of the service grounding conductor, to the neutral bar.
 2. Resistance of neutral to ground shall not exceed 10 Ohms.
 3. Connect the electric service grounding electrode conductors to the incoming metal water pipe system (when available, using a suitable ground clamp) and to a supplemental electrode such as a ground rod or ground ring.
 4. Provide grounding and bonding at the power company's metering equipment.
 5. Provide access and cover for access to the ground grid and removable connections for testing the system.

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- B. Connect the grounding electrode conductor between the ground bus and the grounding electrode system.
 - 1. In rigid PVC conduit.
 - 2. Provide thermo fusion connection for each rod ground electrode.
 - a. All rod electrodes shall be located outside the building in non-paved areas where available. Access cover top shall be flush with finish grade or floor.
 - b. Install rod electrodes as required. Install additional rod electrodes as required to achieve specified resistance to ground.
 - c. The minimum distance between driven ground rod electrodes shall be 10'.
 - 3. The total ground resistance shall not exceed 10 Ohms for service entrance grounds and 25 Ohms for equipment grounds.
 - a. Where this condition cannot be obtained with one electrode, install a longer electrode, deep-driven sectional electrodes, or additional grounding electrodes until the required ground resistance is obtained.
- C. Provide an insulated equipment grounding conductor inside all conduits, raceways, surface raceways, gutters and wireways. The ground wire shall be bonded to each box to suitable lug, bus, or bushing. All bonding jumpers shall be routed inside conduit or raceway.
- D. Provide an insulated isolated equipment grounding conductor in addition to the insulated equipment grounding conductor for all isolated grounding feeders, branch circuits, outlets and isolated grounding receptacles.
- E. Provide all conduit terminating in switchgear, transformers, switchboards, panelboards and voice/data outlets with grounding bushings, where required, and ground wire extended to ground bus in equipment. Install grounding bushings where reducing washers are used and concentric and eccentric knock-outs are used.
- F. Main bus and building grounding electrode conductor installation shall be witnessed by the Architect / Engineer.
- G. Provide bonding to meet Regulatory Requirements.
- H. Interface with lightning protection system when lightning protection system is specified.
- I. Locate and install anchors, fasteners, and supports in accordance with NECA "Standard of Installation".
- J. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
- K. Do not use spring steel clips and clamps.
- L. Do not use powder-actuated anchors.
- M. Do not drill or cut structural members.
- N. Do not use compression or mechanical connectors underground.
- O. Do not use sheetmetal or self-drilling screws for bonding connections. Provide listed or approved connectors.

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- P. Provide grounding access well for each driven ground electrode, not located in manholes or pull boxes.
 - 1. Access well top shall be flush with finish paved surfaces.
 - 2. Ground access wells located in non-paved areas shall be set two-inches above surrounding finished grade. Provide 12-inch wide by 8-inch deep reinforced concrete crown around neck or opening and sloped down away from pull box opening.
 - 3. Provide thermal fusion (exothermic) connectors approved for direct burial.

3.2 METAL FRAME OF BUILDING OR STRUCTURE

- A. Effectively ground the building steel or structure per NEC 250-52 (2).

3.3 UFER GROUND

- A. Provide a UFER ground at bottom of building slab per NEC 250.52 (3), bond to building steel.

3.4 MISCELLANEOUS REQUIREMENTS

- A. Continuity of the equipment grounding system shall be maintained throughout the project. Equipment grounding jumpers shall be installed across conduit expansion fittings, liquid-tight flexible metal and flexible metal conduit, and other non-electrically continuous raceway fittings.
- B. Equipment grounding conductors and grounding electrode conductor shall be stranded copper conductors and run in a suitable raceway. Grounding conductors and grounding electrode conductor shall be continuous, without joints or splices over their entire length, except as allowed by NFPA 70/NEC.
- C. For separately derived alternating current system grounds, bond the case and neutral of each transformer secondary winding directly to the nearest available effectively grounded structural metal member as required in NEC 250.
- D. Exterior Electrical Equipment Racks:
 - 1. Provide driven ground electrode.
- E. Technology/Data/Voice Communications, CATV, CCTV, and MATV Equipment Grounding: Provide grounding electrode conductor from the communications service equipment to the building grounding system as required. Grounding shall conform to ANSI/TIA/EIA 607(A) – Commercial Building Grounding and Bonding Requirements for Telecommunications, National Electrical Code®, ANSI/NECA/BICSI-568 and manufacturer's grounding requirements as minimum. Bonding shall be of low impedance to assure electrical continuity between bonded elements.
 - 1. MDF Closets Telecommunications Main Ground Bar (TMGB): Provide Erico #EGBA14424MM ground bar, wall mounted to the telecommunications plywood backboard. Provide one #3 AWG insulated ground conductor from ground bar to building steel. Provide #2/0 AWG insulated ground conductor to the building electrical service ground at the nearest electrical switchboard or panelboard.
 - 2. IDF Closets Telecommunications Ground Bar (TGB): Provide Erico #EGBA14410FF ground bar mounted to the telecommunications plywood backboard. Provide one #6 AWG insulated ground conductor from ground bar to building steel and to ground bus of nearest electrical panelboard or switchboard.
 - 3. Provide #2/0 AWG insulated ground conductor between each TMGB and all TGBs.
 - 4. Provide #2/0 AWG insulated ground conductor from TMGB to electrical service ground bus at main electrical service switch.

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5. Bond each equipment rack, cabinets, frames, together and with #6 AWG insulated ground conductor to the local TMGB / TGB. Bond and ground equipment racks, housings, messenger cables, raceways, and rack-mounted conduit.
 6. Route TMGB – TGB ground conductor using the shortest, straightest, route practical with long radius curves.
 7. All conduits terminating to cable trays, wireways, and racks shall be mechanically fastened. When connected to a cable tray or rack, it must be connected with ground bushings, wire bonded to the tray or rack, and grounded to the main building grounding system or IDF room grounding bar using #6 AWG copper.
- F. Ground lighting fixture bodies to the conduit grounding system.
- G. Bond receptacle ground to the box and conduit ground system, except where and insulated/isolated grounding receptacle or outlet is specified.
- H. Ground connections to building steel, grounding electrodes and all underground connections shall be by thermal fusion (exothermic).
- I. Provide OZ Type “BJ” bonding jumper at all expansion joints, points of electrical discontinuity or connections in conduit where firm mechanical bond is not possible, such as flexible connections, insulating couplings, etc.
- J. Ground each lighting and power panelboard by connecting the grounding conductors to the grounding stud.
- K. Ground each secondary dry-type transformer to the ground bus of the primary side panelboard. Provide a bonding jumper between the ground stud and the neutral. Ground transformer ground stud to ground ring if a ground ring is installed or the nearest structural steel member.
- L. Bond every item of equipment served by the electrical system to the building equipment ground system. This includes, but is not limited to, switchboards, panelboards, disconnect switches, receptacles, cable trays, controls, fans, air handling units, pumps and flexible duct connections.
- M. Ground each light pole, power distribution poles, and metal conduit stub-ups at each light pole base.
- N. Ground all metal conduit including metal conduit used for bends and penetrations through concrete.
- O. Bond hot water and cold water piping together at each domestic water heater.

3.5 MANHOLE AND/OR PULL BOX GROUNDING

- A. Provide a driven ground rod and ground bond ring in each power and telephone manhole or pull box. Bond cable racks and medium voltage cable shields at splices and terminations, ductbank conduit ground bushings and all other metal components in manholes or pull box to the ground ring.

3.6 COORDINATION

- A. General: Coordinate installation of grounding connections for equipment with equipment installation work.

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3.7 TESTING

- A. Ground Resistance Test: Perform a ground resistance test for comparison to future inspection and testing data by the Owner. Test shall be performed using a Biddle Megger Earth Tester or equivalent test instrument. The test shall not be performed within 48 hours after the last rainfall.
 - 1. Inspect and test in accordance with NETA ATS except Section 4
 - 2. Grounding and Bonding: Perform inspections and tests listed in NETA ATS, Section 7.13
- B. True Root Mean Square (RMS) AC measurements: The True RMS AC Measure test should be performed for all bonding conductors. The recommended maximum AC current value on any bonding conductor should be less than 1 ampere (A). The recommended maximum DC current value should be less than 500 milliamperes (mA). If abnormally high AC current levels are present on any bonding conductor, a dangerous faulty wiring condition likely exists within the room.
- C. Two-Point Bonding Measurements: The Two-point Bonding test should be performed for all bonding conductors. This test should be performed using an earth grounding resistance tester configured for a continuity test. The test is performed by connecting the meter leads between the nearest available grounding electrode (e.g., structural steel) and the TMGB or TGB. The recommended maximum value for the bonding resistance between these two points is 0.1 Ohms (100 milliohms).
- D. Submittals: Furnish instruments and personnel required for tests. Personnel shall be trained in all aspects of testing grounding systems and shall be formally trained on using all test equipment required. Submit 2 copies of certified test results for Owner's record and submit 4 copies of certified test results to Architect / Engineer for review. Test reports shall include date and time of tests, relative humidity, temperature, and weather conditions.
- E. Notify Owner's Commissioning Authority (CxA) prior to performing any tests to the CxA may witness tests at his/her discretion. Refer to Section 26 01 00 Commissioning of Electrical Systems.

END OF SECTION

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SECTION 260527

EXPANSION OF EXISTING ELECTRICAL GROUNDING SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Grounding shall conform to the requirements of:
 - 1. National Electrical Code
 - 2. Governing local codes
 - 3. Local Utility Company
- B. Ground effectively and permanently.
 - 1. Verify existing neutral conductor bonding at the main service disconnect and at other new/relocated or reused separately derived systems.
 - 2. All new/relocated conduit or cable tray systems and busway
 - 3. All new/relocated electrical equipment and related current carrying supports or structures
 - 4. All new / relocated metal piping systems
 - 5. All new building structural metal frames

1.2 REFERENCE STANDARDS

- A. ANSI/IEEE Standard 142 - "Recommended Practice for Grounding of Industrial and Commercial Power Systems."
- B. ANSI/UL 467 - "Safety Standard for Grounding and Bonding Equipment."
- C. Article 250 of the NEC (NFPA 70) for grounding.
- D. NECA – Standard of Installation
- E. NETA ATS – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems
- F. EIA / TIA 607

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Copperweld
- B. nVent ERICO
- C. Burndy
- D. O.Z. Gedney
- E. Eaton

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2.2 GROUNDING ELECTRODES

- A. Driven Rod Electrode
 - 1. 3/4" x 10'-0" copper clad grounding electrode, UL listed
 - 2. UL listed grounding electrode connector
 - 3. Approved thermal fusion methods (exothermic)
- B. Metal Frame of Building
- C. Existing grounding electrode system

2.3 DRIVEN ELECTRODE ACCESS BOX AND COVER

- A. Hubbell Tier 22 FRP 20-inch round bolt down cover with "GROUND" embossed on top.

2.4 MATERIALS AND COMPONENTS

- A. Reference other sections of this specifications for materials specified there.
- B. Heavy-duty, copper, two bolt type, copper alloy or bronze compression lugs for grounding and bonding applications, in configurations required for particular installation.

PART 3 - EXECUTION

3.1 SYSTEMS 600 VOLTS OR LESS

- A. In the existing service equipment, field verify existing condition of ground bus.
 - 1. Field verify existing bond of the ground bus to the existing service grounding conductor, to the neutral bar.
 - 2. Tighten existing ground lugs and connections.
- B. Connect the grounding electrode conductor between the ground bus and the grounding electrode system.
 - 1. In rigid PVC conduit.
 - 2. Provide thermo fusion connection for each rod ground electrode.
 - a. All rod electrodes shall be located outside the building in non-paved areas where available. Access cover top shall be flush with finish grade or floor.
 - b. Install rod electrodes as indicated. Install additional rod electrodes as required to achieve specified resistance to ground.
 - c. The minimum distance between driven ground rod electrodes shall be 10'.
 - 3. The total ground resistance shall not exceed 10 Ohms for service entrance grounds and for equipment grounds.
 - a. Where this condition cannot be obtained with one electrode, install a longer electrode, deep-driven sectional electrodes, or additional grounding electrodes until the required ground resistance is obtained.
 - b. Refer to drawings for project specific ground resistance requirements.
- C. Field verify the grounding electrode conductor between the ground bus and the grounding electrode systems are in compliance with the NEC.
- D. Provide an insulated grounding conductor inside all new conduits, raceways, surface raceways and cables used for power distribution. The ground wire shall be bonded to each box. All bonding jumpers shall be routed inside conduit or raceway.

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- E. Provide an insulated, isolated equipment grounding conductor in addition to the insulated equipment grounding conductor for all isolated grounding feeders, branch circuits, outlets and receptacles.
- F. Provide all new/relocated conduits terminating in switchgear, transformers, switchboards, and panelboards with grounding bushings, where required and ground wire extended to ground bus in equipment.
- G. Where modifications to the main service disconnect are required, main bus and building grounding electrode conductor installation shall be witnessed by the Architect / Engineer.
- H. Interface with lightning protection system when lightning protection system is specified.
- I. Locate and install anchors, fasteners, and supports in accordance with NECA "Standard of Installation".
- J. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
- K. Do not use spring steel clips and clamps.
- L. Do not use powder-actuated anchors.
- M. Do not drill or cut structural members.
- N. Do not use compression or mechanical connectors underground.

3.2 MISCELLANEOUS REQUIREMENTS

- A. Continuity of the building equipment grounding system shall be maintained throughout the project. Grounding jumpers shall be inside conduit, fittings and boxes and shall be installed across conduit expansion fittings, liquid-tight flexible metal and flexible metal conduit, light fixture pigtails in excess of 6', and other non-electrically continuous raceway fittings.
- B. Grounding conductors and grounding electrode conductor shall be stranded copper conductors and run in a suitable PVC raceway. Grounding conductors and grounding electrode conductor shall be continuous, without joints or splices over their entire length, except as allowed by NFPA 70/NEC.
- C. For separately derived alternating current system grounds, bond the case and neutral of each transformer secondary winding directly to the nearest available effectively grounded structural metal member as required in NEC 250.
- D. Technology/Data/Voice Communications, CATV, CCTV, and MATV Equipment Grounding: Provide grounding electrode conductor from the communications service equipment to the building grounding system as required. Provide #6 ground conductor from telephone/voice/CATV/data company demarcation point to building electrical service entrance ground electrode connection and as required by all local utility companies.
 - 1. New MDF Closets Telecommunications Main Ground Bar (TMGB): Provide Erico Cadweld #B544A028 ground bar with 7/16-inch holes, wall mounted to the telecommunications plywood backboard. Provide one #3 AWG insulated ground conductor from ground bar to building steel. Provide #2/0 AWG insulated ground conductor to the building electrical service ground at the main electrical service disconnect.

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2. New IDF Closets Telecommunications Ground Bar (TGB): Provide Erico Cadweld #B542A004 ground bar with 7/16-inch holes, mounted to the telecommunications plywood backboard. Provide one #6 AWG insulated ground conductor from ground bar to building steel.
 3. Provide #2/0 AWG insulated ground conductor between each TMGB and all TGBs.
 4. Provide #2/0 AWG insulated ground conductor from TMGB to electrical service ground bus at main electrical service switch.
 5. Bond each equipment rack with #6 AWG insulated ground conductor to the TMGB / TGB.
 6. Route TMGB – TGB ground conductor using the shortest route practical with long radius curves.
- E. Ground new and removed/replaced lighting fixture bodies to the conduit grounding system.
- F. Receptacles: Provide a ground wire bonded to the conduit ground system, except where and insulated isolated grounding receptacle is specified.
- G. Motor Frames: Ground the frame of each motor with a properly sized separate ground wire around flexible conduit.
- H. Provide grounding access well for each driven ground electrode, not located in manholes or pull boxes.
1. Access well top shall be flush with finish paved surfaces.
 2. Ground access wells located in non-paved areas shall be set two-inches above surrounding finished grade. Provide 12-inch wide by 8-inch deep reinforced concrete crown around neck or opening and sloped down away from pull box opening.
 3. Provide thermal fusion (exothermic) connectors approved for direct burial.
- I. Ground all light poles and all exterior metal structures supporting conduit, switchgear, or light fixtures.
- J. Exterior Electrical Equipment Racks:
1. Provide driven ground electrode for racks mounted remote from building structure.
 2. Where mounted on roof, ground to be building structural steel.
- K. Ground connections to building steel, grounding electrodes and all underground connections shall be by thermal fusion (exothermic).
- L. Transformers: Provide driven ground electrode and building steel electrode at each transformer.
- M. Bond hot water and cold water piping together at each domestic water heater.

3.3 COORDINATION

- A. General: Coordinate installation of grounding connections for equipment with equipment installation work.

3.4 TESTING

- A. Ground Resistance Test: Perform a ground resistance test for comparison to future inspection and testing data by the Owner. Test shall be performed using a Biddle Megger Earth Tester or equivalent test instrument. The test shall not be performed within 48 hours after the last rainfall.

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1. Inspect and test in accordance with NETA ATS except Section 4
 2. Grounding and Bonding: Perform inspections and tests listed in NETA ATS, Section 7.13
- B. The Root Mean Square (RMS) AC measurements: The True RMS AC Measure test should be performed for all bonding conductors. The recommended maximum AC current value on any bonding conductor should be less than 1 ampere (A). The recommended maximum DC current value should be less than 500 milliamperes (mA). If abnormally high AC current levels are present on any bonding conductor, a dangerous faulty wiring condition likely exists within the room.
- C. Two-Point Bonding Measurements: The two-Point Bonding test shall be performed for all bonding conductors. This test should be performed using an earth grounding resistance tester configured for a continuity test. The test is performed by connecting the meter leads between the nearest available grounding electrode (e.g., structural steel) and the TMGB or TGB. The recommended maximum value for the bonding resistance between these two points is 0.1 ohms (100 milliohms).
- D. Submittals: Furnish instruments and personnel required for tests. Personnel shall be trained in all aspects of testing grounding systems and shall be formally trained on using all test equipment required. Submit 2 copies of certified test results for Owner's record and submit 4 copies of certified test results to Architect / Engineer for review. Test reports shall include date and time of tests, relative humidity, temperature, and weather conditions.

END OF SECTION

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SECTION 260533

CONDUIT SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install a complete system of electrical conduits and fittings.

1.2 REFERENCE STANDARDS

- A. National Electrical Code
B. Local codes and ordinances
C. UL
D. ETL

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS – Provide products manufactured in the USA

- A. Raceways:
1. Allied, International Metal Hose, Ipex, Heritage Plastics, Wheatland, Can-Tex, Carlon, Certain-Teed, Anamet, Inc., Electri-Flex Co., Western Tube and Conduit, Sentinel Conduit
 2. PVC Coated RGC: Robroy Perma Cote or Plasti-Bond, – no exceptions
 3. Stainless Steel: Robroy Calbrite, Gibson
 4. Aluminum: Penn Aluminum, American Conduit, Wheatland, Eaton B-Line, Patriot Aluminum Products
 5. Reinforced Thermosetting Resin Conduit (RTRC): FRE Composites, Champion Fiberglass, United Fiberglass
- B. Fittings:
1. Appleton, Crouse Hinds, Topaz, Steel City, O.Z. Gedney, Carlon, Heritage Plastics, Raco, Ipex, International Metal Hose, Lew Electric Fittings Co.
 2. PVC Coated ferrous fittings: Robroy Perma-cote or Plasti-Bond, – no exceptions
 3. Stainless Steel: Robroy, Calbrite, Gibson, Crouse Hinds
 4. Aluminum: Penn Aluminum, American Conduit, Wheatland, Eaton B-Line, Patriot Aluminum Products
 5. Reinforced Thermosetting Resin Conduit (RTRC): FRE Composites, Champion Fiberglass
- C. Condulets and Conduit Bodies:
1. Appleton, Form 85
 2. PVC Coated: Robroy Perma-cote or Plasti-Bond, – no exceptions
 3. Stainless Steel: Robroy, Calbrite, Gibson, Crouse Hinds
 4. Reinforced Thermosetting Resin Conduit (RTRC): FRE Composites, Champion Fiberglass

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- D. Steel MC Cable for light fixture whips:
 - 1. AFC
 - 2. Southwire
 - 3. General Cable
 - 4. Kaf-Tech

2.2 GENERAL

- A. The minimum conduit size shall be $\frac{3}{4}$ -inch unless indicated otherwise in Divisions 26, 27 or 28.
 - 1. Branch Circuits: Minimum conduit size shall be $\frac{3}{4}$ -inch.
 - 2. Feeder Circuits: Minimum conduit size shall be $\frac{3}{4}$ -inch.
 - 3. Technology, telecommunications, and low voltage systems: The minimum conduit size shall be $\frac{3}{4}$ -inches unless noted or indicated otherwise.
 - 4. The minimum conduit size between buildings for technology, voice, data, fire alarm, video, security, surveillance, BMCS, and other telecommunications shall be 2-inch unless indicated otherwise.
- B. The minimum conduit size for flexible metallic conduit for tap connections to individual light fixtures shall be $\frac{1}{2}$ inch, or steel metal clad (MC) cable with insulated ground conductor maximum 6 feet.
- C. Electrical nonmetallic tubing, flexible polyethylene or PVC tubing shall not be used on this project.
- D. BX and AC cable shall not be used on this project.
- E. PVC elbows shall not be used on this project.
- F. Intermediate metal conduit (IMC) shall not be used on this project.

2.3 RIGID METAL CONDUIT

- A. UL labeled, Schedule 40:
 - 1. Mild steel pipe, zinc coated inside and out
 - 2. Aluminum Alloy 6063, T-1 temper
 - 3. Threaded ends
 - 4. Insulated bushings
- B. Fittings shall meet the same requirements as rigid metal conduits.
 - 1. UL labeled
 - 2. Threaded fittings

2.4 ELECTRICAL METALLIC TUBING (EMT)

- A. UL labeled, standard weight:
 - 1. Cold rolled steel tubing, zinc coated inside and out
 - 2. Aluminum Alloy 6005, 6063. Temper T-1
- B. Fittings shall meet the same requirements as EMT conduits.
 - 1. UL labeled
 - 2. Insulated throat connectors
 - 3. Steel fittings with setscrews with lock nuts on threaded ends, no snap locks

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- 4. Cast metal fittings are not approved
- 5. Uni-couple type connectors are not approved
- 6. Split ring, anti-short bushings are not approved

2.5 RTRC CONDUIT FITTINGS AND CONDUIT BODIES

- A. UL listed
- B. Standard wall thickness sizes ¼-inch through 4-inch
- C. Underground medium wall thickness sizes 5 and 6-inch
- D. Conduit interface joints above grade, gasket joint below grade
- E. Extra heavy wall for above ground and/or UL Class 1 Division 2 and Class 1 Zone 2 applications.

2.6 PVC COATED RIGID STEEL WITH URETHANE INTERIOR COATING

- A. The PVC coated galvanized rigid conduit and fittings must be ETL Listed and Verified. The PVC coating must have been investigated and verified by ETL as providing the primary corrosion protection for the rigid metal conduit. Ferrous fittings for general service locations must be ETL Listed with PVC as the primary corrosion protection. Hazardous location fittings, prior to plastic coating must be UL listed for the hazard conditions to which they are to be used. All conduit and fittings must be new, unused material. Applicable UL standards may include UL 6 Standard for Safety, Rigid Metal Conduit, and UL514B Standard for Safety, Fittings for Conduit and Outlet Boxes.
- B. The PVC coated galvanized rigid conduit and fittings must be ETL Verified to the Intertek ETL SEMKO High Temperature H₂O PVC Coating Adhesion Test Procedure for 200 hours. The PVC coated galvanized rigid conduit must bear the ETL Verified PVC-001 label to signify compliance to the adhesion performance standard.
- C. The conduit shall be hot dip galvanized inside and out with hot galvanized threads.
- D. A PVC sleeve extending one pipe diameter or two inches, whichever is less, shall be formed at every female fitting opening except unions. The inside sleeve diameter shall be matched to the outside diameter of the conduit.
- E. The PVC coating on the outside of conduit couplings shall have a series of longitudinal ribs 40 mils in thickness to protect the coating from tool damage during installation.
- F. Form 8 Condulets, ½-inch through 2-inch diameters, shall have a tongue-in-groove gasket to effectively seal against the elements. The design shall be equipped with a positive placement feature to ease and assure proper installation. Certified results confirming seal performance at 15 psig (positive) and 25 inches of mercury (vacuum) for 72 hours shall be available.
- G. Form 8 Condulets shall be supplied with plastic encapsulated stainless-steel cover screws.
- H. A urethane coating shall be uniformly and consistently applied to the interior of all conduit and fittings. This internal coating shall be a nominal 2 mil thickness. Conduit or fittings having areas with thin or no coating shall be unacceptable.

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- I. The PVC exterior and urethane interior coatings applied to the conduit shall afford sufficient flexibility to permit field bending without cracking or flaking at temperatures above 30°F (-1°C).
- J. All male threads on conduit, elbows and nipples shall be protected by application of a urethane coating.
- K. All female threads on fittings or conduit couplings shall be protected by application of a urethane coating.
- L. Independent certified test results shall be available to confirm coating adhesion under the following conditions
 - 1. Conduit and conduit exposure to 150°F (65°C) and 95% relative humidity with a minimum mean time to failure of 30 days. (ASTM D1151)
 - 2. The interior coating bond shall be confirmed using the Standard Method of Adhesion by Tape Test (ASTM D3359).
 - 3. No trace of the internal coating shall be visible on a white cloth following six wipes over the coating which has been wetted with acetone (ASTM D1308).
 - 4. The exterior coating bond shall be confirmed using the methods described in Section 3.8, NEMA RN1. After these tests the physical properties of the exterior coating shall exceed the minimum requirements specified in Table 3.1, NEMA RN1.
- M. Right angle beam clamps and U bolts shall be specially formed and sized to snugly fit the outside diameter of the coated conduit. All U bolts shall be provided with plastic encapsulated nuts that cover the exposed portions of the threads.
- N. All fittings, clamps, straps, struts, and hardware used with PVC coated conduit shall be PVC coated or 316 stainless steel

2.7 STEEL FLEXIBLE CONDUIT

- A. Steel flexible metallic conduit:
 - 1. Zinc coated inside and out
 - 2. 18-inches minimum length, 24-inches maximum length
- B. Steel flexible metallic conduit for tap connections to light fixtures where steel MC Cable fixture whips are not used:
 - 1. 18 inches minimum length; 6 feet maximum length
- C. Liquid tight flexible steel conduit
 - 1. Type L.A. - Grounded - UL Approved
 - 2. 18-inches minimum length, 24-inches maximum length

2.8 PVC CONDUIT

- A. UL labeled Schedule 40 and Schedule 80
- B. PVC fittings and solvent welded joints
- C. Acceptable PVC conduit manufacturer: Ipex, Cantex

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2.9 CONDULETS AND CONDUIT BODIES

- A. UL Labeled
- B. Form 85
- C. PVC Coated: Form 8
- D. LBC Condulets shall be used for size 2 inch and above.
- E. LL and LR Condulets shall not be used for 2 inch and above

2.10 ROOF MOUNTED CONDUIT AND BOX SUPPORTS

- A. Conduit supports and pads suitable for direct sunlight, conduit size, weight, quantity and roof system with unistrut supports and accessories. Conduit supports shall allow for conduit expansion and contraction.
- B. Refer to roofing specifications for additional information. The limitations and restrictions contained in any roofing specification shall prevail and supercede these specifications for roof mounted supports for conduits and boxes.
- C. Approved Manufacturer:
 - 1. Portable Pipe Hangers
 - 2. Eaton B-Line
 - 3. Miro Industries, Inc.

2.11 ALUMINUM CONDUIT

- A. UL Labeled
- B. Aluminum fittings shall meet the same requirements of aluminum conduits, compatible steel fittings.
 - 1. UL Labeled for use with aluminum conduit.

2.12 STAINLESS STEEL CONDUIT

- A. UL Labeled
- B. Rigid Stainless Steel:
 - 1. Type 304 Stainless Steel
 - 2. Threaded ends
 - 3. Insulated Bushings
- C. EMT:
 - 1. Type 304 Stainless Steel
 - 2. Compression Fittings
 - 3. Insulated Bushings
- D. Fittings, elbows, nipples, strut, device box, clamps straps, etc.
 - 1. Type 304 Stainless Steel

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2.13 ELECTRICAL NON-METALLIC TUBING (ENT)

- A. UL labeled Schedule 40
- B. PVC fittings and solvent welded joints
- C. Acceptable manufacture: Carlon

2.14 EXTERIOR IN-GRADE PULL BOXES

- A. Enclosures, boxes and covers are required to conform to all test provisions of the most current American Association of State Highway and Transportation Officials (AASHTO) standards for H-20 loading applications.
 - 1. AASHTO H-20 certified precast concrete, cast iron or other AASHTO recognized materials, rated for deliberate traffic.
 - 2. Conduit entry knock-outs as required
 - 3. Bolt down galvanized steel/cast iron covers
 - 4. Thin wall knocks outs as required
 - 5. Integral bottom
 - 6. Box height as required for specified conduit depth and required top elevation.
 - 7. Concrete design strength of minimum 5,500 PSI at 28-days
 - 8. Place enclosures on a minimum of 6 inches of coarse gravel with a border of 6-inches beyond the enclosures exterior dimension.
 - 9. Size and volume as required for application.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install electrical conduits and fittings for all wiring of any type unless specifically specified or instructed to do otherwise. Install conduits and fittings in accordance with local codes and applicable sections of the NECA "Standard of Installation", concealed where possible.
 - 1. Fasten conduit supports to building structure and surfaces; do not support to roof deck.
 - 2. Arrange supports to prevent misalignment during wiring installation.
 - 3. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.
 - 4. Do not attach conduit to ceiling support wires.
 - 5. Arrange conduit to maintain head room and present neat appearance.
 - 6. Maintain 4-inch clearance between conduit and rooftop surfaces.
 - 7. Cut conduit square using saw or pipe cutter; de-burr cut ends.
 - 8. Bring conduit to shoulder of fittings; fasten securely.
 - 9. Conduit penetrations to all individual motor controllers, VFDs, and motor control cabinets shall only be made at the bottom of the enclosure. For other equipment, provide listed water sealing conduit hubs to fasten conduit to sides or tops of electrical equipment enclosures, device box, gutter, wireway, disconnect, etc.
 - 10. Use suitable caps to protect installed conduit against entrance of dirt and moisture.
 - 11. Ground and bond conduit as required.
 - 12. Identify conduit as required.
 - 13. Route all conduits above building slab perpendicular or parallel to building lines.
 - 14. Do not use no-thread couplings and connectors for galvanized steel, PVC coated galvanized steel, or aluminum rigid conduit.

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- B. Group related conduits; support using conduit rack. Construct rack using steel channel; provide space on each for 25 percent additional conduits.
- C. In areas where raceway systems are exposed and acoustical or thermal insulating material is to be installed on walls, partitions, and ceilings, raceways shall be blocked out proper distance to allow insulating material to pass without cutting or fitting. Also provide Kindorf galvanized steel channels to serve as standoffs for panels, cabinets and gutters.
- D. Securely fasten conduits, supports and boxes, to ceiling (not roof deck), walls, with Rawl Plugs or approved equal anchors. Use lead cinch anchors or pressed anchors. Use only cadmium plated or galvanized bolts, screws. Plastic anchors and lead anchors shall not be used for overhead applications.
- E. Provide separate raceway systems for each of the following when specified, indicated or required:
 - 1. 120/208 volt circuits
 - 2. 277/480 volt circuits
 - 3. Emergency
 - a. Life safety branch
 - b. Critical branch
 - c. Equipment branch
 - 4. Voice/Data
 - 5. Sound reinforcement
 - 6. Theatrical and Architectural Dimming Controls
 - 7. MATV/CATV
 - 8. Security CCTV
 - 9. Security System
 - 10. Communications / PA Systems / Sound System Line Input and Speakers
 - 11. Fire Alarm
 - 12. Lighting and Building Management Control Systems
- F. Unless shown otherwise, do not install conduit in or below concrete building slabs.
- G. Unless shown otherwise, do not install conduit horizontally in concrete slabs.
- H. Roof penetrations shall be made in adequate time to allow the roofing installer to make proper flashing. Conduit for equipment mounted on roof curbs shall be routed through the roof curb. Conduit, gutters, pull boxes, junction boxes, etc. shall not be routed on roof unless specified otherwise. Where specifically indicated to be routed or mounted on the roof, supports shall be as specified, as recommended by roofing manufacturer and roof support manufacturer and as required by NEC. Place supports every five feet along conduit run and within 3 feet of all bends, condulets, and junction boxes. Provide roofing pad under stands at directed by Architect and as recommended by roofing manufacturer and roof support manufacturer. Provide additional unistrut supports and accessories as required.
- I. PVC coated conduit shall have all nicks and cuts to the protective coating repaired using manufacturer's approved touch-up material as recommended by manufacturer. Provide a minimum of two-wraps of 3M-50 type tape over touch-up.

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- J. Installation of the PVC Coated Conduit System shall be performed in accordance with the Manufacturer's Installation Manual. To assure correct installation, the installer shall be certified by Manufacturer to install coated conduit. Submit copies of training certification with submittal. Contractor shall coordinate installation with manufacturer's representative for field training and observation of installed PVC coated rigid galvanized conduit and fittings. Manufacturer's representative shall certify the installation is in accordance with manufacturer's installation instructions. Submit copies of installation certification prior to cover-up of underground installation.
- K. All conduit terminations at locations including but not limited to, switchgear, pull boxes, outlet boxes, stub-up, and stub-outs:
 - 1. Provide insulated throat connectors for EMT conduits.
 - 2. Provide insulated bushing on all rigid conduit terminations.
 - 3. Provide locknuts inside and outside of all boxes and enclosures.
 - 4. Provide threaded type plastic bushing at all boxes and enclosures
- L. In suspended ceilings, support conduit runs from the structure, not the ceiling system construction.
 - 1. Do not support from structural bridging.
 - 2. Do not support from metal roof deck.
- M. Completely install each conduit run prior to pulling conductors. All boxes are to be accessible after completion of construction.
- N. All conduits must be kept dry and free of water or debris with approved pipe plugs or caps. Cap or plug conduit ends prior to concrete pours.
- O. Ream ends of conduits after cutting and application of cutting die to remove rough edges.
- P. Install all above concrete slab conduits perpendicular or parallel to building lines in the most direct, neat and workmanlike manner.
 - 1. Cable Tension:
 - a. 0.008 lb./cmil for up to 3 conductors, not to exceed 10,000 pounds.
 - b. 0.0064 lb./cmil for more than 3 conductors, not to exceed 10,000 pounds
 - c. 1000 lbs. per basket grip.
 - 2. Sidewall pressure: 500 lbs./ft.
 - 3. Conduit runs within the following limits of bends and conduit length between pull points shall not exceed the above installation pulling tension and sidewall pressure limits.
 - a. Three (3) equivalent 90-degree bends: not more than fifty feet (50') between pull points.
 - b. Two (2) equivalent 90-degree bends: not more than one hundred feet (100') between pull points.
 - c. One (1) equivalent 90-degree bend: not more than one hundred fifty feet (150') between pull points.
 - d. Straight pull: not more than two hundred feet (200') between pull points.
 - 4. Indicate sizes of conduits, wireway sections, and cable tray sections on the as-built drawings.
 - 5. Hold horizontal and vertical conduits as close as possible to walls, ceilings and other elements of the building construction. Conduits shall be kept a minimum of 6 inches clear of roof deck / insulation, and 2 inches clear of above floor deck / insulation.

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6. Install conduits to conserve building space and not obstruct equipment service space or interfere with use of space. Conduit shall not be routed on floors, paved areas or grade.
 7. Where a piece of equipment is wired from a switch or box on adjacent wall, the wiring shall go up the wall from the box, across at or near the ceiling, and back down to the equipment. Wiring shall not block the walkway between wall and equipment.
 8. Horizontal runs of conduit on exposed walls shall be kept to a minimum.
 9. Conduit for mechanical / plumbing equipment installed outdoors shall be routed with the associated mechanical / plumbing pipe support rack system where practical, coordinate with Divisions 22 and 23.
 10. Conduits installed in public areas, not concealed by architectural ceilings, shall be supported by galvanized steel channel racks to bottom of roof deck or floor deck. Conduits shall be grouped for neat workman-like appearance.
- Q. Install expansion and deflection fittings and bonding jumpers on straight runs which exceed 200-feet, on center, and at 200-feet maximum, on center, on straight runs which exceed 400-feet, and where conduits cross building expansion joints.
- R. Provide grounding bushings at concentric/eccentric knockouts or where reducing washers are used.
- S. Run conduit to avoid proximity to heat producing equipment, piping surfaces with temperatures exceeding 104 degrees F., and flues, keeping a minimum of 13-inches clear.
- T. Install conduit as a complete system, without conductors, continuous from outlet to outlet and from fitting to fitting. Make up threaded joints of conduit carefully in a manner to ensure a tight joint. Fasten the entire conduit system into position. A run of conduit between outlet and outlet, between fitting and fitting, or between outlet and fitting shall not contain more than the equivalent of four quarter bends, including those bends located immediately at the outlet or fitting.
- U. Conceal conduit systems in finished areas. Conduit may be exposed in mechanical and electrical rooms, and where otherwise shown or indicated only. Run the conduit parallel and perpendicular to the structural features of the building and support with malleable iron conduit clamps at intervals as required by NEC or on conduit racks, neatly racked and bent in a smooth radius at corners.
- V. Conduit bends shall be factory elbows or shall be bent using equipment specifically designed to bend conduit of the type used to maintain the conduit's UL listing. Conduit hanger spacing shall be 10 feet or less and as required by the NEC for all conduit. Beam clamp attachments to steel joist chords is prohibited. Beam clamps may only be used at beams, no exceptions. Connections to joists shall be made with galvanized channel extended between joist chords or with galvanized channel bearing on the vertical legs of joist chord angles.

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- W. Support conduit on galvanized channel, using compatible galvanized fittings (bolts, beam clamps, and similar items), and galvanized threaded rod pendants at each end of channel and secure raceway to channel and channel to structure. Where rod pendants are not used, channel supports are to be secured to structure at each end. Conduit supports are to be secured to structure using washers, lock washers, nuts and bolts or rod pendants; use of toggle bolt "wings" are not acceptable. Support single conduit runs using a properly sized galvanized conduit hanger with galvanized closure bolt and nut and threaded rod. Raceway support system materials shall be galvanized and manufactured by Kindorf, Unistrut, Superstrut, Caddy, or Spring Steel Fasteners, Inc. Provide chrome or nickel-plated escutcheon plates on conduit passing through walls and ceilings in finished areas. Do not support conduit from other conduit, structural bridging or fire rated ceiling system. Do not support more than one conduit from a single all-thread rod support. Provide electrical insulating sleeve or wrapping for aluminum conduit supported by zinc coated supports or fasteners. Channel supports shall have cut ends filed smooth. When installed outside of the building, or in areas subject to moisture, the cut ends shall be painted with ZRC galvanized paint or equivalent.
- X. Terminate all motor connection conduits in mechanical room spaces with a floor pedestal and with "Tee" conduit at motor outlet height for flexible conduit.
- Y. Where conduit is not embedded in concrete or masonry, conduit shall be firmly secured by approved clamps, half-straps or hangers. Tie wire and short pieces of conduit used as supports and or hangers are not approved.
- Z. Where "LB" condulets are used, 2-inches and larger shall be type "LBD".
- AA. No more than 12 conduits containing branch circuits may be installed in junction boxes, pull boxes or gutters.
- BB. Flexible metal conduit and liquid tight flexible metal conduit shall only be used for final connections from junction box to equipment, light fixtures, power poles, etc. They are not to be used in lieu of conduit runs. They shall not be used for wall or roof penetrations unless they are installed in a PVC coated RGC conduit sleeve at least one size larger than the OD of the flexible conduit.
- CC. Where 3-1/2-inch conduit is specified and the required or specified material is Schedule 80 PVC, provide 4-inch conduit.
- DD. "Daisy Chaining" light fixtures installed for lay-in ceiling areas is not allowed. Each light fixture shall have its own fixture whip from junction box. The only exception being light fixtures installed end to end using chase nipples between them, or light fixtures recessed in non-accessible ceilings.
- EE. In above ceiling applications, do not install raceways, junction boxes, gutters, disconnects, etc. within 36 inches directly in front of HVAC control boxes or other equipment requiring access from a point starting from the top of control box / equipment down to ceiling.
- FF. Do not install conduit, junction boxes, etc. within 18 inches of outside edges of roof access openings.
- GG. Install minimum size 2-inch nipple, at least one, between multi-sectional panels for branch circuit independent of feeder conductors.

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3.2 CONDUITS

- A. Conduit above grade indoors:
 - 1. Concealed Conduits: EMT with set screw fittings
 - 2. Exposed conduits:
 - a. Below nine feet AFF where not directly attached and against building walls, ceiling, or structure: Rigid metal conduit or x-wall RTRC.
 - b. Where subject to physical damage: Rigid metal conduit or x-wall RTRC.
 - c. Wet locations: PVC coated galvanized rigid steel or aluminum conduit
 - d. Damp Locations: Aluminum rigid conduit or x-wall RTRC.
 - e. Exposed conduits in mechanical rooms or electrical rooms shall be rigid galvanized steel or x-wall RTRC when installed below 18-inches above finished floor.
- B. Conduit installed above grade outdoors:
 - 1. Galvanized rigid steel or x-wall RTRC for conduits up utility poles and where subject to physical damage or where located less than four feet above finished floor.
 - 2. Aluminum or x-wall RTRC where not subject to physical damage and where located four feet above finished floor.
- C. Conduit where indicated underground:
 - 1. PVC Coated Galvanized rigid steel or RTRC conduit elbows and Schedule 80 PVC, RTRC, or PVC coated galvanized steel straight run conduits. PVC conduits for underground branch circuits shall be Schedule 80 or Schedule 40 PVC.
 - a. PVC conduit and fittings shall be used only for straight horizontal runs and for vertical risers at site lighting pole bases. Bending straight sections of PVC conduit to less than 25-foot radius or the use of PVC factory bends is not allowed.
 - b. Change in direction of conduit runs, either vertical or horizontal, shall be with RTRC or PVC coated galvanized steel elbows or long sweep bends of straight PVC conduit sections. Long sweep bends of straight PVC 20-foot sections shall have a minimum radius of curvature of 25 feet and a maximum arc of 22.5degrees. Multiple long sweep bends of straight PVC sections shall be separated by a minimum of 20-feet of straight, linear, PVC sections.
 - c. Provide RTRC or PVC coated rigid galvanized steel conduit elbows and fittings with urethane interior coating at all changes in direction with radius of less than 25-feet and at all vertical runs to 18 inches above finished floor elevation. For interior slab penetrations, provide continuous RTRC or PVC coated rigid galvanized steel conduit and fittings with urethane interior coating from change in direction to 18 inches above finished floor elevation, except where stubbed-up under and inside equipment or switchgear where conduit shall be terminated at minimum two inches above concrete housekeeping pad.
 - d. Elbows for underground electrical service entrance, feeders, transformer primary / secondary, telecommunication, and low voltage conduits shall be RTRC or PVC coated rigid galvanized steel with long radius as follows:
 - 1) Up to 1-inch conduit, minimum 12-inch radius.
 - 2) 1.5-inch conduit, minimum 18-inch radius.
 - 3) 2-inch conduit, minimum 24-inch radius.
 - 4) 2.5-inch conduit, minimum 30-inch radius.

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- 5) 3-inch conduit, minimum 36-inch radius.
- 6) 3.5 to 6-inch conduit, minimum 48-inch radius.
- e. Conduit for all floor boxes shall be routed below building slab from floor box to nearest column, wall, or as indicated.
- f. Conduits shall not be routed horizontally in building slab, grade beams or pavement.
- 2. Encase all underground conduits in concrete.
 - a. Concrete shall be tinted red throughout with a ratio of 10 pounds of dye per yard of concrete unless prohibited by utility for utility conduits. Concrete encasement for utility installed conductors shall be as specified by the utility and comply with their standards and specifications. Where utility does not require but allows concrete encasement of conduits, provide concrete encasement as specified herein.
 - b. Provide minimum 3-inch concrete encasement around conduits.
 - c. Provide conduit spacers for parallel branch/feeder conduits.
 - d. When prior written approval from Engineer to omit concrete encasement of conduits below building slab is given, conduits either specified or approved in writing to be routed under building slab without concrete encasement for electrical branch circuits or voice / data / video / communications horizontal drops or outlets shall be installed 18 inches below finished floor and on select fill. All other conduits, including but not limited to electrical feeders, voice / data / video / communications vertical, riser, tie, trunk, or service cable conduits shall be installed 48-inches below finished floor and on select fill.
 - e. Use suitable manufactured separators and chairs installed 4 feet on centers. Securely anchor conduit at each chair to prevent movement during backfill placement.
- 3. Install building voice / data / video / communications main service conduits and electrical service transformer primary and secondary conduits with top of concrete encasement minimum 48-inches below finished grade or pavement. Voice / data / video / communications conduits and electrical service primary conduits for utility owned electrical service transformers shall also comply with the respective utility company requirements and standards. All other underground conduits outside of building other than voice / data / video / communications main service conduits and electrical service transformer primary and secondary conduits shall have top of concrete encasement at 36 inches minimum below finished grade or pavement.
- 4. Provide two "caution" plastic tapes at 6-inches and 18-inches below finished slab, grade, or pavement; identify as specified in Section 26 05 00.
- 5. Conduits located outside building, provide magnetic locator tape at top of first compacted layer of backfill or concrete.
- 6. During construction, partially completed underground conduits shall be protected from the entrance of debris such as mud, sand, and dirt by means of conduit plugs. As each section of the underground conduit is completed, a testing mandrel with diameter 1/4-inch smaller than the conduit, shall be drawn through each conduit. A brush with stiff bristles shall be drawn through until conduit is clear of particles of earth, sand, or gravel. Conduit plugs shall then be installed.
- 7. Utility underground conduit for Utility Company cable shall be installed per Utility Company standards, and their specifications for this project.
- 8. Concrete shall be Portland Cement conforming to ASTM-C-150, Type 1, Type III or Type V if specified. Cement content shall be sufficient to product minimum strength of 2,500 PSI.

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9. Contractor shall stake out routing and location of underground conduits using actual field measurements. He shall obtain approval of the Owner and Architect before beginning trenching, horizontal drilling, and excavation.
 10. Verify location and routing of all new and existing underground utilities with the Owner and Architect on the job site. Stake out these existing utilities so that they will not be damaged. Stake out new utilities to provide coordination with other trades and with new and existing utilities, easements, property lines, restricted land use areas, and right-of-ways. Verify existing public utilities with Call811.
- D. Conduit shown in concrete walls, floor or roof slab:
1. PVC Coated Galvanized Rigid steel.
- E. Conduits that penetrate concrete slab, or within 100 feet of cooling towers, or at designated corrosive locations.
1. RTRC
 2. PVC coated galvanized rigid steel
- F. Connections to equipment mounted on roof, rotating equipment, transformers, and kitchen or food processing equipment, or where flexible conduit is required outdoors.
1. Liquid tight flexible metal conduit (1/2 inch may be used for roof top supply / exhaust fans only)
 2. Liquid tight flexible metal conduit for 24-inch maximum length
 3. Conduit for roof-mounted equipment shall be routed inside the roof curb assembly roof opening. Provide permanent lock-off device at panelboard circuit breakers serving roof equipment and accessories to enable tag-out procedures for all power routed through roof curb and to the roof mounted equipment and accessories.
- G. Light fixture whips:
1. Accessible ceilings and open structure: 1/2-inch flexible steel conduit or steel MC cable, length not to exceed 6-feet.
 2. Non-accessible ceilings: 1/2-inch flexible steel conduit. Length as required to make a tap at an accessible j-box. Recessed light fixtures in non-accessible ceilings may be daisy chained using the light fixture's integral, UL listed j-box or internal wire way that is accessible through fixture from below the ceiling.
 3. Dedicated insulated ground wire.
 4. Light fixture whips shall not rest on ceiling grid or tile.
 5. Light fixture whips shall not be supported from the ceiling suspension system. Support from the structure with #13 AWG galvanized iron wire pendants and Caddy clips. Do not support conduit from structural bridging. Flexible conduit and steel MC cable shall be kept a minimum of 2 inches clear of roof deck.
- H. Conduits at Natatorium or therapeutic pool areas:
1. Underground conduit shall be as specified in this section.
 2. Exterior conduits and boxes within 100 feet of exhaust openings shall be x-wall RTRC or PVC coated galvanized rigid steel or stainless steel.
 3. Exposed conduits in chemical storage rooms, pool mechanical equipment (pump rooms, and pool equipment storage rooms shall be Schedule 80 PVC. Boxes shall be PVC, or 304 Stainless Steel.
 4. Exposed conduits and boxes in indoor pool areas and all other indoor public areas shall be Type 304 Stainless Steel.

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- I. Conduits located inside greenhouses and natatorium pump and water treatment rooms:
 - 1. X-wall RTRC
 - 2. Schedule 80 PVC
 - 3. PVC coated galvanized rigid steel conduit and fittings.
- J. Conduits in classified hazardous (Classified) locations:
 - 1. Conduit fittings and seals UL listed for the classification
- K. Conduits embedded in parking structure traffic wearing surface and concrete support structures:
 - 1. Schedule 40 PVC, RTRC, PVC coated rigid galvanized conduit.
 - 2. Schedule 40 ENT may only be used for flat runs embedded in traffic wearing surface concrete topping.
 - 2. Solvent welded fittings only for PVC conduit and ENT.
 - 3. Verify with Structural Engineer prior to construction for any additional limitations for raceway installation restrictions installed in parking structure including but not limited to maximum outside diameter of raceways permitted to be used in the wearing surface, and field cutting or drilling through parking structure structural members or support structures.
 - 4. All raceways shall be securely fastened to prevent floating during concrete installation. ENT raceways shall be completely embedded in concrete material to maintain fire and smoke integratory as required by the NEC.
 - 5. When using ENT or PVC conduits, provide transition to x-wall RTRC or PVC coated rigid galvanized conduit elbows and vertical risers to ensure that only flat horizontal runs of PVC conduit or ENT are used along the top of the parking structure structural support deck and that they are completely concealed and embedded by the wearing surface concrete material topping.

3.3 CONDUIT PENETRATIONS, SLEEVES AND ESCUTCHEONS

- A. Furnish sleeves for placing in construction for all conduit passing through concrete or masonry walls, partitions, beams, all floors other than grade level, and roofs. A conduit sleeve shall be one size larger than the size of conduit, which it serves except where larger sizes are required for manufactured water, fire, or smoke stop fittings.
 - 1. Sleeves set in concrete floor construction shall be minimum Schedule 40 galvanized steel.
 - 2. Sleeves shall extend 3-inches above the finished floor.
- B. Sleeves in concrete or masonry walls shall be RTRC or Schedule 40 galvanized steel. Sleeves shall be set flush with finished wall.
- C. Install manufactured UL listed water, fire, and smoke stop fittings, or caulk around conduit or cables in sleeves with sufficient UL listed fire safe insulation or foam to maintain wall or floor slab fire or smoke rating. Refer to Architecture drawings for locations of rated walls.
- D. Provide Linkseal Mechanical Seals around conduit penetrations through walls below grade. Provide a pull box to install a water stop inside wall penetration. Internally seal low voltage cabling conduit penetrations with waterproof caulking.
- E. Sleeves penetrating walls below grade shall be Schedule 40 black steel pipe with ¼-inch thick steel plate secured to the pipe with continuous fillet weld. The plate shall be located in the middle of the wall and shall be 2-inches wider all around than the sleeve that it encircles. The sleeve should extend a minimum of 24-inches on either side of the penetration. The entire assembly shall be hot-dipped galvanized after fabrication. Do not sleeve or penetrate grade beams.

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- F. Conduit passing through the housing on connected equipment shall pass through a cleanly cut hole protected with a threaded steel bushing. Route conduit through roof openings, for piping and ductwork or through suitable roof jack, with pitch pocket. Coordinate location with roofing installation as required.
- G. Conduit passing through fire rated wall shall be sealed with Fire Stop. Route conduit to preserve fire resistance rating of partitions and other elements, using materials and methods under the provisions of Division 7.

3.4 POWER DISTRIBUTION UNDERGROUND FEEDER CONDUIT AND UNDERGROUND SERVICE ENTRANCE CONDUIT

- A. Power underground feeder and service entrance shall be of individual conduit encased in concrete. Unless shown otherwise, the type of conduit used shall not be mixed in any one underground conduit and shall be the size indicated on the drawings. The concrete encasement surrounding the underground conduit shall be rectangular in cross-section, having a minimum concrete thickness of 3-inches, except that conduit for 120V and above shall be separated from control and signal conduits by a minimum concrete thickness of 3-inches. Encasement concrete shall be tinted in red.
- B. During construction, partially completed underground conduits shall be protected from the entrance of debris such as mud, sand, and dirt by means of conduit plugs. As each section of the underground conduit is completed, a testing mandrel shall be drawn through until each conduit is clear of particles of earth, sand, or gravel. Conduit plugs shall then be installed.
- C. Furnish the exact dimensions and location of power underground conduit to be encased in time to prevent delay in the concrete work.
- D. Conduit for service entrance underground conduits shall be as indicated on the drawings.
- E. Primary power underground conduit shall be installed in accordance with utility company standards and the utility company specifications for this project.

3.5 TELECOMMUNICATIONS, LOW VOLTAGE AND EMPTY CONDUIT SYSTEM RACEWAYS

- A. Conduit shall be installed in accordance with the specified requirements for conduit and with the additional requirements that no length of run shall exceed 100-feet for 1 inch or smaller trade sizes and shall not contain more than two 90-degree bends or the equivalent. Pull or junction boxes shall be installed to comply with these requirements. Provide plastic bushings at all conduit terminations. Provide a grounding bushing on each data and voice conduit.
- B. Conduits shall be installed from outlet box to above an accessible ceiling. All cables routed through open spaces (no-ceiling below roof deck or above floor deck) shall be routed in conduit. Telecommunications systems, CATV, CCTV, fire alarm and BMCS cables can be installed above accessible ceilings without conduit. Cables installed above accessible ceiling shall be plenum rated. Conduit rough in of these cables shall include a 90-degree turn-out to an accessible location with insulated bushings on the end of the conduit.
 - 1. Provide conduit from each telecommunications outlet box to accessible ceiling plenum.
 - 2. Provide conduit from each security / surveillance device outlet box to accessible ceiling plenum.

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3. Provide two conduits for each multi-media outlet box and each outlet box indicated to contain more than four data, audio, or video drops to accessible ceiling plenum.
4. Provide the following minimum conduits for telecommunications and multi-media wall, floor, and ceiling mounted outlet boxes. Use the largest diameter conduit indicated below unless instructed otherwise in writing from the Architect:
 - a. Non-masonry outlet box: Two 1-inch conduits.
 - b. Masonry outlet box: Two 1-inch conduits, or three 3/4-inch conduits.
 - c. Where indicated differently on plans or where conflicts arise, notify the Architect / Engineer prior to installation.
- C. All conduit in which cable is to be installed by others shall have pull string installed. The nylon pull string shall have not less than 200 lb. tensile strength. Not less than 12-inches of slack shall be left at each end. Provide blank cover plate before substantial completion if box is for a future installation after substantial completion of the project. Conduit shall extend to a minimum six inches above nearest accessible ceiling and be turned horizontally with plastic bushing at terminations.
- D. Conduits for Building Entrance Facilities:
 1. Underground Outside Plant: Install a pull box every 300-feet or after 180 degree turns.
 2. Inside Plant: Install a pull box every 150-feet or after 180 degree turns. All turns shall be large sweeps, not sharp 90s, with the radius of the sweep at least 10X the diameter of the conduit. Hence, a 4-inch conduit requires a 40-inch minimum radial sweep. If field conditions absolutely mandate a sharp 90-degree bend to be installed, then a pull box shall be installed at that location regardless of distance.
 3. Building entrance facilities shall not terminate in an IDF or any other space except the MDF.
 4. Coordinate the termination location of the building entrance facilities in the MDF with the room layout and equipment configuration.
 5. Provide 4-inch conduit unless indicated otherwise. Provide (3) fabric innerducts in each 4-inch conduit.

3.6 EXTERIOR IN-GRADE PULL BOXES

- A. Provide pull boxes where specified and as required.
- B. Pull boxes located in pavement shall be set with proper extensions so that top of cover is flush with pavement.
- C. Pull boxes located in non-paved areas shall be set two-inches above surrounding finished grade. Provide 12-inch wide by 8-inch deep reinforced concrete crown around neck or opening and sloped down away from pull box opening.

3.7 ALUMINUM ALLOY CONDUCTORS

- A. Where aluminum alloy conductors are specified, approved and substituted for copper conductors, provide the required conduit size based on conduit fill using NEC or recognized cable manufacturer's conduit fill tables for aluminum alloy compact conductors.

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3.8 IDENTIFICATION

- A. Conduit Systems: Provide adequate marking of conduit larger than one inch exposed or concealed in interior accessible spaces to distinguish each run as either a power (120/208V or 277/480V) or signal / telecommunication conduit (Fire Alarm, BAS, BMCS, Security, CCTV, Access Control, Intrusion Detection, Telecom, etc.). Except as otherwise indicated, use orange banding with black lettering. Provide self-adhesive or snap-on type plastic markers. Locate markers at ends of conduit runs, near switches and other control devices, near items of equipment served by the conductors, at points where conduit passes through walls or floors or enters non-accessible construction, and at spacing of not more than 50-feet along each run of exposed conduit. Switch-leg conduit and short branches for power connections need not be marked, except where conduit is larger than 1-inch.

END OF SECTION

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SECTION 260535

ELECTRICAL CONNECTIONS FOR EQUIPMENT

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Electrical connections as required and scheduled, and as specified.

1.2 RELATED WORK

- A. Refer to other Divisions for specific individual equipment electrical requirements.

1.3 QUALITY ASSURANCE

- A. UL Label: Products shall be UL listed to the extent possible.

PART 2 - PRODUCTS

2.1 MATERIALS AND COMPONENTS

- A. General: For each electrical connection indicated, provide a complete assembly including, but not limited to, pressure connectors, terminals (lugs), electrical insulating tape, heat-shrinkable insulating tubing, cable ties, solderless wire nuts, and other items and accessories needed to complete splices and terminations.
- B. Raceways: Refer to related sections.
- C. Conductors and Connectors: Refer to related section. Conductors at equipment terminations shall be copper.
- D. Terminals: Provide electrical terminals as indicated by the terminal manufacturer for the application.

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL CONNECTIONS

- A. General: Install electrical connections as shown, in accordance with applicable portions of the NECA Standard of Installation, and industry practices.
- B. Conductors: Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Where possible, match conductors of the electrical connection for interface between the electrical supply and the installed equipment.
- C. Splice Insulation: Cover splices with electrical insulation equivalent to, or of a higher rating than, insulation on the conductors being spliced.
- D. Appearance: Prepare conductors by cutting and stripping covering, jacket, and insulation to ensure a uniform and neat appearance where cables and wires are terminated.

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- E. Routing: Trim cables and wires to be as short as practical. Arrange routing to facilitate inspection, testing, and maintenance.
- F. Motor Connections: Where possible, terminate conduit in conduit boxes at motors. Where motors are not provided with conduit boxes, terminate the conduit in a suitable conduit, and make motor connections. Conduit passing through the housing on connected equipment shall pass through a cleanly cut hole protected with an approved grommet. For all AHU or fan motors and all other motors 10 HP and larger, at the motor connection do not use wire nuts. Provide copper alloy split bolt connectors or compression lugs and bolts. Insulate connection with Scotch Super 88 vinyl electrical tape over rubber tape, or Tyco Gelcap Motor Connection Kit.
- G. Conduit connections to equipment including, but not limited to, Variable Frequency Drives, Manual and Automatic Transfer Switches, Surge Suppression Devices, motor controllers, electrical disconnects, food service / processing equipment, electronics, control panels and Owner furnished equipment:
 - 1. Make conduit penetrations only at the bottom flat surface of the equipment and only where permitted by the equipment manufacturer to avoid un-intentional water entry. Coordinate installation of electrical connections for equipment with equipment installation work. Where equipment manufacture does not permit a bottom conduit entry, verify with Owner/Engineer and locate the conduit entry at the side surface as close as possible to the bottom of the enclosure.
 - 2. Where conduit originates from an elevation above the conduit entry, provide a "T" conduit below the enclosure's bottom elevation. Provide conduit from the conduit up to the enclosure bottom horizontal surface for electrical connection.
- H. Identification: Refer to Electrical General Provisions for identification of electrical power supply conductor terminations with markers approved as to type, color, letter and marker size by the Architect. Fasten markers at each termination point, as close as possible to each connecting point.
- I. Equipment and Furnishings: Refer to other Divisions. Coordinate power and control provisions shown for equipment and furnishings with the provisions required for the furnished equipment and furnishings. Where the power and control requirements are less than or equal to those specified, modifications to power and control provisions shall be made at no cost as a part of coordination. Where power and control requirements are in excess of those shown, notify the Architect in writing of the requirements.

END OF SECTION

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SECTION 260537

ELECTRICAL BOXES AND FITTINGS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide electrical box and fitting work as required, scheduled, indicated, and specified.

1.2 QUALITY ASSURANCE

- A. UL Label: Electrical boxes and fittings shall be UL listed.

PART 2 - PRODUCTS-- Provide products manufactured in the USA

2.1 FABRICATED MATERIALS

- A. Interior Outlet Boxes: Provide galvanized steel interior outlet wiring boxes, of the type, shape, and size, including depth of box, to suit respective locations and installation. Construct with stamped knockouts in back and sides. Provide gang boxes where devices are shown grouped. Single box design; sectional boxes are not acceptable, except for wall mounted electronic displays.
1. Type of Various Locations:
 - a. Wall mounted interactive media boards, video displays, televisions, electronic signage and similar installations; recessed wall mounted box for power and/or multi-media (low voltage) outlets: Arlington Industries #TVBS 613, 4-gang steel box with white trim plate.
 - b. Technology, data, voice, video and multi-media outlet boxes at locations other than wall mounted interactive media boards, video displays, televisions, electronic signage and similar installations: minimum 4-inch square (2-gang), 3-inch deep interior outlet boxes. Raco #260H large capacity box with ½ through 2-inch knockouts.
 - c. Security, access control, and video surveillance outlet boxes: single gang, 3-inch deep outlet boxes mounted long axis vertically.
 - d. All other applications: minimum 4-inch square (2-gang) 2-1/8-inch deep boxes.
 - e. Masonry Walls: Galvanized switch boxes made especially for masonry installations; depths of boxes must be coordinated for each installation.
 - f. Surface: Type FS or FD box with surface cover.
 - g. Corrosive locations or natatorium areas: 316 stainless steel construction suitable for the installation.
 - h. Hazardous (Classified) Locations: Explosion proof boxes, seals and fittings.
 - i. Special: Where above types are not suitable, boxes as required, taking into account space available, appearance, and Code requirements
 2. Interior Outlet Box Accessories: Outlet box accessories required as for installation, including covers or wall device plates, mounting brackets, wallboard hangers, extension rings, plaster rings for boxes in plaster construction, fixture studs, cable clamps and metal straps for supporting outlet boxes. Accessories shall be compatible with outlet boxes used and meet requirements of individual wiring.

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- B. Damp Location Outlet and Damp or Wet Location Switch Boxes: Deep type, hot dipped galvanized cast-metal weatherproof outlet wiring boxes, of type, shape, and size required. Include depth of box, threaded conduit ends, and stainless steel cover plate with spring-hinged waterproof caps suitable for application. Include faceplate gasket and corrosion-resistant, tamper / vandal proof fasteners.
- C. Wet Location Outlet Boxes: Hot dipped galvanized cast-iron weatherproof outlet wiring boxes, of type, shape, and size required. Include depth of box, threaded conduit ends.
- D. Junction and Pull Boxes: Galvanized sheet steel junction and pull boxes, with screw-on covers, of type, shape, and size, to suit respective location and installation.
 - 1. Type for Various Locations:
 - a. Minimum Size: 4-inch square, 2-1/8-inches deep.
 - b. 150 Cubic Inches in Volume or Larger: Code gauge steel with sides formed and welded, screw covers unless shown or required to have hinged doors. All boxes mounted above ceiling shall have screw covers. Boxes in all other areas with covers larger than 12-inches shall have hinged with screw covers. Knockouts factory stamped or formed in field with a cutting tool to provide a clean symmetrically cut hole.
 - c. Exterior or Wet Areas: 304 stainless steel NEMA 4X construction with gaskets and corrosion-resistant fasteners
- E. Conduit Bodies: Provide galvanized cast-metal conduit bodies, of type, shape, and size, to suit location and installation. Construct with threaded conduit ends, removable cover, and corrosion-resistant screws.
- F. Bushings, Knockout Closures, and Locknuts: Provide corrosion-resistant punched-steel box knockout closures, conduit locknuts, and insulated conduit bushings of type and size to suit use and installation.
- G. Outlet boxes in fire rated walls: Provide 2-hour rated gasket within box and below cover, equal to Rectorseal Metacaulk box guard and cover guard.

PART 3 - EXECUTION

3.1 INSTALLATION OF BOXES AND FITTINGS

- A. Install electrical boxes and fittings as shown and as required, in compliance with NEC requirements, in accordance with the manufacturer's written instructions, in accordance with industry practices.
- B. Provide recessed device boxes for wall mounted interactive media boards, video displays, televisions, electronic signage and similar installations.
- C. Provide minimum 4-inch square (2-gang), 3-inch deep interior outlet boxes for technology, data, voice, video, and multi-media outlet boxes at locations other than wall mounted interactive boards, video or visual displays. Provide single gang only, 3-inch deep outlet boxes mounted long axis vertically for security, access control, and video surveillance, coordinate with security equipment installation. Provide minimum 4-inch square (2-gang) 2-1/8-inch deep boxes for all other applications. Where indicated differently on plans or where conflicts arise, notify the Architect / Engineer prior to installation. Box extenders or plaster rings shall not be used to increase size. Provide increased box size as required.

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- D. Junction and pull boxes, condulets, gutters, located above grid ceilings shall be mounted within 18-inches of ceiling grid. Junction and pull boxes above grid ceilings shall be mounted in the same room served. Junction boxes and pull boxes required for areas with inaccessible ceilings shall be located above the nearest accessible ceiling area. All junction box or pull box openings shall be side or bottom accessible. Removal of light fixtures, mechanical equipment or other devices shall not be required to access boxes. Outlet boxes above ceiling for low voltage terminations shall face towards the floor.
- E. Use outlet and switch boxes for junctions on concealed conduit systems except in utility areas where exposed junction or pull boxes can be used.
- F. Determine from the drawings and by measurement the location of each outlet. Locate electrical boxes to accommodate millwork, fixtures, marker boards, and other room equipment at no additional cost to the Owner. The outlet locations shall be modified from those shown to accommodate changes in door swing or to clear interferences that arise from construction as well as modifying them to center in rooms. The modifications shall be made with no cost as part of coordination. Check the conditions throughout the job and notify the Architect of discrepancies. Verify modifications before proceeding with installation. Set wall boxes in advance of wall construction, blocked in place and secured. Set all wall boxes flush with the finish and install extension rings as required extending boxes to the finished surfaces of special furring or wall finishes. Provide wall box support legs attached to stud to prevent movement of box in wall.
- G. Unless noted or directed otherwise at installation, place outlet boxes as indicated on architectural elevations and as required by local codes.
- H. Outlets above counters, mount long axis horizontally. Refer to architectural elevations and coordinate to clear backsplash and millwork.
- I. Provide pull boxes, junction boxes, wiring troughs, and cabinets where necessary for installation of electrical systems. Surface mounted boxes below 9 feet and accessible to the public shall not have stamped knockouts.
- J. Provide weatherproof boxes for interior and exterior locations exposed to weather or moisture.
- K. Provide knockout closures to cap unused knockout holes in boxes.
- L. Locate boxes and conduit bodies to ensure access to electrical wiring. Provide minimum 12-inch clearance in front of box or conduit body access.
- M. Secure boxes to the substrate where they are mounted, or embed boxes in concrete or masonry.
- N. Boxes for any conduit system shall not be secured to the ceiling system, HVAC ductwork or piping system.
- O. Provide junction and pull boxes for feeders and branch circuits where shown and where required by NEC, regardless of whether or not boxes are shown.
- P. Coordinate locations of boxes in fire rated partitions and slabs to not affect the fire rating of the partition or slab. Notify the Architect in writing where modification or construction is required to maintain the partition or slab fire rating.

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- Q. Exterior boxes installed within 50-feet of cooling towers or water treatment areas shall be of 304 stainless steel, weatherproof NEMA 4X construction.
- R. Identification: Paint the exterior and cover plates of building interior junction boxes and pull boxes located above accessible ceilings or non-finished areas to correspond to the following colors:
1. Orange: - 480/277 VAC systems
 2. Light Blue: - 240 VAC three phase delta systems.
 3. Red – All Emergency circuits, regardless of voltage, and fire alarm system.
 4. Light Green - 120/208 VAC 3 phase and 120/240 VAC single-phase systems
 5. Yellow – Building Management and Control System - BMCS
 6. White - Security and Surveillance equipment circuits
- S. All box covers shall be labeled with Panel ID and circuit numbers of all circuits available in box using permanent black marker. Boxes containing main feeders are to list where fed from and load (example “MSB to Panel HA”). Information listed is to be legible, markovers are not acceptable. Multi-sectional panel numbers are not to be listed on covers (example “LA2” referring to Panel LA sec. 2 is to be listed as “LA”). Label covers for special applications explaining contents (example “Emerg. Gen. Annunciator controls”, “IDF ground”). Do not attach box covers that have both sides painted or labeled differently. In public areas where boxes are painted same color as room per architect, label inside covers. Boxes that are not used shall be labeled as not used and include panel ID. Example “Not Used Panel LA”. Unused raceways not in sight of panel shall be terminated in a box and labeled not used and include panel identification.
- T. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.
- U. Use flush mounting outlet box in finished areas unless specifically indicated as being used with exposed conduit.
- V. Locate flush-mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- W. Do not install flush mounting box back-to-back in walls; provide minimum 6 inches with stud separation. Provide minimum 24 inches with separation in acoustic rated walls.
- X. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness. Provide UL listed materials to support boxes in walls to prevent movement. Ensure box cannot be pushed inside wall.
- Y. Use stamped steel bridges to fasten flush mounting outlet box between studs.
- Z. Install flush mounting box without damaging vapor barriers, wall insulation or reducing its effectiveness.
- AA. Use adjustable steel channel fasteners for hung ceiling outlet box.
- BB. Do not fasten boxes to ceiling support wires.
- CC. Support systems are to hang vertically straight down. All-thread supports, when used, are not to be installed at an angle or bent.
- DD. Use gang box where more than one device is mounted together. Do not use sectional box.

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- EE. Use gang box with plaster ring for single device outlets.
- FF. Support outlets flush with suspended ceilings to the building structure.
- GG. Mount boxes to the building structure with supporting facilities independent of the conduits or raceways.
- HH. Where multiple feeders are in one pull box, conductors shall be wrapped with 3M No. 7700 Arc and fireproof tape.
- II. Provide plaster rings of suitable depth on all outlet boxes. Face of plaster ring shall be within 1/8 inch from finished surface.
- JJ. Equip boxes supporting fixtures designed to accept fixture studs with 3/8-inch stud (galvanized malleable iron) inserted through back of box and secured by locknut. Boxes not equipped with outlets shall have level metal covers with rust-resisting screws.
- KK. Do not mount junction boxes above inaccessible ceilings or in inaccessible spaces. Do not mount junction boxes above ceilings accessible only by removing light fixture, mechanical equipment or other devices. At inaccessible spaces use junction box furnished with light fixture or light fixture wiring compartment UL listed for through wiring.
- LL. No more than 12 conduits containing branch circuits may be installed in any junction or pull box.
- MM. All junction boxes shall be protected from building finish painters' over spray and from fire proofing overspray. Remove protective coverings when painting and fire proofing are complete.
- NN. Bond equipment grounding conductor to all junction and pull boxes.
- OO. Do not mount boxes or conduit bodies on walls directly above electrical panels or switchgear located next to walls.
- PP. Do not mount boxes or conduit bodies within 18 inches of outside edges of roof access openings.
- QQ. Box extenders or plaster rings shall not be used to increase the Code mandated cable capacity of a box. Provide proper size box.

3.2 ADJUSTING

- A. Adjust flush-mounting outlets to make front flush with finished wall material.
- B. Install knockout closures in unused box openings.

END OF SECTION

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SECTION 260540

ELECTRICAL GUTTERS AND WIREWAYS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide electrical gutter work as shown, as specified and as required.
- B. Application: The types of electrical gutters required for the project include the following:
 - 1. Electrical wiring gutters
 - 2. Voice / Data / Video / Communication and signal distribution wireway

1.2 QUALITY ASSURANCE

- A. UL Label: Gutters and wireways shall be UL labeled.

PART 2 - PRODUCTS

2.1 ELECTRICAL GUTTERS AND WIREWAYS

- A. General: Provide hinged electrical gutters and wireways in the types and sizes indicated or required, minimum 16 gauge thickness, with rounded edges and smooth surfaces; constructed in compliance with applicable standards; with features required.
- B. Size: Provide size indicated. Where size is not indicated, construct in accordance with the NEC and other standards. Gutters shall be of manufacturer's standard lengths, without field cutting or field extensions.
- C. Accessories: Provide gutter and wireway accessories where indicated, constructed of same metal and finish as gutters or wireways.
- D. Supports: Provide gutter and wireway supports indicated, conforming to NEC, and as recommended by the manufacturer, and as specified in Section 26 05 33 Conduit Systems.
- E. Materials and Finishes: NEMA 1 gutters and wireways shall have gray powder coat finish over galvanized steel. Gutters and wireways installed outside shall be NEMA 3RX minimum. Gutters or wireways installed within 100-feet of cooling towers, at kitchen or food preparation areas, and natatorium, spa or therapy pool areas shall be of 304 stainless steel NEMA 4X construction.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide gutters and wireways only where specified or required. Use of gutters and wireways shall be kept to a minimum.
- B. Finishing: Remove burrs and sharp edges of gutters and wireways wherever they could be injurious to conductor insulation or jacket.

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- C. Installation: Install gutters and wireways where shown or required, in accordance with the manufacturer's written instructions, NEC, NECA "Standard of Installation," and with recognized industry practices to ensure that the gutters and wireways comply with the specified requirements. Comply with requirements of NEMA and the NEC pertaining to installation of electrical gutters.
- D. Grounding: Electrically ground gutters and wireways to ensure continuous electrical conductivity. Provide equipment grounding conductor.
- E. Conductors:
 - 1. Complete gutter and wireway installation before starting the installation of conductors.
 - 2. Provide sufficient space to permit access for installing, splicing, and maintaining the conductors.
- F. A maximum of 12 conduits containing branch circuits shall be allowed to be installed in any gutter or wireway.

END OF SECTION

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SECTION 260550

FIRESTOPS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide firestop as required, and as specified. Refer to Architectural drawings for all fire and smoke rated partitions, walls, floors, etc.
- B. Types: Firestop required for the project includes smokestop.

1.2 QUALITY ASSURANCE

- A. UL Label: Firestops shall be UL labeled.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Nelson
- B. 3M (Minnesota Mining Manufacturing)
- C. Hilti
- D. Specified Technologies, Inc.
- E. Metacaulk

2.2 MATERIAL AND COMPONENTS

- A. General: Except as otherwise indicated, provide firestop manufacturer's standard materials and components as indicated by published product information, designed and constructed as recommended by the manufacturer, and as required for installation.

2.3 FIRESTOP

- A. Conduits: Provide a soft, permanently flexible sealant for 1-1/2 to 2 hour rated fireproofing for steel conduits (up to 4" diameter).
- B. Low Voltage Cables, Fiber Optic Cable and Innerduct: Provide Specified Technologies, Inc. EZ-Path single, double, or triple pathways as required.

PART 3 - EXECUTION

3.1 INSTALLATION OF FIRESTOPS

- A. General: Install firestops in accordance with the manufacturer's installation instructions and industry practices to ensure that the firestops comply with requirements. Comply with UL and NFPA standards for the installation of firestops.

END OF SECTION

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SECTION 260573

ARC FLASH HAZARD ANALYSIS / SHORT-CIRCUIT / COORDINATION STUDY

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections apply to this section.

1.2 SUMMARY

- A. The contractor shall furnish short-circuit and protective device coordination studies as prepared by the original equipment manufacturer (OEM) under this contract.
- B. The contractor shall furnish an Arc Flash Hazard Analysis Study per the requirements set forth in the current version of NFPA 70E – Standard for Electrical Safety in the Workplace. The arc flash hazard analysis shall be performed according to the IEEE Standard 1584-2002, the IEEE Guide for Performing Arc-Flash Calculations.
- C. The Scope of the studies shall include new distribution equipment supplied by switchboard / panelboard company under this contract.
- D. Related Sections include the following:
 - 1. Division 26 Section “Summary of Electrical Work”

1.3 REFERENCES

- A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - 1. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems.
 - 2. IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
 - 3. IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis
 - 4. IEEE 241 – recommended Practice for Electric Power Systems in Commercial Buildings
 - 5. IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems
 - 6. IEEE 1584 – Guide for Performing Arc-Flash Hazard Calculations
- B. American National Standards Institute (ANSI):
 - 1. ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power and Regulating Transformers
 - 2. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures
 - 3. ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
 - 4. ANSI C37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories

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- C. The National Fire Protection Association (NFPA)
 - 1. NFPA 70 – National Electrical Code – latest edition
 - 2. NFPA 70E – Standard for Electrical Safety in the Workplace

1.4 SUBMITTALS FOR REVIEW / APPROVAL

- A. The studies shall be submitted to the design engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the study may cause delays in equipment shipments, approval from the Engineer may be obtained for a preliminary submittal of data to ensure that the selection of device ratings and characteristics will be satisfactory to properly select the distribution equipment. The formal study will be provided to verify preliminary findings.

1.5 SUBMITTALS FOR CONSTRUCTION

- A. The results of the short-circuit, protective device coordination and arc flash hazard analysis studies shall be summarized in a final report. A minimum of five (5) bound copies of the complete final report shall be submitted. For large system studies, submittals requiring more than five (5) copies of the report will be provided without the section containing the computer printout of the short-circuit input and output data. Electronic PDF copies of the report shall be provided upon request.
- B. The report shall include the following sections:
 - 1. Executive Summary including Introduction, Scope of Work, and Results / Recommendations
 - 2. Short-Circuit Methodology Analysis Results and Recommendations
 - 3. Short-Circuit Device Evaluation Table
 - 4. Protective Device Coordination Methodology Analysis Results and Recommendations
 - 5. Protective Device Settings Table
 - 6. Time-Current Coordination Graphs and Recommendations
 - 7. Arc Flash Hazard Methodology Analysis Results and Recommendations including the details of the incident energy and flash protection boundary calculations, along with Arc Flash boundary distances, working distances, Incident Energy levels and Personal Protection Equipment levels.
 - 8. Arc Flash Labeling section showing types of labels to be provided. Section will contain descriptive information as well as typical images.
 - 9. One-line system diagram that shall be computer generated and will clearly identify individual equipment buses, bus numbers used in the short-circuit analysis, cable and bus connections between the equipment calculated maximum short-circuit current at each bus location, device numbers used in the time-current coordination analysis, and other information pertinent to the computer analysis.

1.6 QUALIFICATIONS

- A. The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the responsible charge and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting the power system studies.

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- B. The Registered Professional Electrical Engineer shall be an employee of the equipment manufacturer or an approved engineering firm.
- C. The Registered Professional Electrical Engineer shall have a minimum of five (5) years of experience in performing power system studies.
- D. The approved engineering firm shall demonstrate experience with Arc Flash Hazard Analysis by submitting names of at least ten actual arc flash hazard analyses it has performed in the past year.
- E. The engineering firm shall have a minimum of twenty-five (25) years' experience in performing power system studies.

1.7 COMPUTER ANALYSIS SOFTWARE

- A. The studies shall be performed using SKM Systems Analysis Power Tools for Windows (PTW) software program.

PART 2 – PRODUCT

2.1 STUDIES

- A. The contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E – Standard for Electrical Safety in the Workplace, reference Article 130.3 and Annex D. This study shall also include short-circuit and protective device coordination studies. All studies to be prepared by Switchboard / Panelboard Manufacturer.

2.2 DATA

- A. Contractor shall furnish all data as required for the power system studies. The engineer performing the short-circuit, protective device coordination and arc flash hazard analysis studies shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.
- B. Source combination may include present and future motors and generators.
- C. Load data utilized may include existing and proposed loads obtained from Contract Documents provided by Owner or Contractor.
- D. If applicable, include fault contribution of existing motors in the study. The Contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

2.3 SHORT CIRCUIT ANALYSIS

- A. Transformer design impedances shall be used when test impedances are not available.
- B. Provide the following:
 - 1. Calculation methods and assumptions
 - 2. Selected base per unit quantities

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3. One-line diagram of the system being evaluated that clearly identifies individual equipment buses, bus numbers used in the short-circuit analysis, cable and bus connections between the equipment, calculated maximum short-circuit current at each bus location and other information pertinent to the computer analysis.
 4. The study shall include input circuit data including electric utility system characteristics, source impedance data, conductor lengths, number of conductors per phase, conductor impedance values, insulation types, transformer impedances and X/R ratios, motor contributions, and other circuit information as related to the short-circuit calculations.
 5. Tabulations of calculated quantities including short-circuit currents, X/R ratios, equipment short-circuit interrupting or withstand current ratings and notes regarding adequacy or inadequacy of the equipment rating.
 6. Results, conclusions, and recommendations. A comprehensive discussion section evaluating the adequacy or inadequacy of the equipment must be provided and include recommendations as appropriate for improvements to the system.
- C. For solidly-grounded systems, provide a bolted line-to-ground fault current study for applicable buses as determined by the engineer performing the study.
- D. Protective Device Evaluation:
1. Evaluate equipment and protective devices and compare to short circuit ratings
 2. Adequacy of switchgear, motor control centers, and panelboard bus bars to withstand short-circuit stresses
 3. Contractor shall notify Owner in writing, of any circuit protective devices improperly rated for the calculated available fault current.

2.4 PROTECTIVE DEVICE TIME-CURRENT COORDINATION ANALYSIS

- A. Protective device coordination time-current curves (TCC) shall be displayed on log-log scale graphs.
- B. Include on each TCC graph a complete title with descriptive device names
- C. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
- D. Identify the device associated with each curve by manufacturer type, function and, if applicable, tap, time delay, and instantaneous settings recommended.
- E. Plot the following characteristics on the TCC graphs, where applicable:
1. Electric utility's overcurrent protective device
 2. Medium voltage equipment overcurrent relays
 3. Medium and low voltage fuses including manufacturer's minimum melt, total clearing, tolerance and damage bands.
 4. Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands
 5. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves
 6. Medium voltage conductor damage curves
 7. Ground fault protective devices, applicable
 8. Pertinent motor starting characteristics and motor damage points, where applicable

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9. Pertinent generator short-circuit decrement curve and generator damage point
 10. The largest feeder circuit breaker in each motor control center and applicable panelboard.
- F. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.
- G. Provide the following:
1. A One-Line Diagram shall be provided which clearly identifies individual equipment buses, bus numbers, device identification numbers and the maximum available short-circuit current at each bus when known.
 2. A sufficient number of log-log plots shall be provided to indicate the degree of system protection and coordination by displaying the time-current characteristics of series connected overcurrent devices and other pertinent system parameters.
 3. Computer printouts shall accompany the log-log plots and will contain descriptions for each of the devices shown, settings of the adjustable devices, and device identification numbers to aid in locating the devices on the log-log plots and the system one-line diagram.
 4. The study shall include a separate, tabular printout containing the recommended settings of all adjustable overcurrent protective devices, the equipment designation where the device is located, and the device number corresponding to the device on the system one-line diagram.
 5. A discussion section which evaluates the degree of system protection and service continuity with overcurrent devices, along with recommendations as required for addressing system protection or device coordination deficiencies.
 6. Contractor shall notify Owner in writing of any significant deficiencies in protection and / or coordination. Provide recommendations for improvements.

2.5 ARC FLASH HAZARD ANALYSIS

- A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA 70E-2009, Annex D. The arc flash hazard analysis shall be performed in conjunction with the short-circuit analysis (Section 2.3) and the protective device time-current coordination analysis (Section 2.4).
- B. The flash protection boundary and the incident energy shall be calculated at significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway and splitters) where work could be performed on energized parts.
- C. Circuits 240V or less fed by single transformer rated less than 125 kVA may be omitted from the computer model and will be assumed to have a hazard risk category 0 per NFPA 70E.
- D. Working distances shall be based on IEEE 1584. The calculated arc flash protection boundary shall be determined using those working distances.
- E. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.

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- F. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location in a single table. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum. Conversely, the maximum calculation will assume a maximum contribution from the utility. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable as well as any stand-by generator applications.
- G. The Arc-Flash Hazard Analysis shall be performed utilizing mutually agreed upon facility operational conditions, and the final report shall describe, when applicable, how these conditions differ from worst-case bolted fault conditions.
- H. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors should be decremented with time. Fault contribution from motors should be decremented as follows:
 - 1. Fault contribution from induction motors should not be considered beyond 5 cycles.
- I. For each piece of ANSI rated equipment with an enclosed main device, two calculations shall be made. A calculation shall be made for the main cubicle, sides, or rear; and shall be based on a device located upstream of the equipment to clear the arcing fault. A second calculation shall be made for the front cubicles and shall be based on the equipment's main device to clear the arcing fault. For all other non-ANSI rated equipment, only one calculation shall be required and it shall be based on a device located upstream of the equipment to clear the arcing fault.
- J. When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.
- K. Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.
- L. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. A maximum clearing time of 2 seconds will be used based on IEEE 1584-2002 Section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.
- M. Provide the following:
 - 1. Results of the Art-Flash Hazard Analysis shall be submitted in tabular form, and shall include device or bus name, bolted fault and arcing fault current levels, flash protection boundary distances, working distances, personal-protective equipment classes and AFIE (Arc Flash Incident Energy) levels.
 - 2. The Arc-Flash Hazard Analysis shall report incident energy values based on recommended device setting for equipment within the scope of the study.

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3. The Arc-Flash Hazard Analysis may include recommendations to reduce AFIE levels and enhance worker safety.

PART 3 – EXECUTION

3.1 FIELD ADJUSTMENT

- A. Contractor shall adjust relay and protective device settings according to the recommended settings table provided by the coordination study.
- B. Contractor shall make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.
- C. Contractor shall notify Owner in writing of any required major equipment modifications.

3.2 ARC FLASH LABELS

- A. Contractor shall provide a 4.0 in. x 4.0 in. Brady thermal transfer type label of high adhesion polyester for each work location analyzed.
- B. The labels shall be designated according to the following standards:
 1. UL 969 – Standard for Marking and Labeling Systems
 2. ANSI Z535.4 – Product Safety Signs and Labels
 3. NFPA 70 (National Electric Code) – Article 110.16
- C. The label shall include the following information:
 1. System Voltage
 2. Flash protection boundary
 3. Personal Protective Equipment category
 4. Arc Flash Incident energy value (cal/cm²)
 5. Limited, restricted, and prohibited Approach Boundaries
 6. Study report number and issue date
- D. Labels shall be printed by a thermal transfer type printer, with no field markings.
- E. Arc flash labels shall be provided for equipment as identified in the study and the respective equipment access areas per the following:
 1. Floor Standing Equipment – Labels shall be provided on the front of each individual section. Equipment requiring rear and / or side access shall have labels provided on each individual section access area. Equipment line-ups containing sections with multiple incident energy and flash protection boundaries shall be labeled as identified in the Arc Flash Analysis table.
 2. Wall Mounted Equipment – labels shall be provided on the front cover or a nearby adjacent surface, depending upon equipment configuration.
 3. General Use Safety Labels shall be installed on equipment in coordination with the Arc Flash Labels. The General Use Safety labels shall warn of general electrical hazards associated with shock, arc flash, and explosions, and instruct workers to turn off power prior to work.
- F. Labels shall be field installed by Contractor. The technician providing the installation shall have completed an 8-hour instructor led Electrical Safety Training Course which includes NFPA 70E material including the selection of personal protective equipment.

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END OF SECTION

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SECTION 260800

COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes commissioning process requirements for electrical systems, assemblies, and equipment.

1.3 CONTRACTOR RESPONSIBILITIES

- A. Perform commissioning tests at the direction of the CxA.
- B. Attend construction phase controls coordination meeting.
- C. Participate in electrical systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.
- D. Provide information requested by the CxA for final commissioning documentation.
- E. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.
- F. Provide project-specific construction checklists and commissioning process test procedures for actual electrical systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.
- G. Direct commissioning testing.
- H. Verify testing, adjusting, and balancing of Work are complete.
- I. Provide test data, inspection reports, and certificates in Systems Manual.

1.4 COMMISSIONING DOCUMENTATION

- A. Provide the following information to the CxA for inclusion in the commissioning plan:
 - 1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
 - 2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.

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3. Process and schedule for completing construction checklists and manufacturer's pre-start and startup checklists for electrical systems, assemblies, equipment, and components to be verified and tested.
4. Certificate of completion certifying that installation, pre-start checks, and startup procedures have been completed.
5. Certificate of readiness certifying that electrical systems, subsystems, equipment, and associated controls are ready for testing.
6. Test and inspection reports and certificates.
7. Corrective action documents.

1.5 SUBMITTALS

- A. Certificates of readiness.
- B. Certificates of completion of installation, pre-start, and startup activities.

PART 2 - PRODUCTS

(Not Applicable)

PART 3 - EXECUTION

3.1 GENERAL

- A. Refer to Division 01 "General Commissioning Requirements."

3.2 DEFERRED TESTING

- A. Initial commissioning will be done as soon as contract work is completed, regardless of building occupancy and equipment loading. Deferred testing under full- or heavy-load conditions will be handled at later time by Construction Manager and CxA.
 1. If adequate load may be artificially placed upon heating or cooling equipment, CxA, at his discretion, may perform functional testing during non-peak load periods.
 2. Construction Manager is to provide services of personnel and participate in seasonal testing process in the same manner as he would in non-seasonal testing.
 3. Until off-season commissioning can be accomplished, Owner may retain an amount from Construction Manager's payment sufficient to cover the cost of off-season testing.
- B. Unforeseen Deferred Tests: If any check or test cannot be completed due to building structure, required occupancy condition, or other reason, execution of checklists and functional testing may be delayed upon approval of Owner. Tests shall be conducted in same manner as seasonal tests, as soon as possible. Services of required parties will be negotiated. Make final adjustments to Operation and Maintenance Manuals and record drawings due to unforeseen deferred tests.
 1. Construction Manager is to provide services of personnel and participate in deferred testing in the same manner as he would for normal commissioning.
 2. Until deferred testing can be accomplished, Owner may retain an amount from Construction Manager's payment sufficient to cover the cost of deferred testing.

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3.3 PRE-FUNCTIONAL CHECKLISTS

- A. Construction Manager shall conduct Pre-functional Testing to document compliance with installation and start-up checklists prepared by Commissioning Authority for the Division 26 items.
- B. Refer to Division 01 "General Commissioning Requirements." for issues relating to pre-functional checklists and testing, including list of systems to be commissioned, description of process, details on non-conformance issues relating to pre-functional checklists and test.

3.4 TRAINING

- A. Refer to Division 01 "General Commissioning Requirements."

3.5 O&M MANUALS

- A. Refer to Division 01 "General Commissioning Requirements."

3.6 SYSTEM START-UP

- A. Construction Manager is solely responsible for system start-up. CxA may, at his discretion, witness start up procedures, but will not perform any Functional Testing of systems until Construction Manager has completed start-up and resolved all operating deficiencies.

3.7 TESTING PREPARATION

- A. Certify that electrical systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
- B. Certify that instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.
- C. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
- D. Inspect and verify the position of each device and interlock identified on checklists.
- E. Check all notification and initiation devices and interlocks with associated systems during each mode of operation.

- F. All circuit breakers 100 amperes and larger shall be subject to testing in accordance with the appropriate specification.

3.8 FUNCTIONAL TESTING PROCEDURES OF SYSTEMS TO BE COMMISSIONED

- A. All Electrical and Electrically Powered Equipment:
 - 1. Inspect electrical wiring and grounding for proper connections, color coding, and quality of installation.
 - 2. Verify supply voltage, all hot legs.
 - 3. Verify amperage is within allowable limits.

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4. Inspect for physical damage, proper installation, anchorage.
5. Verify unit runs smoothly and quietly.
6. Verify operation of safeties.
7. Verify maintenance and NEC clearances are maintained.

B. Service Grounding Test:

1. CxA will witness Construction Manager perform three point fall-of-potential tests on main grounding electrode system per IEEE Standard No. 81, Section 9.04. Construction Manager will provide CxA ample advance notice of test so that CxA may be witness, or he shall re-test in CxA's presence. Ground resistance testing is to include lightning protection system as well as electrical power systems.

C. Emergency Generator / Auto Transfer Switches:

1. Review / confirm load bank testing adequacy.
2. Inspect and verify proper power wiring.
3. Cut power at breaker(s) as required to activate ATS and generator. Record times of all major events (ATS pickup, transfer, generator start signal, generator up to speed, emergency power transfer, etc.)
4. Observe and document operating characteristics (voltage, amps, generator load, speed, power factor, etc.).
5. Verify operation of local control panels and remote annunciator panels.

D. Electrical Distribution System:

1. Circuit breaker panels:
 - a. Wiring:
 - 1) Verify wiring connections are secure.
 - 2) Verify ground wires properly terminated, panels are grounded.
 - 3) Verify wiring color coding is proper.
 - b. Verify panel is properly identified.
 - c. Verify load indicated in circuit directory is actual load served in space (by opening circuit breaker and observing response in space).
 - d. Verify load identification corresponds to room number and is adequately descriptive of load.
2. Receptacle and Device Test:
 - a. Test receptacle with a receptacle circuit tester for proper polarity.
 - b. Test each receptacle or branch circuit breaker having ground-fault circuit protection.

E. Lighting Systems:

1. Light Fixtures: Verify all lamps work without flicker.
2. Motion Sensors:
 - a. Verify sensors pick up motion and turn on lights immediately.
 - b. Verify that lights turn off after specified time.

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- c. Verify sensor coverage includes entire room area being sensed.
- d. For ceiling mounted occupancy switches, verify light switches still function in circuit.

F. Lightning Protection Systems:

- 1. Visually inspect all devices to ensure:
 - a. All specified devices are in place.
 - b. Devices are securely wired.
 - c. Wiring is continuous.
 - d. Clamps are securely adhered to roof.
 - e. Dissimilar metals are not touching.
 - f. Ground wires go to building ground loop at specified locations.
- 2. Test resistance to ground from various locations on lighting protection wiring.

G. Variable Frequency Drives:

- 1. Functional Testing of VFDs is to be undertaken with Functional Testing of system that they serve; refer to Functional Testing of air handlers, pumps, etc.
- 2. Verify all motors run proper direction when system is in VFD mode or bypass mode of operation.
- 3. Verify communications interface with DDC control system.
- 4. Verify functionality of safety interlocks.

H. Transformers:

- 1. Verify primary and secondary voltages are within acceptable range and secondary voltage taps (where applicable) are appropriate.

I. UPS (Uninterruptible Power Supply):

- 1. Verify system senses modes of power failure.
- 2. Verify switch to emergency power.
- 3. Verify switch back to normal power.

J. Motor Control Centers:

- 1. Breaker sizes and adjustable trip settings are set correctly.
- 2. Wire size is correct.
- 3. Housekeeping pad has correct dimensions.
- 4. Tested for short circuits.
- 5. Wire insulation performance tested.

END OF SECTION

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SECTION 260925

ELECTRICAL CONTACTORS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Miscellaneous electrical contactors as shown, required, scheduled, and specified.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturers: Provide products produced by one of the following:
Schneider Electric - Square D
ABB-General Electric
Siemens
Eaton

2.2 CONTACTORS

- A. Provide contactors as shown, required, and specified. The number of poles, ampere-ratings, and pole arrangements shall be as required. Contactors shall conform to the following:
1. Rated for continuous duty at full rated current in an unventilated enclosure. Eight-hour duty ratings are not acceptable.
 2. Contacts shall be readily replaceable, self-aligning, silver alloy.
 3. Load contactors shall be rated for not less than 30A continuous rating. Auxiliary contacts shall be rated for not less than 10 amperes.
 4. Contactors rated for lighting and mixed loads shall have an interrupting capacity of 150% of their continuous duty rating.
 5. Contactors shall be capable of successfully handling inrush currents at 20 times rating.
 6. Provide a minimum of two spare load contacts on each individual contactor rated 60A or less for future use.
- B. Electrically-held Devices shall conform to the following:
1. AC operated units shall have laminated low loss electrical steel core pieces with machine ground pole faces and shading coils.
 2. Units rated at 300A and above shall have DC operating coils and include the necessary rectifier for the AC/DC operation.
 3. Normally open contactors shall be spring-loaded open and magnetically closed.
 4. Contactors for emergency lighting or power shall be normally closed.
- C. Controls: Individual contactors operated by automatic controls shall have 30.5mm HAND-OFF-AUTOMATIC switches, otherwise provide HAND-OFF switches. Contactor controls shall be mounted in the contactor enclosure cover. Contactors serving receptacle loads controlled by local switching shall not have Hand-Off-Auto nor Hand-Off switching.
- D. Control Power. Provide dedicated 120-volt circuit for contactor control power and indicator pilot lights. Do not use same circuit feeding load.

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- E. Enclosure
 - 1. Contactors and control enclosures installed in indoor locations shall be NEMA 1 heavy-duty enclosures unless shown otherwise.
 - 2. Contactors and control enclosures installed at kitchen and food preparation locations, hose down areas, cooling towers, exterior locations, in greenhouses, and in other corrosive areas shall be NEMA 4X, stainless steel.
- F. Minimum interrupting rating shall be 35KAIC.

PART 3 - EXECUTION

3.1 INSTALLATION OF MISCELLANEOUS ELECTRICAL CONTROLS

- A. Provide electrically held contactors, with line side wiring complete, in accordance with the National Electrical Code and manufacturer's recommendations.
- B. Fuses: Install fuses where coil control power is fed from line side of contactor.
- C. Adjustment: Adjust operating mechanisms for free mechanical movement.
- D. Coordinate contactor control and operation requirements with the Building Management Control System.
- E. Identify each contactor as specified in Section 26 05 00.
- F. Contactors shall not be installed above ceiling and shall be readily accessible. Locate contactors in same room as panelboard serving the load unless otherwise indicated.

3.2 INTERIOR AND EXTERIOR LIGHTING CONTROL

- A. Parking lot lighting, building mounted exterior lighting, and exterior signage shall be controlled by separate lighting contactors by the specified Building Management and Control System. Interior lighting as noted on the plans shall be controlled as noted on the plans and as specified by the Building Management and Control System. Contractor shall circuit all systems to be controlled by the Building Management and Control System through contactors compatible with system controls and shall ensure the control and operation of lighting control system is complete.
- B. Provide mechanically held contactors where control is three-wire, momentary control signal.
- C. Provide electrically held contactors where control is two-wire, constant control signal for open or close.
- D. Provide normally closed contactors for emergency lighting and power circuits where contactors are indicated or required.
- E. Provide normally closed contactors for circuits controlled by "emergency power off" or teacher control switches in science classrooms, computer labs, and vocational instructional areas.
- F. Provide control contactors and cabling for bi-level or tri-level LED drivers. Bi / tri level control contactors for exterior lighting shall be controlled by the Building Management Control System, with local BMCS manual override for both "ON" and "HIGH" settings. Bi / tri level controls for interior lighting shall be controlled by occupancy sensors and local control switch.

END OF SECTION

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SECTION 260944

LIGHTING CONTROLS – STAND ALONE OPERATION

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Lighting control system and components:
 - 1. Touch panel controls
 - 2. Low and line voltage wall stations
 - 3. Power interfaces
 - 4. Sensors

1.2 SUMMARY

- A. The lighting control system specified in this section shall provide manual lighting control, sensor-based (both occupancy and daylight control when indicated, specified, or required by AHJ).
- B. The system shall be capable of turning lighting and plug loads on/off as well as dimming lights (if lighting load is capable and indicated to be dimmed). Dimmers shall be capable of smooth dimming lights to off.
- C. All system devices within a group or controlled area shall be networked together, enabling wired or wireless digital communication between devices within that group.
- D. The system architecture shall be stand-alone groups (areas) of devices.
- E. The system shall not require any centrally hardwired switching equipment.
- F. The system shall be capable of wireless, wired, or hybrid wireless/wired communication architectures. All powered devices shall be wired for power. Battery operation shall not be used unless specifically indicated on the drawings, typically due to existing conditions which prohibit wired power sources.
- G. The term “occupancy sensor” shall be interchangeable with the term “vacancy sensor” as the control hardware shall be the same device and be capable of either function.

1.3 SUBMITTALS

- A. Specification line-by-line compliance review consisting of a marked-up copy of these specifications with contractor comments. Refer to Submittals specification section for additional instructions.
- B. Product Datasheets (general device descriptions, dimensions, electrical specifications, wiring details, nomenclature)
- C. Riser Diagrams – typical per room type (detailed drawings showing device interconnectivity of devices)
- D. Other Diagrams – as needed for special operation or interaction with other system(s)

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- E. Example Contractor Startup/Commissioning Worksheet – must be completed prior to factory start-up and commissioning.
- F. Hardware Operation Manuals
- G. Other operational descriptions as needed.

1.4 PROJECT CLOSEOUT DOCUMENTATION

- A. Provide a factory published manual
 - 1. Warranty
 - 2. Technical support contact
 - 3. Electronic manual on manufacturer's website for free download
- B. Completed Startup/Commissioning Worksheet with Owner's acceptance and date clearly noted.

1.5 QUALITY ASSURANCE

- A. All components and the manufacturing facility where product was manufactured must be RoHS compliant.
- B. In high humidity or cold environments, the sensors shall be conformably coated and rated for condensing humidity and -40 degrees Fahrenheit (and Celsius) operation.
- C. All applicable products must be UL or ETL Listed or other acceptable national testing organization.

1.6 PROJECT CONDITIONS

- A. Only install equipment after the following site conditions are maintained:
 - 1. Ambient Temperature 14 to 105 degrees F (-10 to 40 degrees C).
 - 2. Relative Humidity less than 90% non-condensing.
- B. Standard electrical enclosures shall be permanently installed.
- C. Equipment shall be protected from dust, debris and moisture.

1.7 WARRANTY

- A. Five (5) year manufacturer's warranty parts replacement beginning upon completion of Factory Start-up and Commissioning date as noted on the Owner accepted Startup / Commissioning Worksheet.

1.8 MAINTENANCE & SUSTAINABILITY

- A. Provide new parts, upgrades, and/or replacements available for a minimum of 5 years available to the end user.
- B. Provide free telephone technical support.
- C. Spare Parts: Provide minimum of 1 unit up to 5% of each hardware device product used, whichever is greater.

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PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
1. Acuity Brands Lighting, Inc.
 2. Legrand North America, LLC
 3. Cooper Lighting Controls
 4. Douglas Lighting Controls
 5. Lutron
 6. Leviton
 7. Crestron
 8. Hubbell

2.2 SYSTEM REQUIREMENTS

- A. System shall have an architecture that is based upon three main concepts; 1) intelligent lighting control devices 2) standalone lighting control zones. Intelligent lighting control devices shall consist of one or more basic lighting control components; occupancy sensors, photocell sensors, relays, UL 924 emergency lighting relays, dimming outputs, manual switch stations, manual dimming stations. Combining one or more of these components into a single device enclosure is be permissible so as to minimize overall device count of system.
- B. Lighting control zones shall consist of one or more intelligent lighting control components and fully functional in stand-alone operation.
- C. Low voltage devices within a lighting control zone shall be capable of being connected with low voltage cabling in any order.
- D. Lighting control zone shall be capable of automatically configuring itself for default operation without any start-up labor required.
- E. Power for devices within a lighting control zone shall come from either resident devices already present for that zone. Standalone power supplies are not acceptable.
- F. All switching and dimming for a specific lighting zone shall take place within the devices located in the zone itself (i.e. not in remotely located devices such as panels) to facilitate system robustness and minimize wiring requirements.
- G. Individual lighting zones requiring or indicated with intelligent room controllers shall be capable of being segmented into several local channels of occupancy, photocell, and switch functionality for more advanced configurations and sequences of operation.
- H. Operating modes shall be utilized only in manners consistent with local energy codes. Where daylight controls are indicated or required the photocell functions noted below shall be incorporated.
1. Auto-On / Auto-Off (via occupancy sensors)
 - a. Zones with occupancy sensors automatically turn lights on when occupant is detected.
 - b. Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.

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- c. Pressing a switch will turn lights off. The lights will remain off regardless of occupancy until switch is pressed again, restoring the sensor to Automatic On functionality.
2. Manual-On / Auto-Off (also called Semi-Automatic or Vacancy)
 - a. Pushing a switch will turn lights on.
 - b. Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.
3. Auto On / Predictive Off
 - a. Zones with occupancy sensors automatically turn lights on when occupant is detected.
 - b. Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.
 - c. Pressing the switch will turn the lights off and a short "exit timer" begins. After the timer expires, sensor scans the room to detect whether occupant is still present. If no occupancy is detected, zone returns to auto-on. If occupancy is detected, lights must be turned on via the switch.
4. Auto ON at 50% or less / Auto Off (Occupancy with dimming)
 - a. Operating mode designed specifically IECC compliance using occupancy mode for specific areas.
 - b. Zones with occupancy sensors automatically turn lights on to maximum 50-percent (adjustable and programmable to 50-percent max) when occupant is detected.
 - c. Pushing a switch will raise or lower light levels.
 - d. Zones with occupancy and/or photocell sensors turn lights off when vacancy or dim accordingly when daylight is detected to maintain desired light level.
 - e. Pushing a switch will turn lights off.
5. Manual-On to Auto-On/Auto-Off
 - a. Pushing a switch will turn lights on.
 - b. After initial lights on, zones with occupancy and/or photocell sensors turn lights on/off according to occupancy/vacancy and/or daylight conditions.

2.3 INDIVIDUAL DEVICE SPECIFICATIONS

- A. Occupancy sensors:
 1. Occupancy sensors shall sense the presence of human activity within the desired space and fully control the on/off function of the lights.
 2. Only passive infrared (PIR) technology, which detects occupant motion, shall be used to initially turn lights on from an off state, thus preventing false on conditions.
 3. Dual technology sensors shall be used. Only where ultrasonic or microphonic technology might create a false occupied state, not allowing the lights to automatically turn off shall PIR only be used. Acceptable dual technology includes PIR/Microphonics technology (also known as Passive Dual Technology or PDT) which both looks for occupant motion and listens for sounds indicating occupants or PIR/Ultrasonic technology.
 4. Sensors shall include a minimum of one integrated dry contact switching relay, capable of switching 1 amp at 24 VAC/VDC (resistive only) for BAS/BMCS control.
 5. Sensors shall be available in multiple lens options which are customized for specific applications.
 6. Embedded luminaire sensors shall be capable of both PIR and Dual Technology occupancy detection. Embedded sensors shall have an optional photocell.
 7. Ceiling, fixture, recessed, & corner mounted sensors shall be available.
 8. Sensors shall have optional features for photocell/daylight override, dimming control, and low temperature/high humidity operation.

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- B. Daylight (photocell and/or dimming) sensors:
1. Photocell shall provide for an on/off set-point, and a deadband to prevent the artificial light from cycling. Delay shall be incorporated into the photocell to prevent rapid response to passing clouds.
 2. Photocell and dimming sensor's set-point and deadband shall be automatically calibrated through the sensor's microprocessor by initiating an "Automatic Set-point Programming" procedure. Min and max dim settings as well as set-point may be manually entered.
 3. Deadband setting shall be verified and modified by the sensor automatically every time the lights cycle to accommodate physical changes in the space (i.e., furniture layouts, luminaire depreciation, or luminaire outages).
 4. Combination units that have all features of on/off photocell and dimming sensors may be used
 5. Luminaire mounted dimming photocells shall be embedded into luminaire such that only the lens shows on luminaire face.
- C. Power (Relay) Packs:
1. Power Packs shall incorporate one Class 1 relay, a 0-10 VDC dimming output, and contribute low voltage power to the rest of the system.
 2. Power Packs shall accept 120 or 277 VAC, rated for a minimum 16 Amps for any type of lighting load or motor load rated to 1 HP, provide 0-10 VDC dimming control, be plenum rated, and provide Class 2 power to the system.
 3. Every Power Pack parameter shall be available and configurable locally.
 4. Power Pack shall securely mount to junction location through a threaded ½ inch chase nipple or be capable of being secured within a luminaire ballast channel. Plastic clips into junction box shall not be accepted. All Class 1 wiring shall pass through chase nipple into adjacent junction box without any exposure of wire leads. Note: UL Listing under Energy Management or Industrial Control Equipment automatically meets this requirement, whereas Appliance Control Listing does not meet this safety requirement.
 5. When required by local code, Power Pack shall install inside standard electrical enclosure and provide UL recognized support to junction box. All Class 1 wiring is to pass through chase nipple into adjacent junction box without any exposure of wire leads.
 6. Secondary Packs shall be available that provide up to 5 Amps of switching and can line voltage dim 120 VAC incandescent/halogen lighting loads.
 7. Secondary Packs shall be available that provide up to 5 Amps of switching and can dim line voltage 120/277 VAC magnetic low voltage transformers.
 8. Secondary Packs shall be available that provide up to 4 Amps of switching and can dim 120 VAC electronic low voltage transformers.
 9. Power/Secondary Packs shall be available that are UL924 listed for switching of Emergency Power circuits and control of 0-10 VDC dimming circuit.
 10. Secondary Packs shall be available that control louver/damper motors for skylights.
 11. Secondary Packs shall be available that provide a pulse on/pulse off signal for purposes of controlling shade systems via relay inputs.
 12. Power (Secondary) Packs shall be available that provide up to 20 Amps switching of general purposed receptacle (plug-load) control.
- D. Relay & Dimming Room Controller (Panel)
1. Panel shall incorporate up to 3 normally closed latching relays capable of switching 120/277 VAC or up to 2 Dual Phase relays capable of switching 208/240/480 VAC loads.

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2. Relays shall be rated to switch up to a 30A ballast load at 277 VAC.
 3. Panel shall provide one 0-10VDC dimming output paired with each relay.
 4. Panel shall power itself from an integrated 120/277 VAC supply.
 5. Panel shall supply current limited low voltage power to other devices in the same lighting zone.
 6. Panel shall provide auxiliary low voltage device power connected wired directly to a dedicated terminal connection.
- E. Auxiliary Input / Output (I/O) Devices for enhanced room controls:
1. Devices shall be plenum rated and be inline wired, screw mountable, or have an extended chase nipple for mounting to a ½" knockout.
 2. Specific I/O devices shall have a dimming control output that can control 0-10 VDC LED drivers by sinking up to 20 mA of current.
 3. Specific I/O devices shall have an input that reads a 0-10 VDC signal from an external device.
 4. Specific I/O devices shall have a switch input that can interface with either a maintained or momentary switch and run a switch event (toggle the lighting load) or run a local/remote control profile.
 5. Specific I/O devices shall sense state of low voltage outdoor photocells.
 6. Specific I/O devices shall enable RS-232 communication between lighting control system and Touch Screen based A/V control systems.
 7. Specific I/O devices shall sense momentary and maintained contact closures, and either toggle a connected load after a momentary contact or ramp the load high/low during a maintained contact (stopping when the contact releases).
- F. Low Voltage Wall Switches & Dimmers:
1. Devices shall provide toggle on/off switch control.
 2. Devices color shall match building standard line voltage wiring device color.
 3. Devices with mechanical push-buttons shall provide tactile with LED user feedback.
 4. Devices with mechanical push-buttons shall be made available with custom button labeling
- G. Graphic Wall Station:
1. Minimum 3.5-inch full color touch screen for selecting up to 16 programmable lighting control preset scenes or acting as up to 16 on/off/dim control switches.
 2. Color shall match building standard for line voltage switching.
 3. Device shall enable configuration of all switches, dimmers, and lighting preset scenes via password protected setup screens.
 4. Device shall enable user supplied .jpg screen saver image to be uploaded.
 5. Surface mount to single-gang recessed switch box.
 6. Micro-USB style connector for local computer connectivity.
- H. Scene Controllers:
1. Two, three, four, or eight buttons for selecting programmable lighting control profiles or acting as on/off switches.
 2. Color shall match building standard for line voltage switching.
 3. Devices shall provide LED user feedback.
 4. Device shall be capable of reprogramming other devices in its zone so as to implement user selected lighting scene.
 5. Device shall have LEDs indicating current selection.

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2.4 START-UP & SUPPORT FEATURES

- A. To facilitate start-up, all devices daisy-chained together shall automatically be grouped together into a functional lighting control zone.
- B. All lighting control zones shall be able to function according to default settings once adequate power is applied and before any field programming is performed.

PART 3 - EXECUTION

3.1 GENERAL

- A. Provide the quantity of sensors required for complete and proper coverage to completely cover the controlled areas. Contractor shall verify room coverage and ceiling heights with manufacturer and provide the quantity and type of occupancy sensors as required. Rooms shall have one hundred (100) percent coverage of small motion detection to completely cover the controlled areas to accommodate all occupancy habits of single or multiple occupants at any location within the room(s). The locations and quantities of sensors shown on the drawings are diagrammatic and indicate only rooms that are to be provided with sensors. Proper judgment must be exercised in executing the work so as to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components, architectural components, or Owner installed equipment which may cause obstructions to sensor coverage.
- B. Provide ceiling mounted sensors. Wall mounted sensors shall only be used where ceiling mounted sensors are proven by the manufacturer to be impractical, or if specifically indicated on the drawings.
- C. For ceilings up to 12-feet AFF, control equipment shall be mounted above an accessible ceiling. Control equipment shall be wall mounted on 24x24-inch fire resistive 0.75-inch thick plywood back board mounted to the wall above the ceiling. Do not paint fire resistive plywood or obliterate the fire resistive labeling. Locate the control equipment directly above the space/area main entry wall switch station, observing good installation practice and shall be consistent throughout the project. Where the ceiling is over 12-feet, the control equipment shall be located in an adjoining ancillary room/area where the ceiling is 12-feet AFF or lower, typically adjacent to the ancillary room/area above ceiling control equipment location, verify exact location with Owner.
- D. Control units used for the security or fire systems shall be powered from the emergency power source as indicated on the drawings. Other control units shall be powered from the lighting circuit, which they control.
- E. Refer to other specification sections for line voltage wiring device requirements, including momentary on/off toggle switches used with low voltage sensors.

3.2 INSTALLATION

- A. Use lighting control wiring with jacket color that matches Owner's cable color standards.
- B. Install the work of this Section in accordance with manufacturer's printed instructions unless otherwise indicated.

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- C. The installing electrical contractor shall complete, prior to request of factory start up and site commissioning, complete installation of all devices, their respective loads landed and confirmed operations, switches installed, and confirmed operational.
- D. The installing contractor shall, prior to request of factory start up and site commissioning, request an on-site meeting by including the manufacture's local authorized representative, the Owner and the general contractor, to assist in identification of any open-ended issues, thereby eliminating potential for delays and system commission interruptions.
- E. Upon confirmation of progress by local factory representative, the installing electrical contractor shall complete the manufacture's start up request form(s), including any field changes from the contract documents.
- F. The installing electrical contractor shall provide a preliminary as-built drawing prior to commissioning to the manufacturer's representative. Drawing shall include all wire routing, room by room device ID's and locations of all lighting control devices.
- G. Install sensors in accordance with manufacturer's written instructions, requirements of NEC, and in accordance with industry practices. Do not install devices until wall construction and wiring is completed.
- H. Install sensors and switches only in electrical boxes that are clean, free from excess building materials, debris, and similar matter.
- I. Install sensors plumb and aligned in the plane of the wall, or ceiling in where they are installed.
- J. Install wall occupancy sensor switches in boxes on the strike side of doors as hung. Where more than one switch is in the same location, install switches in a multi gang box with a single cover plate.
- K. Provide a cover plate for every switch. Refer to Architectural drawing, elevations, etc. for exact location of wall switches where indicated on the Architectural plans. Coordinate location of all wall switches with other specialty items and millwork and avoid conflicts. Coordinate with all trades to avoid conflicts during construction. Mounting heights of all switches shall comply with current Accessibility Standards and local codes.
- L. Unless indicated otherwise, circuit relays/switchpacks ahead of local control switches. Source -> relay/switchpack -> local toggle switch(s).
- M. Coordinate with BMCS/BAS Contractor for interface of BMCS/BAS System and wiring connections.
- N. Low voltage cabling installed above ceiling shall be supported every 5 feet at a minimum height of 3 feet above grid/ceiling but no closer than six inches below deck. Support system shall be ceiling wire attached to structure and clipped to ceiling support grid using Caddy drop wire securing clip #EC311. Cabling shall hang plumb to devices.

3.3 SENSOR TESTING AND ADJUSTMENT

- A. At the time of installation, the contractor shall test and adjust each sensor for proper detection of motion appropriate to room usage. The contractor shall follow the testing and adjustment procedures as written in the manufacturer's installation instructions for each sensor model. Relocate sensors as needed for proper coverage.

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- B. Prior to testing and adjusting, verify with Owner/Architect the initial settings for each type of area based on its intended function and use.
- C. Verify with Owner all adjustable functions of each type of occupancy sensor prior to installation. Set all adjustable functions of each type of occupancy sensor as directed by Owner. Initial settings unless directed by Owner / Architect (some settings may not apply to all sensors):
 - 1. Time delay = 10 minutes
 - 2. Zero Time Delay = OFF
 - 3. Auto-On = OFF
 - 4. Manual-On = ON
 - 5. Self-Adjust = OFF
 - 6. Disable Self-Adjust = OFF
 - 7. Energy Saver (Dual Level) = ON
 - 8. Manual Override = OFF
- D. Bi-level occupancy wall switches shall be initially set with the energy saver feature enabled.
- E. Before energizing, check for continuity of circuits, short circuits, and grounding connections. After energizing, check devices to demonstrate proper operation.
- F. Operate each wall switch with circuit energized and verify proper operation

3.3 FACTORY COMMISSIONING

- A. Upon completion of the installation, the system shall be commissioned by the manufacturer's factory authorized representative who will verify a complete fully functional system.
- B. The factory commissioning shall include the following services. Programming of all button stations, configuration and of all occupancy sensors and photocells.
- C. Provide written or computer-generated documentation on the commissioning of the system including room by room description including:
 - 1. Sensor parameters, time delays, sensitivities, and daylighting set points.
 - 2. Sequence of operation, (e.g., manual ON, Auto OFF. etc.)
 - 3. Load Parameters
- D. The electrical contractor shall provide in writing to the manufacturer, General Contractor, Architect, and the Owner with 21 Owner's business days' written notice of the requested system startup and adjustment date.
- E. The electrical contractor shall provide at least (1) journeyman electrician familiar with the installation of the system dedicated to assisting the factory start-up technician for the entire duration of the commissioning process.
- F. Upon completion of the system commissioning the factory-authorized technician shall provide the proper training to the Owner's personnel on the adjustment and maintenance of the system.
- G. Re-commissioning – After 90 days from full certificate of occupancy, re-calibrate all sensor time delays and sensitivities to meet the Owner's Project Requirements. Provide a detailed report to the Architect / Owner of re-commissioning activity.

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END OF SECTION

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SECTION 261215

DRY-TYPE TRANSFORMERS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Work Included: Low Voltage (less than 600 Volt) transformer work as shown, scheduled, indicated, and specified.
- B. Types: Transformers required for the project include dry-type transformers.

1.2 QUALITY ASSURANCE

- A. Standards: Transformers shall be designed and tested in accordance with NEMA and ANSI C33.4 and C89.2 standards.
- B. UL Label: Transformers shall be UL labeled.

1.3 STANDARDS

- A. UL-506
- B. ANSI C75.11
- C. NEMA ST-20
- D. DOE 2016 Efficiencies

1.4 SUBMITTALS

- A. Include outline and support point dimensions of enclosures and accessories, unit weight, voltage, KVA, and impedance ratings and characteristics, sound level, tap configurations, insulation system type and rated temperature rise.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Schneider Electric - Square D
- B. General Electric
- C. Siemens
- D. Eaton
- E. Acme
- F. Hammond

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2.2 MATERIALS AND COMPONENTS

- A. Except as otherwise indicated, provide transformer manufacturer's standard materials and components as indicated by published product information, designed and constructed as recommended, and as required for a complete installation.

2.3 DRY-TYPE TRANSFORMERS

- A. General: Indoor transformers shall be dry-type, multiple-winding transformers, rated as shown, and shall have manufacturer's standard impedance.
- B. Construction: Transformer core shall be constructed of cold-rolled, oriented, high permeability silicon steel, either formed as a coil or laminated.
- C. Taps: Transformers 15 to 30 kva shall have two 5% taps, one above and one below normal. Transformers 45 kva and larger shall have four 2-1/2% taps, two above and two below normal.
- D. Temperature Rating: Transformers shall use an insulation system that has been temperature classified and approved by UL. Transformers shall have a maximum winding temperature rise of 150°C with an insulation system temperature classification of 220°C.
- E. Load Rating:
1. Transformers shall be capable of operating at 100% of nameplate rating continuously while in an ambient temperature not exceeding 40°C.
 2. Transformers shall be capable of meeting the daily overload requirement of ANSI C57.12.
- F. Vibration Isolation: Each transformer core and coil shall be mounted in the transformer enclosure on rubber vibration isolators.
- G. Sound Rating: The transformer shall have sound levels equal to or lower than those ratings established in NEMA ST-20 and as shown in the following table. Sound ratings shall be measured in accordance with ANSI C89.91.

Transformer Rating (kva) (600 Volt Class)	Maximum Sound Level Decibels: NEMA ST-20
0 to 9	40
10 to 50	45
51 to 150	50
151 to 300	55
301 to 500	60

- H. Testing:
1. The manufacturer shall have tested each transformer for proper operation before shipment.
 2. The manufacturer shall have performed the following additional tests on units identical to the design type being supplied. Furnish proof of performance of these tests in the form of test data sheets upon request:
 - a. Sound levels.
 - b. Temperature rise tests.
 - c. Full-load core and winding losses.
 - d. Percent regulation with 80 and 100% power factor load.

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- e. Percent impedance.
- f. Exciting current.
- g. Insulation resistance.

PART 3 - EXECUTION

3.1 INSTALLATION OF TRANSFORMERS

- A. General: Install transformers where shown, in accordance with the manufacturer's written instructions and industry practices to ensure that the transformers meet the specifications. Comply with requirements of NEMA and NEC standards, and applicable portions of NECA Standard of Installation, for installation of transformers. Transformers shall be floor mounted. Ceiling mounted transformers are not acceptable.
- B. Dry-Type Transformer Mounting: Indoor, floor mount transformer on properly sized Amber/Booth Type RVD rubber-in-shear vibration isolators. Only where specifically indicated on the plans or approved in writing by the Owner/Engineer, transformers shall be trapeze mounted using properly sized Amber/Booth type BRD rubber-in-shear hangers. Transformer enclosures shall make no contact with wall surfaces.
- C. Conduit: Conduit directly connected to transformer enclosures shall be flexible liquid tight conduit extending for a minimum of 18-inches and a maximum of 24 inches from transformer enclosure as measured along the conduit centerline. Include a ground wire, size in accordance with NEC, internal in each length of flexible conduit.
- D. Grounding: Ground and bond transformers as a separately derived system unless noted otherwise, refer to NEC 250. Installation of bonding strap or bonding conductor between ground and neutral bus shall be witnessed by the Engineer prior to applying power and terminating secondary conductors.

3.2 TESTING

- A. Insulation Tests: Before energizing, check transformer windings for continuity.
- B. Winding Current: During initial no-load energizing, check current in each primary winding.
- C. Tap Settings: Measure and record load current and voltage of transformers while loaded to verify proper transformer tap settings.
- D. Submittals: Furnish instruments and personnel required for tests. Submit four copies of certified test results to Engineer for review. Reports include transformer tested, date and time of tests, relative humidity, temperature, and weather conditions.
- E. Notification: Notify Engineer in writing of any deviation from manufacturer's pre-shipment test data.

END OF SECTION

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SECTION 262315

CENTRALIZED EMERGENCY LIGHTING INVERTER

PART 1 – GENERAL

1.1 DESCRIPTION

This specification defines the electrical and mechanical characteristics and requirements for a three phase uninterruptible stored emergency power supply system. The system as specified herein includes all the components required to deliver reliable, high quality uninterruptible power for emergency illumination and related life safety equipment. The system shall incorporate an online, dual conversion, microprocessor DSP controlled, high frequency, IGBT PWM input PFC converter and output inverter, a high speed automatic bypass transfer device, a battery charger, an energy storage battery platform, an advanced full diagnostic monitor with automatic system testing and a touchscreen color LCD display panel, as well as all the related hardware components and software to facilitate a functional centralized system. The emergency power supply system shall provide immunity from power line disturbances and power interruptions. The specified system shall include an uninterrupted, normally on output power section and a normally off standby output power section, thus enabling compatibility with emergency lighting fixtures operating in (a) normally on and standby mode(s). A self-diagnostic monitoring alarm system shall continuously advise of system status and battery condition.

1.2 STANDARDS

The system shall be designed in accordance with applicable portions of the following standards:

- A. American National Standards Institute (ANSI C57.110)
- B. American National Standards Institute (ANSI C62.41 Category B-3)
- C. Institute of Electrical and Electronic Engineers (IEEE 519-1992)
- D. National Electrical Manufacturers Association (NEMA PE 1-2003)
- E. National Electric Code (Latest Revision of NEC Article 700 – Emergency Systems)
- F. National Fire Protection Association (NFPA 70) (NFPA 101) (NFPA 111) (NFPA 99)
- G. NFPA 101 Section 7.9.3.1.3 – Periodic Testing of Emergency Lighting Equipment
- H. Federal Communications Commission (FCC Class A limits, 47 C.F.R. Part 15, Subparts A, B)
- I. Listed UL Standard: ANSI/UL 924 Emergency Lighting and Power Equipment rated with 90 minutes of battery backup time, for use in accordance with NEC Article 700 (ANSI/NFPA 70), the Life Safety Code (ANSI/NFPA 101), and the International Building Code (IBC).

Inverter systems installed in locations requiring seismic bracing by local codes or ordinances shall be seismic-rated and tested in accordance with applicable portions of the following additional standards:

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- J. ICC - AC156: "Acceptance Criteria for Seismic Certification by Shake-Table Testing of Nonstructural Components and Systems"
- K. ASCE 7-10
- L. California Building Code – CBC 2016
- M. International Building Code – IBC 2015

1.3 SUBMITTALS

- A. Manufacturer Requirements:
 - 1. The manufacturer shall be ISO 9001:2015 "Quality Assurance Certified" and shall upon request furnish certification documents.
 - 2. The manufacturer shall be a United States based manufacturer with 15 years experience or greater in design and fabrication of centralized stored electrical energy emergency and standby power systems.
- B. Product Data:
 - 1. The manufacturer shall supply documentation for the installation of the system, including wiring diagrams and cabinet outlines showing dimensions, weights, BTUs, input/output current, input/output connection locations and required clearances.
 - 2. Factory test results shall be provided to show compliance with the requirements. The manufacturer shall include battery test documentation which demonstrates compliance with the specified minimum emergency reserve with full rated KW load.
 - 3. Submittals shall be specific for the equipment furnished and shall include as-built information.
 - 4. Where the system is required to be seismic rated, the manufacturer shall supply a seismic testing certificate of compliance to validate that the system was shake-table tested and met the code requirements specified.
- C. Full copy of this specification with line-by-line compliance, deviations, or non-compliance.

1.4 WARRANTY

- A. The manufacturer shall guarantee the inverter's power components and system electronics to be free from defects in material and workmanship during the warranty period. Inverter systems shall include a factory-authorized start up service, after which a 3 year parts and 3 year factory-authorized on-site labor warranty shall be provided.
- B. Battery warranty shall be 1 year full replacement, 9 year prorated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Approved manufactures:
 - 1. Digital Signal Power Manufacturing (DSPM)
 - 2. Myers

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2.2 MANUFACTURED UNITS

- A. The system shall be designed and manufactured to assure maximum reliability, serviceability and performance. All control devices and system electronics shall be accessible via the front of the inverter cabinet for rapid service or replacement. The system's advanced monitor shall be mounted on the front door of the inverter cabinet for easy observation of system status, electrical measurements and battery condition. The system is to be furnished with an internally located inverter input circuit breaker, inverter output circuit breaker, and bypass switch. System batteries shall be provided in a separate standalone front access battery cabinet, matching the height and depth of the inverter cabinet. The batteries and DC conductors shall be DC circuit breaker protected. Cabinets are to be floor mounted, constructed of steel, powder-coated, and NEMA 1 rated for indoor use, and provided with a field installed drip shield. Where indicated to be located outdoors, provide NEMA 3R minimum enclosure suitable to the project specific outdoor environmental conditions. The inverter controls, bypass, and breakers shall be front accessible through a hinged, key lockable door. The inverter cabinet shall have a protective dead front panel that allows the operation of the bypass switch and AC breakers while preventing physical contact with live electrical connections. All conductors and transformer windings shall be copper constructed. Seismic-rated systems shall be provided with floor mounting brackets.
- B. The system shall include a factory-installed output distribution cabinet designed for front access only service. Located within the distribution cabinet shall be (factory-installed output branch circuit breakers as specified and the standby, normally off AC output bus. The output distribution cabinet shall be capable of accommodating 1 pole, 2 pole, and 3 pole branch circuit breakers fed from the inverter system output. A total of (12 pole positions per phase shall be available for unmonitored breakers) (8 pole positions per phase shall be available for monitored breakers). Circuit breakers shall be wired to the (normally on AC output bus) (and) (normally off AC output bus) as indicated or required. The output distribution cabinet shall include a hinged, key lockable front door.
- C. The system shall operate in accordance with requirements as specified herein to support any combination of LED lighting, fluorescent ballast fixtures, incandescent lamps, electronic and high power factor fluorescent ballasts, quartz re-strike HID fixtures, halogen, or other approved loads up to the output rating of the system. The "Normally On" and "Normally Off" AC output(s) shall be 100% rated and limited only by the system's maximum KVA/KW output rating.

2.3 MODES OF OPERATION

- A. Normal Operation: The load is supplied with regulated power derived from the normal AC power input terminals through the input PFC AC/DC converter and output DC/AC inverter. A full load rated DC/DC battery charger shall be used to charge the batteries.
- B. Uninterrupted Emergency Operation: Upon the failure or unacceptable deviation of commercial AC power, energy shall be supplied by the battery through the output DC/AC inverter and shall continue to supply power to the load without switching loss or disturbance. When power is restored at the AC input terminals of the system, the input AC/DC PFC converter shall supply power to the load through the output DC/AC inverter. Simultaneously the DC/DC battery charger shall recharge the batteries. There shall be no break or interruption of power to the load upon failure or restoration of the commercial AC power.

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- C. Standby Emergency Operation: Upon the failure or unacceptable deviation of commercial AC power, or upon a remote input "command on signal", the standby, normally off AC output bus shall become energized, thus providing emergency power for standby lighting fixtures which are required to illuminate only in the event of emergency. User-adjustable settings shall be programmable via the touch screen LCD display panel and include transfer on delay time (0 to 8 seconds), transfer off delay time (0 to 15 minutes), and a soft start control (0 to 172 cycles) to accommodate the high inrush current associated with energizing normally off emergency lights.
- D. Automatic Restart: If the loss of AC input power exceeds the available battery run time, a low battery shutdown shall occur to protect the batteries. Once the AC input power source returns and is within acceptable voltage and frequency limits, the inverter system shall automatically restart.
- E. Manual Restart: The inverter system shall require a manual restart from a shutdown resulting from the following events.
 - 1. Remote or local emergency power off activated
 - 2. Inverter system failure
 - 3. Low battery shutdown, if manual restart option is selected

2.4 AUTOMATIC BYPASS OPERATION

- A. Automatic Bypass: The system shall include an automatic static bypass for fault clearing, instantaneous overload conditions that exceed specified levels and/or to connect the load to the AC input power bypass source in the event of a system fault or failure. The static bypass switch shall transfer the load from the inverter output to the AC input power bypass source under the following fault conditions.
 - 1. Output overload capacity exceeded
 - 2. Inverter output voltage or frequency out of limits
 - 3. Inverter system failure
 - 4. Over temperature
 - 5. DC bus out of limits
 - 6. Manual bypass switch transfer initiated
- B. Automatic Bypass Inhibited: The static bypass switch shall not transfer the load from the inverter output to the AC input power bypass source if that source is not within limits when a fault condition occurs. If the AC input power bypass source is out of limits (factory set at +8, -12% of nominal voltage and +/-5% of nominal frequency), the inverter system shall shut down and an alarm shall sound.
- C. Automatic Retransfer from Bypass: The retransfer of the load from the AC input power bypass source to the inverter output shall be automatically initiated whenever the inverter is capable of assuming the critical load.
- D. Automatic Retransfer Inhibited: The retransfer of the load from the AC input power bypass source to the inverter output shall be inhibited if any of the following conditions exist.
 - 1. Inverter output not in sync range with AC input power source
 - 2. Voltage difference between inverter output and AC input power bypass source exceeds limits
 - 3. Inverter system failure
 - 4. System in static bypass resulting from an over temperature condition

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2.5 MANUAL BYPASS OPERATION

- A. Internal Bypass Switch: The inverter system shall include a standard push-to-turn, make-before-break bypass switch, accessible behind the front door of the inverter enclosure. Pushing the manual bypass switch shall invoke the inverter's static bypass prior to turning the switch to the bypass position. The bypass switch shall provide complete isolation of the inverter output terminals from external circuits. When the load is supplied from the AC input power source through the bypass switch, the AC supply terminals shall remain energized to permit operational checking of the system. Returning to normal mode shall be accomplished by placing the bypass switch in its normal position via the push-to-turn function, without disrupting power to the load.
- B. Wall Mounted Maintenance Break-Before-Make Bypass (wrap around bypass): On inverter systems where the nominal input and output voltages are the same, an external, wall mounted, push-to-turn, 4 pole, break-before-make, wrap around maintenance bypass switch shall be provided for field installation. When in bypass mode, the switch will bypass the inverter system and feed the load power directly from the AC input power source. The inverter system's main input breaker, output breaker, and battery breaker may then be opened, allowing the inverter to be fully serviced, including the complete maintenance and replacement of circuit cards or components. The bypass switch shall have an auxiliary contact to indicate the position of the switch for remote monitoring purposes. The bypass switch shall be provided with a padlock attachment for lockout/tagout purposes during maintenance.

2.6 OUTPUT POWER RATING

- A. System Power Output Capability: The stored emergency power supply system output power rating shall be as indicated on the drawings or as required for the load indicated, whichever is greater.

2.7 BATTERY BACKUP TIME

- A. Battery Time Reserve Capacity: Battery shall be capable of producing emergency power for 90 minutes at full rated watts.

2.8 MAIN CIRCUIT BREAKERS

- A. System Input Breaker Rating: The inverter input breaker shall be included and sized to accommodate full rated load, low line input, and maximum recharge current simultaneously. An LSI adjustable breaker shall be provided.
- B. System Output Breaker Rating: The inverter output breaker shall be included and sized to accommodate full rated load continuously (and monitored to indicate an "output circuit breaker open" condition). An LSI adjustable breaker shall be provided.

2.9 INPUT SPECIFICATIONS

- A. Input Voltage: as indicated or required, three phase (wye), 60Hz.
- B. Input Voltage Operating Range: +10% to -15% at full load without battery usage.
- C. Frequency Range: 57 hertz to 63 hertz.

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- D. Power Factor: Self-correcting to >0.98 (approaching unity).
- E. Input Current Harmonics: <10% THD (total harmonic distortion) at 100% load.
- F. System AIC (Amperes Interrupting Current) Rating: 65k AIC.

2.10 OUTPUT SPECIFICATIONS

- A. Output Voltage: as indicated or as required, three phase (wye), 60Hz
- B. Sine Wave Voltage: 3% THD (total harmonic distortion) maximum with linear load.
- C. Frequency: 60 Hz, +/- 0.5 Hz under full load while in the battery operation mode.
- D. Voltage Regulation: +/-3% typical
- E. Phase (Angle) Imbalance: 120° +/- 0.5°
- F. Transient Voltage Response:
 - 1. 100% load step: +/- 10% for 1 cycle, then +/-3% for 2-3 cycles maximum
 - 2. Loss or return of AC input power: +/-3% for 2-3 cycles maximum
 - 3. Manual transfer of 100% load: +/- 10% for 1 cycle, then +/-3% for 2-3 cycles maximum
- G. Transient Voltage Recovery Time: 1 cycle to within 3% of nominal output voltage.
- H. Output Power Rating: KVA at 1.0 power factor (unity). KVA = KW
- I. Load Power Factor Range Permitted: 0.7 leading to 0.7 lagging (not exceeding full kVA/KW output rating).
- J. Overload Rating (without use of static bypass): Up to: 110% for 2 minutes, 125% for 30 seconds, 150% for 10 seconds, 400% for 4 cycles when fed from the AC power source, or on battery.
- K. LED Inrush Rating (without use of static bypass): Peak overload capability of 1700% during a current surge of ¼ cycle, when fed from the AC power source or on battery, to accommodate inrush current from LED fixtures/drivers.
- L. Fault Clearing (with bypass available): 150% for 1 minute, 500% for 1 second, 1000% for 1 cycle.
- M. Efficiency: 90% typical, kW and model dependent.

2.11 BATTERY SPECIFICATIONS

- A. Battery Time:
 - 1. 90 Minutes at full rated kilowatt output, listed ANSI/UL 924 Emergency Lighting and Power Equipment.
- B. Battery Type: Integral, valve regulated, sealed lead calcium, maintenance free, with front access terminals for ease of installation and maintenance.

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- C. Charger: 3 stage, temperature compensated, smart charge.
- D. Recharge Time: UL 924, NFPA 101, NFPA 111, and C22.2 No. 141-15 compliant.
- E. Bus Voltage: Factory-programmable from 216 - 384 VDC, or from 132 - 168 VDC, kW rating and model dependent.

2.12 ENVIRONMENTAL SPECIFICATIONS

- A. Operating Temperature:
 - 1. 20°C to 35°C for ANSI/UL 924 Emergency Lighting and Power Equipment listed 90 minute models. To satisfy ANSI/UL 924 requirements for a 35°C listing or C-UL / CSA requirements), UL or C-UL testing shall have been performed in a 40°C environment, with the inverter system tested under full load and at low line input voltage. Optimum battery performance and life shall be achieved at 25°C.
- B. Inverter Storage Temperature: -20°C to 50°C.
- C. Battery Storage Temperature: 25°C for 6 months before charging is required. For each 9°C rise, reduce storage time by half.
- D. Relative Humidity: 95% non-condensing.
- E. Elevation: 0 to 6600 ft. (2000 meters). Units installed at elevations greater than 6600 ft. shall be de-rated.
- F. Audible Noise Level: Not greater than 60 dba at 1 meter.

2.13 MECHANICAL

- A. Cabinet Dimensions for ANSI/UL 924 Emergency Lighting and Power Equipment listed models with 90 Minutes shall be as such to occupy the location indicated on the drawings and allow for all manufacture and required NEC working clearance requirements. Where dimensions of any of the approved manufactures will not fit in the space indicated, notify the Architect/Engineer prior to construction.
- B. Enclosure: NEMA 1, powder-coat painted steel construction, and sealed prohibiting rodent entry. Where indicated to be installed outdoors, additional enclosures with heating, cooling, or ventilation shall be provided to meet the manufactures requirements for environmental operating conditions based on project specific environmental conditions.
- C. Drip Shield: A drip shield assembly shall be included to cover the inverter and battery cabinets and the output distribution cabinet. The assembly shall extend 2 inches beyond the inverter system cabinetry width and depth, and shipped loose for field installation.

2.14 DISPLAY MONITOR AND DIAGNOSTICS

- A. Display Monitor: An advanced display monitor shall be included to uphold NFPA and CSA guidelines for emergency illumination, emergency backup time, and unattended periodic and annual testing of the centralized emergency power system. The system shall include a local, front mounted, sealed, touch screen, color LCD display monitor to verify system electrical and temperature measurements, inform/alarm for abnormal system status, allow programming of user specified set points and inform of periodic system and battery test results.

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- B. Electrical Parameters – The three phase monitor shall display the following electrical parameters:

Input Voltage L-N
Input Frequency
Input Current L-N
Input VA L-N
Input Watts L-N
Input Power Factor L-N
Input KVA Total
Input KW Total
Output Voltage L-N
Output Frequency
Output Current L-N
Output VA L-N
Output Watts L-N
Output Power Factor L-N
Output KVA Total
Output KW Total
Output Percent Load L-N (% KVA)
Output Percent Load Total (% KVA)
Battery Voltage
Battery Charge/Discharge Current

- C. Alarm Conditions – The three phase monitor shall display the following status and alarm conditions:

Input Over Voltage L-N
Input Under Voltage L-N
Improper Phase Rotation
Input Frequency High
Input Frequency Low
Output Over Voltage L-N
Output Under Voltage L-N
Output VA L-N High (output overload)
Output VA L-N Low (user-programmable limit referenced during automatic battery test, to verify integrity of egress lighting)
Output Frequency High
Output Frequency Low
Battery Voltage High
Battery Voltage Low
Battery Charger Current High
System On Battery
Low Battery Warning
Low Battery Shutdown
Over-Temperature Shutdown
 - Inductors (if static bypass source is not available)
 - IGBT (if static bypass source is not available)
 - Transformer
 - SCR
Input Fuse Failure
DC Link Over Voltage
DC Link Under Voltage

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DC Charger (Rectifier) Failure / DC Open
IGBT Fault
Output Circuit Breaker Open
REPO Shutdown
System in Static Bypass
Static Bypass Input Out of Range
Static Bypass Fault
Excessive Auto Retransfers Attempted
Manual Restart Required
Battery Test Fail

- D. Operational Conditions – The three phase monitor shall display the following operational conditions:

System Normal
System Alarm
System Shutdown
Battery Time Remaining (expressed in minutes)
Battery Test In Process (including a “countdown” of time remaining in test)
Off Bus Connecting
Off Bus Returning
System in Manual Bypass
System in Static Bypass

- E. System Control – The three phase monitor shall allow for the following system control via the touch screen display:

Start Up
Shutdown

- F. User-programmable Set Points – The three phase monitor shall allow for the following user-programmable set points:

High/low alarm thresholds
Low output VA level referenced during periodic and annual battery testing to verify egress lighting integrity
Off bus transition delays
Periodic battery test duration with date and time in compliance with NFPA 101 and C22.2 No. 141-15
Annual battery test duration with date and time in compliance with NFPA 101 and C22.2 No. 141-15

- G. Periodic Testing – The three phase monitor shall incorporate system diagnostics and provide for automatic and manual testing of the system/batteries as follows:

1. Feature a factory-set 5 minute battery discharge test every 30 days or 90 days, and a user-programmable (enable/disable) annual battery discharge test, factory-set for 90 minutes. Dates and times of tests shall be user-programmable.
2. Report the battery test results with a pass/fail indication, time and date stamped, via the local monitor panel and via (BACnet/IP) (BACnet MS/TP) (Ethernet TCP/IP) (MODBUS TCP) (MODBUS RS485), verify with Owner and building management control or BMCS/BAS system requirements.

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3. During the battery test, the monitor shall perform a user-programmable egress lighting integrity test. The egress lighting integrity test shall measure the KVA load on the output of the system, and if the output load falls below the customer defined value, the inverter shall provide an audible and visual alarm, thus indicating fixture maintenance or component replacement.
 4. A manual, proprietary password protected "Push to Test" feature shall be provided to initiate NFPA 101-compliant system test. An "Abort Test" feature shall be included.
- H. Data-Logging – The three phase monitor shall provide the following data-logging:
1. Maintain a historic log that sequentially records a minimum of 25 battery tests which indicate time, date and pass/fail results. The log shall be made available through the local monitor and via the building BMCS/BAS communications.
 2. Maintain a historic log that sequentially records 50 of the most recent alarms, indicating the time and date of abnormal occurrences. The log shall be made available through the local monitor display and via the building BMCS/BAS communications.

2.15 COMMUNICATIONS INTERFACE

- A. Computer Port: System shall include an RS232 serial communications port for authorized access to electrical parameters, system status, alarms, system set point programming, and the test and alarm logs. Factory authorized service engineer shall have access to password-protected factory settings and configurations.
- B. Status / Alarm Relay Contacts: System shall include isolated, potential free (Form C) relay contacts accessible via a terminal strip for customer's hardwired connection to building monitoring and security systems. Contacts shall be rated for 1A at 120VAC / 2A at 28VDC. Status / alarm contacts shall include inverter on, on battery power, low battery, general alarm, battery test pass, battery test fail, output circuit breaker open, in bypass, and periodic or annual system test activated.
- C. Remote Emergency Power Off (REPO) Interface: System shall be provided with an REPO interface for customer's normally open relay contact, which shall shut down the inverter system when the relay contacts close.
- D. Remote Monitoring Communications: Systems shall include remote monitoring and reporting of electrical parameters, system status, alarms, event logs, and automatic battery pass / fail test results with time and date stamp via the building BMCS/BAS communications.

2.16 ACCESSORIES

- A. Output Distribution Cabinet: The system shall include a factory-installed output distribution cabinet to accommodate factory-installed output branch circuit breakers as specified or indicated and the standby, normally off AC output bus when indicated.
- B. Standby Emergency Operation: The system shall include only a normally off AC output bus where indicated or required, typically in non-air conditioned indoor environments to reduce overheating of the space occupied by the emergency lighting inverter. Where the emergency lighting inverter is specified only with a normally off AC output bus, provide a UL 1008 listed automatic transfer switch to signal the emergency lighting inverter to energize the normally off AC output bus, this arrangement is similar to a stand-by engine driven emergency generator configuration.

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- C. Wall Mounted Maintenance Bypass: The system shall be provided with an external wrap around maintenance bypass for field installation where indicated or required.
- D. Status / Alarm Relay Contacts: System shall include isolated, potential free (Form C) relay contacts.
- E. Remote Emergency Power Off (REPO) Interface: System shall be provided with a REPO interface when required by the local AHJ.
- F. Remote Monitoring Communications: Systems shall include remote monitoring and reporting.
- G. Remote Annunciator Panel: The system shall be provided with a remote annunciator panel for remote status indication of inverter on, on battery power, low battery, general alarm, and test active. The annunciator panel shall be provided with an interface cable to connect to the inverter's status / alarm terminal strip. Locate remote annunciator panel as directed by Architect/Owner or as indicated on the drawings.
- H. External Load Control Relay: Provide UL 924 listed load control relays to shunt around local control devices (i.e. dimmer control, wall switch, occupancy sensor) powered from the inverter's normally on output, in order to provide full illumination to designated emergency lights upon the failure or loss of commercial AC power. Refer to Light Fixtures specifications for additional requirements.
- I. Drip Shield: A drip shield assembly shall be included to cover the inverter system cabinetry.

2.17 SERVICEABILITY

- A. The inverter's power section, including all control cards and system electronics, shall be front-accessible and located behind a secure hinged access door for ease of service or component replacement. An internal inverter bypass switch must be provided. A DC circuit breaker and DC Anderson connector shall be incorporated into the design to facilitate rapid replacement of the batteries via the front of the system enclosure. No side access shall be required. To facilitate inverter diagnostics and programming, a RS232 serial communications port shall be provided for access to electrical measurements, system set points, and system logs.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The emergency lighting inverter shall be set in place, wired and connected in accordance with the approved installation drawings and owner's/technical manual delivered with equipment.
- B. The equipment shall be installed in accordance with local codes and manufacturer's recommendation.
- C. The equipment shall be checked out and started by a factory or by a factory authorized representative customer support representative from the equipment manufacturer. Visual and mechanical inspection of electrical installation, initial emergency inverter startup and operational training shall be performed. A signed service report shall be submitted after equipment is operational.

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- D. The following inspection and test procedures shall be performed by field service personnel during the startup:
 - 1. Visual Inspection:
 - a. Ensure that shipping members have been removed.
 - b. Ensure that interiors are free of foreign materials, tools and dirt.
 - c. Check for damage (dents, scratches, frame misalignment, damage to panel devices, etc.).
 - d. Check doors for proper alignment and operation.
 - 2. Mechanical Inspection:
 - a. Check all the power wiring connections for tightness.
 - b. Check all the control wiring connections for tightness.
 - 3. Electrical Inspection:
 - a. Check input and bypass for proper voltage and phase rotation.
 - b. Check battery for proper voltage and polarity.
 - 4. Start-up:
 - a. Energize the emergency lighting inverter
 - b. Check the DC output voltage and inverter output voltage
 - c. Check the inverter output voltage on battery operation
 - d. Check for the proper synchronization
 - e. Perform manual transfers and returns
 - f. Perform auto transfers
 - g. Check the parallel operation
- E. Comply with the requirements of NEMA and NEC, and NECA Standard of Installation, for installation of this type of equipment.
- F. Torque bus connections and tighten mechanical fasteners.
- G. Concrete Pads: Install lighting inverter, battery cabinets, and all other related floor mounted equipment on a 4" reinforced concrete housekeeping pad. The housekeeping pad shall extend 3" beyond the housing of the equipment unless shown otherwise. Equipment shall be bolted to the housekeeping pad using 3/8" minimum galvanized bolts and anchors on 30" maximum centers or as required for seismic rating. Furnish the exact position of any block outs, dimensions, and location of the housekeeping pads to prevent delay of the concrete work.
- H. Adjustment: Adjust operating mechanisms for free mechanical movement. Adjust circuit breaker time characteristic curves as recommended by the Fault Current and Coordination Analysis or as directed by the Engineer.
- I. Indicating displays and programming: Provide initial factory start-up and programming with Owner present. Integrate with the Building Management System for monitoring and logging of all system data.

3.2 TESTING

- A. Notify Owner's Commissioning Authority (CxA) prior to performing any tests so that the CxA may witness tests at the CxA's discretion.
- B. Pre-energization checks: Before energizing, check for continuous of circuits and for short circuits.

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- C. Provide thermal infrared scan of the lighting inverter under full load as directed and witnessed by Owner. Correct any deficiencies causing abnormal heating and repeat the scan. Provide digital documentation with deficiencies corrected for comparison to future test.
- D. Submittals: Furnish instruments and personnel required for tests. Submit 4 copies of certified test results to the Architect for review. Test reports shall include switchboard tested, date and time of test, relative humidity, temperature, and weather conditions.

3.3 TRAINING

- A. Provide minimum two hours of dedicated training provided by a factory authorized representative to Owner's personnel regarding programming, operating, and use of the emergency lighting inverter components including all indicating instruments and safety features.

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SECTION 262416

PANELBOARDS AND ENCLOSURES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Panelboards and enclosures, including cabinet, as shown, scheduled, indicated, and specified.

1.2 QUALITY ASSURANCE

- A. UL Standards: Panelboards and enclosures shall conform to all applicable UL standards and shall be UL labeled.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Schneider Electric - Square D
- B. ABB-General Electric Co.
- C. Siemens
- D. Eaton

2.2 MATERIALS AND COMPONENTS

- A. General: Panelboards shall be dead-front type equipped with fusible switches or circuit breakers as shown and as required.
- B. The overcurrent protective device short circuit, coordination and arc flash studies performed by the overcurrent protective device manufacturer shall be used by the respective switchgear vendor(s) to select appropriate equipment, switchgear, and overcurrent protective device characteristics such as but not limited to: equipment bracing, AIC rating, circuit breaker frame size and trip settings, and fuse type/class. The appropriate equipment suitable and required by the studies for code compliance shall be included with the submittal data for review and provided at no additional cost to the Owner. The appropriate equipment recommended by the studies for enhanced selective coordination or enhanced arc flash energy reduction beyond code compliance shall be included with the submittal data for review and consideration purposes by the engineer.
- C. Busing Assembly: Panelboard phase, neutral, and equipment ground busing shall be copper. Bus structure and mains shall have ratings as shown and scheduled. Furnish a bare uninsulated ground bus inside each panelboard enclosure. Two section panelboards shall be connected with copper cable, with an ampacity conforming to the upstream overcurrent device. Neutral bus termination quantity for branch circuit panelboards shall match or exceed the maximum number of single pole circuit breakers the panelboard will accept.

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- D. Main circuit breakers and feeder / branch circuit breakers:
1. Less than 125 Amps: Thermal magnetic with factory fixed trip.
 2. 125-600 Amps: Thermal magnetic with adjustable instantaneous trip of 5X – 10X with short time tracking.
 3. 601 Amps and larger: Solid state true RMS sensing with adjustable: current set by rating plug or adjustable dial, I²t settings, ground fault (where required), instantaneous trip, and short time trip; 80-percent continuous current rating.
 4. Provide permanent lock-off device where indicated or required for circuit breaker to be used as a remote safety disconnect switch.
 5. General requirements:
 - a. Make prepared space provisions for additional breakers or fused switches so that no additional bus or connectors will be required to add circuit breakers or fused switches in the available device mounting space.
 - b. Two and three pole breakers shall have internal common trips.
 - c. All circuit breakers used as the main or branch mounted back-fed main shall be bolt-on. All circuit breakers used in 600 Amp and smaller panelboards shall be bolt-on breakers. Circuit breakers for distribution panelboards rated 601 amps and larger shall have plug-on or bolt-on circuit breakers.
 - d. Branch circuit panelboard shall have interrupting capacity as shown or as required, but in no case less 10k AIC for 120/208/240-Volt systems, and 18k AIC for 277/480-Volt systems.
 - e. 15 and 20 Amp circuit breakers for lighting circuits shall be UL listed switch duty (SWD).
 - f. Personnel ground fault interrupter (GFI) circuit breakers, where shown, shall be maximum 5 mA ground fault trip and shall include a TEST button.
 - g. Equipment ground fault interrupter (EGFI/EGPD) circuit breakers, where shown or required shall be 30mA ground fault trip and shall include TEST button.
 - h. Circuit breakers with 1,200 Amp and larger frame shall have Energy Reducing Maintenance Switching with local status indicator (ERMS).
- E. Fusible Switches for distribution panelboards: Fusible switches shall be quick-make, quick-break type. Each switch shall be enclosed in a separate steel enclosure. The enclosure shall employ a hinged cover for access to the fuses. Interlock cover with the operating handle to prevent opening the cover when the switch is in the ON position. This interlock shall be constructed so that it can be overridden for testing fuses without interrupting service. The switches shall have padlocking provisions in the OFF position. Switches shall include positive pressure rejection type fuse clips for use with UL Class J fuses and be UL labeled for 200,000 AIC.
- F. Spaces: Where space for future breakers or switches is shown, panelboard enclosure shall include removable blank panels or knockouts to allow installation of future breakers or switches, prepared spaces, and panelboard busing shall be complete, including required connectors.
- G. Integrated Equipment Rating: Do not apply series ratings. Each panelboard, as a complete unit, shall have a short-circuit rating equal or greater than the available short circuit current. Rating shall have been established by tests on similar panelboards with the circuit breakers or fusible switches installed.

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- H. GFCI circuit breakers not available in the required panel AIC rating shall be series rated with the upstream over current protection device to provide the panelboard with required AIC rating. Coordinate series rating requirements with manufacturer. Mark the panel per NEC 110. The marking shall be visible and state the following "CAUTION-ENGINEERED SERIES COMBINATION SYSTEM RATED XXX AMPERS. IDENTIFIED REPLACEMENT COMPONENTS REQUIRED".
- I. Panelboard Enclosures:
 - 1. Provide sheet steel enclosures, minimum 16-gauge nominal thickness, with multiple knockouts, unless shown otherwise. Provide all NEMA 1 panelboard fronts with spring-loaded door pulls, and flush lock and key, panelboard enclosures keyed alike to match the Owner's standard key system; coordinate with Owner.
 - 2. All NEMA 1 enclosure panelboards shall be hinged "door-in-door" type with interior hinged door with hand operated latch or latches, as required providing access only to circuit breaker or fusible switch operating handles, not to exposed energized parts. Outer hinged door shall be securely mounted to the panelboard box with factory bolts, screws, clips, or other fasteners, requiring a tool for entry. Hand operated latches are not acceptable. Push inner and outer doors shall open left to right. Manufacturer hardware (OEM), screws, and bolts shall be used to secure dead fronts and covers. Do not use third party hardware. Do not use power tools to secure panel hardware. Provide gray powder coat finish over a rust inhibitor.
 - 3. Equip with interior circuit directory frame, card, and clear plastic covering for panelboards.
 - 4. Panelboards located in kitchen preparation or natatorium areas shall have Type 316 stainless steel front, door, and trim with a NEMA 1 rating for the entire enclosure.
 - 5. Panelboards at exterior locations shall be NEMA 4X Type 316 stainless steel.
 - 6. Panelboards at hose down areas, cooling towers, in greenhouses, and other corrosive locations shall be NEMA 4X 316 stainless steel.
 - 7. Enclosure shall be for recessed or surface mounting as shown or as required.
 - 8. Enclosures shall be fabricated by the same manufacturer as panelboards to be enclosed. Multi-section panelboards shall have same physical dimensions.

PART 3 - EXECUTION

3.1 INSTALLATION OF PANELBOARDS AND ENCLOSURES

- A. General: Install panelboards and enclosures, as shown, including electrical connections, in accordance with the manufacturer's written instructions, the requirements of NEC, NECA Standard of Installation, and industry practices. Circuit breakers shall be factory installed except for required field modifications due to actual site conditions.
- B. Coordination: Coordinate installation of panelboards and enclosures with conductor and raceways installation work.
- C. Anchoring: Anchor enclosures to walls and structural surfaces ensuring that they are permanently and mechanically secured.

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- D. Directory Card: Provide a typed circuit directory card(s) upon completion of work. Directory card shall be of super heavy-weight index card stock, 110 lb, white. Directory shall include type of load (i.e.: receptacles, lighting, exhaust fan, etc.) and location (i.e.: Room 102, Office, etc.) Room number shall be identified as the actual graphics room number assigned to the space and not the room number identified on the Plans. Circuits with shunt trip shall be identified with the control circuit operating the shunt trip (i.e.: Kitchen Hood No. 2). Shunt trip breakers with common trip circuit shall be grouped in the panelboard (i.e.: circuits 1, 3, 5 and 7).
- E. Fuses: Install fuses, of the ratings and class shown.
- F. Circuit Arrangement: Branch circuits shall be arranged to provide the best possible phase balance, unless shown otherwise.
- G. Panelboards not intended to be used as service entrance (SE) rated or for establishing a separately derived neutral system shall have the factory installed neutral to ground bonding screws and straps removed and disposed of.
- H. Recessed or flush mounted panelboards: Terminate spare conduits in junction box 18-inches above accessible ceiling close to panelboard location. Label junction box cover as "not used" and include panel identification.
 - 1. Provide (3) 1-inch and (3) ¾-inch spare conduits above accessible ceiling to j-box from each panelboard section.
 - 2. Where recessed panelboard is located above another building floor, also provide (3) 1-inch and (3) ¾-inch conduits to j-box in ceiling space on floor below.
- I. Conductors shall be bent neatly opposite the fuse switch or circuit breaker to which they are to be attached. Vertically installed conductors shall be neatly tie-wrapped. Conductors shall be connected in a neat and professional manner. Conductors brought in from the top or bottom of the cabinet shall be bent neatly opposite the fuse or circuit breaker to which they are to be attached. Each conductor shall be run along the full height of the panel and returned to the circuit breaker or fuse location to allow relocation of the conductor to any position along the bus. Panelboard shall be cleaned of all construction debris prior to substantial completion review. Neutral and grounding conductors shall be installed similar to the phase conductors.
- J. Circuit breakers and conductors installed for SPD devices shall be located at the top or bottom of the panelboard in respect to the location of the SPD device. Route all conductors to the SPD device with straight as possible run, using longest sweep bends and the shortest conductor length possible. Twist all SPD conductors and secure with tie straps wherever possible.
- K. Install copper ground bus for copper ground conductors. Ground conductors size #1 and larger are to be landed to panelboard enclosure with mechanical lugs and not to ground bus.
- L. Install panels so that breaker number 1 is the top left breaker.
- M. In panels that contain multi-layered neutral bus, install neutrals beginning with the back neutral bus row and work forward. Do not make up neutrals on front neutral bus row unless all other rows are full.
- N. Label breaker mounting space with stick-on number labels.

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- O. Mount the fully aligned panelboard such that the maximum height of the top circuit breaker above the finished floor shall not exceed 78-inches. Mount panelboards as high as practical and such that the bottom of the cabinets will not be less than 6 inches above the finished floor.

3.2 TESTING

- A. Before energizing, energization, check for continuity of circuits and short circuits.
- B. Provide thermal infrared scan of panelboards under full load as directed and witnessed by Owner. Correct any deficiencies causing abnormal heating and repeat the scan. Provide digital video documentation with deficiencies corrected for comparison to future test. Make corrections as needed as soon as possible as directed by the Owner. Repeat the scan at the 11-month prior to closeout, and make corrections prior to close-out.

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SECTION 262416

PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.
 - 3. SPD for panelboards.
 - 4. Fused coordination panels.

1.3 DEFINITIONS

- A. ATS: Acceptance testing specification.
- B. GFCI: Ground-fault circuit interrupter.
- C. GFEP: Ground-fault equipment protection.
- D. HID: High-intensity discharge.
- E. MCCB: Molded-case circuit breaker.
- F. SPD: Surge protective device.
- G. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard.
 - 1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
 - 2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details.
 - 2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.

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3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
4. Detail bus configuration, current, and voltage ratings.
5. Short-circuit current rating of panelboards and overcurrent protective devices.
6. Include evidence of NRTL listing for SPD as installed in panelboard.
7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
8. Include wiring diagrams for power, signal, and control wiring.
9. Key interlock scheme drawing and sequence of operations.
10. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graph paper; include selectable ranges for each type of overcurrent protective device. Include an Internet link for electronic access to downloadable PDF of the coordination curves.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Panelboard Schedules: For installation in panelboards.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Keys: Two spares for each type of panelboard cabinet lock.
 2. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 3. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: ISO 9001 or 9002 certified.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NECA 407.

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1.10 FIELD CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet (2000 m).

1.11 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.

1. Panelboard Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace SPD that fails in materials or workmanship within specified warranty period.

1. SPD Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS AND LOAD CENTERS COMMON REQUIREMENTS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NEMA PB 1.

E. Comply with NFPA 70.

F. Enclosures: Flush and Surface-mounted, dead-front cabinets.

1. Rated for environmental conditions at installed location.

- a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
- b. Outdoor Locations: NEMA 250, Type 3R.
- c. Kitchen and Wash-Down Areas: NEMA 250, stainless steel.
- d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

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- e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
 - 2. Height: 84 inches (2.13 m) maximum.
 - 3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
 - 4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
 - 5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
 - 6. Finishes:
 - a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Galvanized steel.
- G. Incoming Mains:
 - 1. Location: Top or Bottom.
 - 2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.
- H. Phase, Neutral, and Ground Buses:
 - 1. Material: Tin-plated aluminum.
 - a. Plating shall run entire length of bus.
 - b. Bus shall be fully rated the entire length.
 - 2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
 - 3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
 - 4. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
 - 5. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.
 - 6. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and listed and labeled by an NRTL acceptable to authority having jurisdiction, as suitable for nonlinear loads in electronic-grade panelboards and others designated on Drawings. Connectors shall be sized for double-sized or parallel conductors as indicated on Drawings. Do not mount neutral bus in gutter.
- I. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 1. Material: Tin-plated aluminum.
 - 2. Terminations shall allow use of 75 deg C rated conductors without derating.
 - 3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
 - 4. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.

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5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
 6. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
 7. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
 8. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.
- J. NRTL Label: Panelboards or load centers shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards or load centers shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.
- K. Future Devices: Panelboards or load centers shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- L. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.
1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
 2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
- B. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 2.

2.3 POWER PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton.
 2. General Electric Company; GE Energy Management - Electrical Distribution.
 3. SIEMENS Industry, Inc.; Energy Management Division.
 4. Square D; by Schneider Electric.
- B. Panelboards: NEMA PB 1, distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
- D. Mains: Circuit breaker, Fused switch or Lugs only, as indicated on the drawings.

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- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.
- G. Branch Overcurrent Protective Devices: Fused switches.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton.
 - 2. General Electric Company; GE Energy Management - Electrical Distribution.
 - 3. SIEMENS Industry, Inc.; Energy Management Division.
 - 4. Square D; by Schneider Electric.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker or lugs only.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- F. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.

2.5 SPD

- A. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 100 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.
- B. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V or 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:
 - 1. Line to Neutral: 1200 V for 480Y/277 V, 700 V for 208Y/120 V.
 - 2. Line to Ground: 1200 V for 480Y/277 V, 700 V for 208Y/120 V.
 - 3. Neutral to Ground: 1200 V for 480Y/277 V, 700 V for 208Y/120 V.
 - 4. Line to Line: 1800 V for 480Y/277 V, 1200 V for 208Y/120 V.
- C. Protection modes and UL 1449 VPR for 240/120-V, single-phase, three-wire circuits shall not exceed the following:
 - 1. Line to Neutral: 700 V.
 - 2. Line to Ground: 700 V.
 - 3. Neutral to Ground: 700 V.
 - 4. Line to Line: 1200 V.

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- D. SCCR: Equal to the SCCR of the panelboard in which installed.
- E. Current Inominal Rating: 20 kA.
- F. SPD shall be internal to the panelboard and equipped with a disconnecting means.

2.6 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton.
 - 2. General Electric Company; GE Energy Management - Electrical Distribution.
 - 3. SIEMENS Industry, Inc.; Energy Management Division.
 - 4. Square D; by Schneider Electric.
- B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers:
 - a. Inverse time-current element for low-level overloads.
 - b. Instantaneous magnetic trip element for short circuits.
 - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 3. Electronic Trip Circuit Breakers:
 - a. RMS sensing.
 - b. Field-replaceable rating plug or electronic trip.
 - c. Digital display of settings, trip targets, and indicated metering displays.
 - d. Multi-button keypad to access programmable functions and monitored data.
 - e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
 - f. Integral test jack for connection to portable test set or laptop computer.
 - g. Field-Adjustable Settings:
 - 1) Instantaneous trip.
 - 2) Long- and short-time pickup levels.
 - 3) Long and short time adjustments.
 - 4) Ground-fault pickup level, time delay, and I squared T response.
 - 4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 - 5. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
 - 6. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
 - 7. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
 - 8. Subfeed Circuit Breakers: Vertically mounted.
 - 9. MCCB Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.

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- b. Breaker handle indicates tripped status.
 - c. UL listed for reverse connection without restrictive line or load ratings.
 - d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
 - f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - g. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
 - h. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
 - i. Multipole units enclosed in a single housing with a single handle or factory assembled to operate as a single unit.
 - j. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
 - k. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.
- C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
- 1. Fuses and Spare-Fuse Cabinet: Comply with requirements specified in Section 262813 "Fuses."
 - 2. Fused Switch Features and Accessories:
 - a. Standard ampere ratings and number of poles.
 - b. Mechanical cover interlock with a manual interlock override, to prevent the opening of the cover when the switch is in the on position. The interlock shall prevent the switch from being turned on with the cover open. The operating handle shall have lock-off means with provisions for three padlocks.
 - c. Auxiliary Contacts: Two normally open and normally closed contact(s) that operate with switch handle operation.

2.7 FUSED COORDINATION PANELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 1. Cooper Bussmann, an Eaton business.
 - 2. Littelfuse, Inc.
 - 3. SIEMENS Industry, Inc.; Energy Management Division.
- B. Furnish with Integral SPD.
- C. Construction:
- 1. Panelboard circuits 100A and less shall incorporate overcurrent protection and branch-circuit rated disconnecting means into a single integrated component.
 - 2. Interiors shall be factory assembled.
 - 3. Panelboard shall be equipped with a six-space spare fuse compartment for storing replacement branch circuit fuses. Spare fuse compartment shall be located behind locking panel door.
 - 4. Bus bars shall be tin-plated copper with sufficient cross-sectional area to meet UL 67 temperature rise requirements.

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5. 100% rated neutrals shall be standard, 200% rated neutral where indicated in the associated schedules or drawings.
 6. Main lug conductor terminations:
 - a. MLO terminations shall be rated for 60/75°C, Cu-Al.
 - b. Main disconnect terminations shall be rated for 75°C, Cu Only.
 7. NEMA 1 panelboards shall be field convertible for top or bottom incoming feed. NEMA 3R panelboards are bottom feed only
- D. Main Disconnect:
1. Permanently installed lockout means shall be provided on the main disconnect for lockout tagout procedures.
 2. Main disconnect shall be quick-make, quick-break type.
- E. Branch Fused Disconnects:
1. Device shall have visible circuit ON/OFF indication with colored and international symbol markings.
 2. Device shall provide open fuse indication via permanently installed indicating light.
 3. Device shall be UL and cUL Listed 600Vac/200kA or 125Vdc/100kA voltage/short-circuit current rating, load-break disconnect with amp ratings and number of poles as indicated on the panelboard schedule.
 4. Fuse and disconnect assembly shall be a finger-safe component with trim installed.
 5. Fuse and disconnect shall be mechanically interlocked so as not to allow fuse removal while fuse terminals are energized.
 6. No special tools shall be required for fuse removal.
 7. Devices shall have bolt-on style bus connectors.
 8. Device housing shall be clearly marked with device amperage.
 9. Permanently installed lockout means shall be provided on the device for lockout tagout procedures. Permanently installed means for locking device in the ON position shall also be available.
 10. Device shall provide fuse amp rating rejection at the following ampacities to ensure continued circuit protection at the specified circuit rating: 15A, 20A, 30A, 40A, 50A, 60A, 70A, 90A & 100A.
- F. Main and Branch Overcurrent Protection:
1. All overcurrent protective devices shall have a minimum UL Listed interrupting rating of 300kA and CSA Certified interrupting rating of 200kA.
 2. Branch circuit overcurrent protection shall be 600Vac UL Listed minimum 300kA IR and CSA Certified minimum 200kA IR finger-safe fuse with Class CF (equivalent to Class J) performance characteristics.
 3. Main overcurrent protective devices shall be 600Vac UL Listed minimum 300kA IR and CSA Certified minimum 200kA IR Class J fuses or Class CF (equivalent to Class J) performance fuses.
 4. Where panelboard main fuses are installed, fuses in panelboard branch circuits shall selectively coordinate with main fuses for all overcurrents up to 200kA.
- G. Interrupting Rating: 50 kAK min unless indicated greater on the drawings.

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2.8 IDENTIFICATION

- A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.
- B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.
- C. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.
 - 1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.
- B. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
- C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.
- D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Comply with NECA 1.
- C. Install panelboards and accessories according to NEMA PB 1.1.
- D. Equipment Mounting:
 - 1. Attach panelboard to the vertical finished or structural surface behind the panelboard.
 - 2. Comply with requirements for seismic control devices specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

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- F. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- G. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.
- H. Mount panelboard cabinet plumb and rigid without distortion of box.
- I. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- J. Mount surface-mounted panelboards to steel slotted supports 5/8 inch (16 mm) in depth. Orient steel slotted supports vertically.
- K. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
 - 2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.
- L. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
- M. Install filler plates in unused spaces.
- N. Stub four 1-inch (25 mm) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (25 mm) empty conduits into raised floor space or below slab not on grade.
- O. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

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3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform the following tests and inspections:
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers and low-voltage surge arrestors stated in NETA ATS, Paragraph 7.6 Circuit Breakers and Paragraph 7.19.1 Surge Arrestors, Low-Voltage. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
 - c. Instruments and Equipment:
 - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- D. Panelboards will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573.16 "Coordination Studies."

3.6 PROTECTION

- A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION

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SECTION 262417

FUSIBLE BRANCH CIRCUIT PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish and install fusible branch circuit panelboards as specified and as shown on the associated drawings.

1.2 REFERENCES

- A. UL 248 – Low-Voltage Fuses
- B. UL 98 – Enclosed and Dead-front switches
- C. UL 67 – Panelboards
- D. UL 50 – Enclosures for Electrical Equipment
- E. NEMA PB 1 – Panelboards
- F. NEMA PB 1.1 – Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less
- G. NEMA FU 1 – Low Voltage Cartridge Fuses
- H. NFPA-70 – National Electrical Code
- I. CSA Standard C22.2 No. 248 – Low Voltage Fuses

1.3 SUBMITTALS

- A. Construction drawings including:
 - 1. Overall, wiring gutter, and interior mounting dimensions
 - 2. Conduit entrance/exit locations, size, number/phase, and termination types
 - 3. Main/branch device, neutral, and ground locations
 - 4. Assembly and component device and nameplate information
- B. Assembly ratings including:
 - 1. Voltage, ampacity, and short-circuit current (bracing) ratings
- C. Branch device ratings including:
 - 1. Voltage, ampacity, and interrupting ratings of fused branch devices

1.4 SPECIFICATION COMPLIANCE REVIEW

- A. Mark up a complete copy of the specification section for the product to indicate a) acknowledgement of the specification requirement (Comply), or b) acknowledgement that the particular specification requirement does not apply to this specific project (Not Applicable) or, c) acknowledgement that the specification requirement cannot be made or that a variance is being submitted for review to the Architect / Engineer / Owner (Does Not Comply, Explanation:) Do not submit an outline form of compliance, submit a complete copy with the product data.

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- B. The overcurrent protective device short circuit, coordination and arch flash studies performed by the overcurrent protective device manufacturer shall be used by the respective switchgear vendor(s) to select appropriate equipment, switchgear, and overcurrent protective device characteristics such as but not limited to: equipment bracing, AIC rating, circuit breaker frame size and trip settings, and fuse type/class. The appropriate equipment suitable and required by the studies for code compliance shall be included with the submittal data for review and provided at no additional cost to the Owner. The appropriate equipment recommended by the studies for enhanced selective coordination or enhanced arc flash energy reduction beyond code compliance shall be included with the submittal data for review and consideration purposes by the engineer.

1.5 SYSTEM DESCRIPTION

- A. The panelboards shall be UL and cUL Listed

1.6 QUALIFICATIONS

- A. The equipment manufacturer shall have a minimum five years experience in producing electrical distribution panelboards.
- B. Fusible branch circuit panelboards shall be listed to UL67.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Equipment shall be shipped without branch circuit fuses installed. Where main fuses are specified, equipment shall be shipped with main fuses installed.
- B. Inspect equipment for possible damage during delivery and prior to installation.
- C. Handle and store in accordance with manufacturer's instructions.

1.8 INSTALLATION, OPERATION, AND MAINTENANCE MATERIALS

- A. Furnish operation and maintenance tools/key(s) if available from manufacturer.
- B. Manufacturer shall provide copies of installation, operation and maintenance manuals to owner including replacement parts list if available.

1.9 WARRANTY

- A. Manufacturer shall warrant specified equipment free of materials and workmanship defects for 18 months from the date of shipment or 12 months from date of first use, whichever occurs first.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Fusible Branch Circuit Panelboards
 1. Eaton Bussmann Quik-Spec™ Coordination Panels type QSCP.
 2. Mersen

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2.2 PANELBOARD RATINGS

- A. Panelboards shall be labeled with a short-circuit current rating equal to or greater than that indicated on the associated schedules or drawings.
- B. Non-service entrance rated panelboards shall be UL and cUL listed. Service entrance rated panelboards shall be UL listed.
- C. Panelboards shall be rated 600Vac and have a current rating as indicated on the associated schedules or drawings.
- D. Panelboard overcurrent protective device interrupting ratings shall be fully rated for the maximum available fault current and have a UL listed interrupting rating of 300kA.
- E. Current ratings, configuration of poles and number of circuits shall be indicated on associated schedules or drawings.

2.3 CONSTRUCTION

- A. Panelboard branch circuits shall incorporate overcurrent protection and branch-circuit rated disconnecting means into a single integrated component.
- B. Interiors shall be factory assembled.
- C. Bus bars shall be tin-plated copper with sufficient cross sectional area to meet UL67 temperature rise requirements.
- D. Bonded neutral shall be provided where specified in associated drawings.
- E. Isolated or Non-isolated equipment ground bar shall be provided as indicated in the associated schedules or drawings.
- F. Where a service-entrance rated panelboard is indicated in associated schedules or drawings, a bonded neutral and non-isolated equipment ground bar shall be provided by the manufacturer.
- G. Main lugs shall be rated for 75-degree C terminations.
- H. Panelboards shall be field convertible for top or bottom incoming feed.

2.4 MAIN DISCONNECT

- A. Permanently installed lockout means shall be provided on the main disconnect for lockout tag out procedures.
- B. Main disconnect shall be quick-make, quick-break type.

2.5 BRANCH FUSED DISCONNECTS

- A. Device shall have visible circuit ON/OFF indication with colored and international symbol markings.
- B. Device shall provide open fuse indication via permanently installed neon indicating light.

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- C. Device shall be UL and cUL Listed 600Vac, 200kA short-circuit current rating, load-break disconnect with amperage ratings and number of poles as indicated on the panelboard schedule.
- D. Fuse and disconnect assembly shall be a finger-safe component with trim installed.
- E. Fuse and disconnect shall be mechanically interlocked so as not to allow fuse removal while fuse terminals are energized.
- F. No special tools shall be required for fuse removal.
- G. Devices shall have bolt-on style bus connectors.
- H. Device housing shall be clearly marked with device amperage.
- I. Permanently installed lockout means shall be provided on the device for lockout tag out procedures. Permanently installed means for locking device in the ON position shall also be provided.
- J. Device shall provide fuse ampere rating rejection at the following ampacities to ensure continued circuit protection at the specified circuit rating: 15A, 20A, 30A, 40A, 50A, & 60A.

2.6 MAIN & BRANCH OVERCURRENT PROTECTION

- A. All overcurrent protective devices shall have a minimum interrupting rating of 300kA.
- B. Branch circuit overcurrent protection shall be UL listed 600Vac, minimum 300kA IR, IP20 finger-safe fuse with Class J performance characteristics.
- C. Main overcurrent protective devices shall be UL listed 600Vac, minimum 300kA IR, Class J time-delay fuses.
- D. Where panelboard main fuses are installed, fuses in panelboard branch circuits shall selectively coordinate with main fuses for all overcurrents up to 200kA.

2.7 ENCLOSURE

- A. Mounting shall be surface or flush mount as indicated in associated schedules or drawings.
- B. Boxes shall be a nominal 20 inches wide and 5-³/₄ inches deep with wire bending space per the National Electrical Code®.
- C. Panelboard trim shall be supplied with lockable door covering all disconnect handles.
- D. Panelboard trim shall be dead-front construction covering all energized parts.
- E. Enclosures shall be NEMA Type 1 or Type 3R as indicated in associated schedules or drawings.
- F. Door-in-door type trim shall be provided for all NEMA 1 enclosures.
- G. Front trim shall be lockable. All lock assemblies shall be keyed alike.

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PART 3 - EXECUTION

3.1 INSTALLATION OF PANELBOARDS AND ENCLOSURES

- A. General: Install panelboards and enclosures, as shown, including electrical connections, in accordance with the manufacturer's written instructions, the requirements of NEC, NECA Standard of Installation, and industry practices.
- B. Coordination: Coordinate installation of panelboards and enclosures with conductor and raceways installation work.
- C. Anchoring: Anchor enclosures to walls and structural surfaces ensuring that they are permanently and mechanically secured.
- D. Directory Card: Provide a typed circuit directory card(s) upon completion of work. Directory card shall be of super heavy-weight index card stock, 110 lb, white. Directory shall include type of load (i.e.: receptacles, lighting, exhaust fan, etc.) and location (i.e.: Room 102, Office in Room 102, Storage Room north of Room 102, etc.). Room number shall be identified as the actual graphics room number assigned to the space and not the room number identified on the Plans. If no school room number is assigned, list school name for room. List corridors as "corridor". If unsure how to list rooms that may not have a number or name contact maintenance electrical supervisor or his designee. Circuits with shunt trip shall be identified with the control circuit operating the shunt trip (i.e.: Kitchen Hood No. 2). Shunt trip breakers with common trip circuit shall be grouped in the panelboard (i.e.: circuits 1, 3, 5 and 7). All breakers controlled via contactors, or that supply control voltage to contactors shall be noted, and provide information at the bottom of directory card to include exact location of contactors, (example – plenum of Room 100) and how controlled (example – via BMCS). If breakers serve more than one contactor, the notations shall be separate for each contactor. Directory cards shall be large enough, including plastic holders, to include all necessary information. Directory cards are not to be folded to fit in holders. All breaker spaces are to be identified including for 2-pole and 3-pole breakers (list load on each space).
- E. Fuses: Install fuses, of the ratings and class shown, in each power distribution and motor control panelboard.
- F. Circuit Arrangement: Arrange branch circuit connections to 3-phase lighting and appliance panelboards so that when two or three circuits are run with a common neutral, each circuit is connected to a different phase unless shown otherwise. Branch circuits shall be connected to the circuit breakers in the lighting and appliance panelboard to provide the best possible phase balance, unless shown otherwise.
- G. Spare Conduits: Provide (3) 1-inch and (3) ¾-inch spare conduits capped to 6-inches above accessible ceiling space and (3) 1-inch and (3) ¾-inch conduits capped down to ceiling space on floor below for all recessed lighting and appliance panelboards and all lighting and appliance panelboards located above ground floor.
- H. Conductors shall be bent neatly opposite the fuse or circuit breaker to which they are to be attached. Vertically installed conductors shall be neatly tie-wrapped. Conductors shall be connected in a neat and professional manner. Conductors brought in from the top or bottom of the cabinet shall be bent neatly opposite the fuse or circuit breaker to which they are to be attached. Each conductor shall be run along the full height of the panel and returned to the circuit breaker or fuse location to allow relocation of the conductor to any position along the bus. Neutral and grounding conductors shall be installed similar to the

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phase conductors. Panelboard shall be cleaned of all construction debris prior to substantial completion review.

- I. Circuit breakers and conductors installed for surge protection devices shall be located at the top or bottom of the panelboard in respect to the location of the surge protection device. Route all conductors to the surge protection device using long sweep bends and the shortest conductor length possible.
- J. Install ground bus for ground conductors. Ground conductors size #1 and larger are to be landed to can with mechanical lugs and not to ground buss.
- K. Install panels so that breaker number 1 is the top left breaker. Panel interiors shall not be installed where breaker number 1 is the bottom right breaker.
- L. In panels that contain multi-layered neutral bus install neutrals beginning with the back neutral bus row and work forward. Do not make up neutrals on front neutral bus row unless all other rows are full.
- M. Label breaker mounting space with stick-on number labels.
- N. Verify connected load(s) and selection of fuse sizes prior to selection and installation. Install fuses in accordance with Article 2.4.

3.2 TESTING

- A. Before energizing, energization, check for continuity of circuits and short circuits.
- B. Provide thermal infrared scan of panelboards under full load as directed and witnessed by Owner. Provide digital video documentation with test results for comparison to future test. Make corrections as needed as soon as possible as directed by the Owner. Repeat the scan at the 11-month prior to closeout, and make corrections prior to close-out.

END OF SECTION

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SECTION 262425

ENCLOSED SWITCHES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Safety and disconnect switch work where required, scheduled, indicated, specified, and required. For switches indicated or rated above 1,200 Amps, provide switchboard construction as specified for switchboards.
- B. UL Approved: Safety and disconnect switches shall have UL approval and the UL label.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Schneider Electric - Square D
- B. ABB-General Electric Co.
- C. Siemens
- D. Eaton

2.2 ENCLOSED SWITCHES

- A. General: Provide heavy duty type, dead-front, sheet steel enclosed, surface-mounted safety switches of the type and size indicated. Safety switches shall be rated for the voltage of the circuit where they are installed. Safety switches used as motor disconnects shall be rated for the motor horse power served.
- B. The overcurrent protective device short circuit, coordination and arc flash studies performed by the overcurrent protective device manufacturer shall be used by the respective switchgear vendor(s) to select appropriate equipment, switchgear, and overcurrent protective device characteristics such as but not limited to: equipment bracing, AIC rating, circuit breaker frame size and trip settings, and fuse type/class. The appropriate equipment suitable and required by the studies for code compliance shall be included with the submittal data for review and provided at no additional cost to the Owner. The appropriate equipment recommended by the studies for enhanced selective coordination or enhanced arc flash energy reduction beyond code compliance shall be included with the submittal data for review and consideration purposes by the engineer.
- C. Switch Mechanism:
 - 1. Safety switches shall be quick-make, quick-break type with permanently attached arc suppressor. Constructed so that switch blades are visible in the OFF position with the door open. The operating handle shall be an integral part of the box, not the cover. Switch shall have provision to padlock in the OFF position. Safety switches shall have a cover interlock to prevent unauthorized opening of the switch door when the switch mechanism is in the ON position, or closing of the switch mechanism when the switch door is open.

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2. Cover interlock shall have an override mechanism to permit switch inspection by authorized personnel. Current-carrying parts shall be constructed of high conductivity copper with silver-plated switch contacts. Lugs shall be suitable for copper conductors and front removable.
- D. Neutral: Provide safety switches with number of switched poles indicated. Where a neutral is present in the circuit, provide a solid neutral with the safety switch. Where a ground conductor is present in the circuit, provide a separate solid ground with the safety switch.
- E. Auxiliary Contacts: Disconnect switches related to all smoke control fans shall have auxiliary contacts for fire alarm system monitoring of the position of the disconnect switch.

2.3 ENCLOSED SWITCHES WITH OVERCURRENT AND/OR GROUND FAULT PROTECTION

- A. Overcurrent protective devices 1,200 Amps and below:
 1. Where switch is intended as a building service disconnect provide solid neutral and ground bus and service entrance SE rating.
 2. Molded case circuit breakers:
 - a. Greater than 800 Amp: Solid state true RMS sensing with adjustable: current, I²t settings, ground fault (where required), instantaneous trip, and short time trip; 80-percent continuous current rating.
 - b. 800 Amp and smaller: Solid state true RMS sensing with fixed current setting by rating plug or dial. Breaker shall have adjustable instantaneous trip function with short time tracking.
 - c. 1,200 Amp and larger frame circuit breakers regardless of trip shall have Energy Reducing Maintenance System switch with local status indicator (ERMS).
 3. Fusible switches:
 - a. Quick-make, quick-break units utilizing the double-break principle of circuit interrupting to minimize arcing and pitting and shall conform to the ratings shown.
 - b. Individual door over the front, equipped with a voidable interlock that prevents the door from being opened when the switch is in the ON position unless the interlock is purposely defeated by activation of the voiding mechanism. All switches shall have externally operated handles.
 - c. 600 Amps and below equipped for Class J fuses.
 - d. 601 Amps and above shall be equipped for Class R or L fuses.
 - e. When required by the latest edition of the NEC or the AHJ, 1,200 Amp fused switches regardless of fuse size installed shall have Energy Reducing Maintenance System switch with local status indicator (ERMS).
- B. Ground Fault Interrupter (GFI) protection: Where shown or required, ground fault protection shall be achieved with adjustable pickup for ground fault currents, field-adjustable from 200 amperes and instantaneous to 60 cycle time delay. The ground fault protection system shall include necessary current sensors, internal wiring, and relays to coordinate opening the monitored faulted circuits.
 1. Ground fault protection shall be set at minimum setting for both current and time during construction. The manufacturer shall include in the submittal data the minimum setting of the device and the recommended setting for normal building operation.

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2. The ground fault system shall be factory-tested before shipment as specified:
 - a. The manufacturer shall provide a factory ground fault protection system test for circuit testing and verification of tripping characteristics. The manufacturer shall pass predetermined values of current through the sensors and measure the tripping time for each phase and neutral. The measured time-current relationships shall be compared to the trip-characteristic curves. If the ground fault device trips outside the range of values indicated on the curve, the ground fault device shall be replaced or recalibrated.
 - b. Relays, electrically operated switches, shunt-trip switches, circuit breakers, and similar items shall have proper voltages applied to their circuits and satisfactory operation demonstrated.
 - c. Upon completion of the factory ground fault protection system test, the current and time on each ground fault device shall be set to minimum values.

2.4 ENCLOSURES

- A. Enclosures in indoor locations shall be NEMA 1 unless shown otherwise.
- B. Enclosures in exterior locations shall be NEMA 4X stainless steel.
- C. Enclosures at kitchen and food preparation locations, exterior kitchen supply and exhaust fans, hose down areas, cooling towers, in greenhouses, and in other corrosive areas shall be NEMA 4X, stainless steel.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install safety and disconnect switches where required or indicated, in accordance with the manufacturer's written instructions, requirements of the NEC, NECA Standard of Installation, and industry practices. Provide fuse identification label when fused switches are required showing type and size inside door of each switch. Include devices in coordination study to indicate overcurrent devices will selectively coordinate.
- B. Location: Provide safety switches within 50' and in sight of motor served. There shall be minimum code required clearance in front of safety switch and a clear path in which to access the switch. (i.e.: not having to walk and/or stand on obstacles such as drain pans on floor to service).
- C. Supports: Provide all safety and disconnect switches with galvanized angle or other supports where mounting on wall or other rigid surface is impractical. Switches shall not be supported by conduit alone. Where safety and disconnect switches are mounted on equipment served, the switch shall not inhibit removal of service panels or interfere with access areas, not void the warranty of the equipment served. Provide mounting hardware that will allow removal of safety and disconnect switches with common work tools. Do not utilize drive pin anchors through enclosure.
- D. Ground Fault Interrupter (GFI) test and settings: Where adjustable ground fault interrupter settings are provided or required, after completion of construction and before final acceptance testing, the ground fault protection system shall be field-tested and reset to the manufacturer's settings for both current and time by a representative of the manufacturer's engineering service department. After the test, set ground fault to 50-percent of the overcurrent device rating.

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- E. Safety and Disconnect Switches: Install disconnect switches for motor-driven equipment, appliances, motors, and motor controllers within sight of the controller position unless indicated otherwise.
- F. Variable Frequency Drive (VFD) Warning Plaque: Provide VFD warning plaque at safety disconnect switches which are located down-stream of VFDs. Secure plaque to disconnect switch or immediately adjacent to disconnect switch with fasteners. Plaque shall be Yellow-White-Yellow 3-layer plastic laminated engraved with: "WARNING" (1/2 Inch Letters). "TURN OFF VFD BEFORE OPENING THIS SWITCH FOR MAINTENANCE." (1/4 inch letters).
- G. Provide disconnect switch for electric duct heaters.
- H. Where disconnect switch is used or indicated as the utility service building disconnect, provide main bonding jumper and neutral to ground bond connected to the building's grounding system. Do not bond neutral to ground when there is a neutral to ground bond upstream from the same derived neutral system serving the disconnect switch.
- I. Disconnect switches related to all smoke control fans shall have auxiliary contacts for fire alarm system monitoring of the position of the disconnect switch, coordinate with Division 28. Coordinate with fire detection and alarm contractor for the fire alarm and detection system to monitor all disconnect switches open/closed position that serve the smoke control system. All fire alarm and control wiring directly related to the monitoring of the supply power disconnect switches and control of the smoke control fans shall be installed in conduit.

3.2 TESTING

- A. General: Before energizing, check for continuity of circuits and short circuits.
- B. Provide thermal infrared scan of the enclosed switches rated 200 Amps or larger under full load prior to testing / maintenance and modifications and of the modified and new switchboard sections after construction as directed and witnessed by Owner. Make corrections as needed as soon as possible as directed by the Owner. Repeat the scan at the 11-month prior to closeout, and make corrections prior to closeout. Provide digital video documentation with test results for comparison between prior condition and post construction modifications and future tests.

END OF SECTION

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SECTION 262430

FUSES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Fuse work as shown and scheduled, and as specified.
- B. Types: Fuses required for the project include the following:
 - 1. 250 volt current limiting fuses
 - 2. 600 volt current limiting fuses

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturers: Provide products produced by Bussman or Littlefuse.

2.2 CURRENT LIMITING FUSES - 600 VOLTS AND LESS

- A. General: Provide 200,000 amperes interrupting capacity (AIC) current-limiting fuses of the current ratings shown and voltage rating equal to or greater than the voltage at the point of application.
- B. Types:
 - 1. Fuses in circuits supplying individual motors, groups of motors, or loads including motors, 600 amperes or less, shall be UL Class RK1 or Class J, time delay fuses, Bussman LPS-RK (600V) LPJ-SP (600V), LPN-RK (250V).
 - 2. Fuses in circuits supplying individual motors, groups of motors, or loads including motors, 601 to 4000 amperes, shall be UL Class L time delay fuses, Bussman KRPC "HI-CAP".
 - 3. Fuses in circuits supplying other than motor loads, 600 amperes or less, shall be UL Class RK1, time delay fuses, Bussman LPS-RK (600V), LPN-RK (250V).
 - 4. Fuses supplying surge protection devices (SPD) shall be surge rated for use with SPD devices.

2.3 SPARE FUSES

- A. General: Provide spare fuses in the amount of 10% of each type and size installed, but not less than 3 spares of a specific size and type. Deliver to the Owner at the time of project acceptance. Fuses shall be encased in a labeled steel enclosure with padlock provision, to be wall mounted where directed.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install fuses in fuse holders immediately before energizing of the circuit where the fuses are installed. Fuses shall not be installed and shipped with equipment.
- B. Labels: Place fuse identification labels, showing fuse size and type installed, inside the cover of each switch.

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END OF SECTION

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SECTION 262773

LINE VOLTAGE WIRING DEVICES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide wiring device work as shown, scheduled, indicated, and specified. Low voltage and/or digital control switches required for lighting controls and lighting control systems shall be as specified and required for the low voltage and / or digital control lighting system. Refer to drawings or other specification sections for low voltage / digital lighting control systems. Cover plates for lighting control systems shall be as specified in this section unless specifically required otherwise by the low voltage / digital control device bulkhead or form factor.

1.2 QUALITY ASSURANCE

- A. UL Label: Wiring devices shall be UL labeled.
- B. NEMA Standard WD1 and WD6.
- C. Fed. Spec. WC596, W-S-896

1.3 SUBMITTALS

- A. Mark up a complete copy of the specification section for the product to indicate a) acknowledgement of the specification requirement (Comply), or b) acknowledgement that the particular specification requirement does not apply to this specific project (Not Applicable) or, c) acknowledgement that the specification requirement cannot be made or that a variance is being submitted for review to the Architect/Engineer/Owner (Does Not Comply, Explanation:) Do not submit an outline form of compliance, submit a complete copy of the specification section with the product data.
- B. Submit a sample of each style and color of 120-Volt duplex receptacle and each 120/277-Volt switch with related cover plate. Attach plate to wiring device and label back side of plate with job description with permanent black marker.
- C. Submit manufacturer's product data sheet for each style of device and plate on the project.
- D. Submit drawings of plans, elevation and sections of receptacles and outlets in casework, cabinetwork and built-in place furniture. Coordinate dimensions with millwork shop drawings and related architectural drawing series.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Toggle switches, straight blade and twist lock devices, interior cover plates:
 - 1. Leviton
 - 2. Hubbell
 - 3. Pass and Seymour
 - 4. Eaton

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- B. Dimming
 - 1. Leviton
 - 2. Lutron

2.2 WIRING DEVICE COLOR

- A. Device color shall be gray except 20A, 125V receptacles and toggle wall switches which are directly supplied from an emergency source shall be red, and heavy duty 30 Amp and larger simplex devices which shall be black in color where the building standard color is not available. Provide equivalent hospital grade devices where red is not available in grade specified. Verify with Owner / Architect prior to submitting for approval. Color change kits as required for dimming switches. Low voltage lighting control devices specified elsewhere shall match the line voltage wiring device color specified in this section.

2.3 RECEPTACLES

- A. Industrial grade tamper resistant smooth face duplex receptacles, 2 pole, 3 wire grounding, with ground connection and poles internally connected to mounting yoke, with metal mounting straps, locking plug-tail or back and side wired with screw type terminals, NEMA indicated, (X=color designation).
 - 1. 20A, 125V duplex NEMA #5-20R: Leviton #5362-SGX
 - 2. 20A, 125V isolated ground duplex NEMA #5-20R: Leviton #5362-IGX
 - 3. 20A, 125V ground fault circuit interruption (GFCI) NEMA #5-20R weather and tamper resistant: Leviton #G5362-WTX
 - 4. 20A, 125V weather resistant (WR), tamper resistant: Leviton #TWR20-GY
 - 5. 20A, 125V plug load control, split circuit marked for "controlled", tamper resistant: Leviton #TDR20-S1G
 - 6. 15A, with 20A feed-through, NEMA #5-15R, 125V duplex, arc fault (AFCI), tamper resistant: Leviton #AFTR1-HGX
- B. Heavy-Duty Simplex: Single heavy-duty type receptacles, with green hexagonal equipment ground screw, with metal mounting straps, back or side wiring, black molded phenolic compound.
 - 1. 15-60A, 125-250V, straight blade, NEMA configuration as indicated or as required by Owner.
 - 2. 15-50A, 125-480V, twist lock, NEMA configuration as indicated or as required by Owner.
- C. Hospital grade receptacles, 2 pole, 3 wire grounding, with ground connection and poles internally connected to mounting yoke, with metal mount straps, locking plug-tail or back and side wired with screw type terminals, molded phenolic compound, NEMA configuration indicated.
 - 1. 20A, 125V grounded duplex NEMA #5-20R: Leviton #8300-X
 - 2. 20A, 125V isolated ground duplex NEMA #5-20R: Leviton #8300-LIG (orange)
 - 3. 20A, 125V ground fault circuit interruption (GFCI) with indicator light: Leviton NEMA 5-20R-8898-HGX
 - 4. 20A/125V Tamper Resistant Duplex NEMA 5-20R: Leviton 8300-SGX
- D. USB 2-port charger / tamper-resistant with 125-Volt receptacles:
 - 1. USB type A/C, 1 type A and 1 type C port, 5.1A 5.0VDC charging. 20A, 125V, NEMA 5-20R: Leviton #T5833-HGX
 - 2. USB A, 2 type A ports, 5.1A 5.0VDC charging. 20A, 125V, NEMA 5-20R: Leviton #T5832-HGX

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- E. USB 4-port charger:
 - 1. USB type A+C, 2 type A ports and 2 type C ports. 5.0A 5.0VDC charging. Hubbell #USB4ACX.
 - 2. USB type A, 4 type A ports. 5.0A 5.0VDC charging. Hubbell #USB4X.

2.4 WALL SWITCHES

- A. Toggle: Industrial grade flush toggle switches, with mounting yoke insulated from mechanism, equipped with plaster ears, switch handle, back and side-wired screw terminals.
 - 1. Single-pole, 120/277V, 20A switch: Leviton #1221-2X
 - 2. Double pole 120/277V, 20A switch: Leviton #1222-2X
 - 3. Three-way, 120/277V, 20A switch: Leviton #1223-2X
 - 4. Four-way, 120/277V, 20A switch: Leviton #1224-2G
 - 5. Pilot light single-pole, 120/277V, 20A switch: Leviton #1221-PL
 - 6. Momentary, 120/277V, 20A, single-pole double throw, center off: Hubbell only, #HBL 1557G
- B. Toggle key operated switch (verify manufacture and key type with Owner prior to construction).
 - 1. Single-pole, 120/277V, 20A key operated switch: Hubbell HBL #1221GY
 - 2. Two-pole, 120/277, 20A key operated, Hubbell HBL #1222GY
 - 3. Three-way, 120/277V, 20A key operated switch: Hubbell HBL #1223GY
 - 4. Four-way, 120/277V, 20A key operated switch: Hubbell HBL #1224GY
 - 5. Momentary, single pole double throw, center off, 20A key switch: Hubbell #HBL 1557LG.
 - 6. Key: Hubbell #HBL 1209. Key switches shall be keyed alike to match the Owner's standard key system. Coordinate with Owner.

2.5 WALL DIMMERS

- A. Wall Box Dimmers: Self-contained, wall box mounted, linear slide square law dimmers with ON/OFF switch. Dimmers shall operate continuously at rated load in an ambient temperature up to 40°C and an input of 100 to 277V. Heat sink fins may be removed only as approved by Owner / Engineer for narrow ganging after applying de-rating.
 - 1. Single-pole, 120/277V, 1000/2308 Watt incandescent / magnetic low voltage: Leviton #AWSMT-MBW.
 - 2. Single-pole, 120/277V, 1500/3463 Watt incandescent / magnetic low voltage, 2-gang heat sink: Leviton #AWSMT-MCW.
 - 3. Single-pole, 120/277V, 1920/4432-Watt LED / fluorescent 0-10V dc, 75 mA current sink: Leviton #AWSMT-7DW.
 - 4. Three, four- or five-way remote switch: Leviton #AWSRT-00W.
 - 5. Color change kit as required.

2.6 GFCI – GROUND FAULT CIRCUIT INTERRUPTER, BLANK FACE

- A. 20A, 125V, GFCI, switch rated, blank face feed through, Hubbell #GFBF20GYL, gray finish, stainless steel cover plate black laser engraved with device protected, (example: DRINKING FOUNTAIN GFCI).

2.7 INTERIOR WALL COVER PLATES AND FASTENERS

- A. Type 302 non-magnetic stainless-steel with satin finish (also required for wall box device cover plates for low voltage and digital lighting controls specified elsewhere).

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- B. Cover plate laser plate engraving for device identification (other than low voltage lighting controls).
1. Provide laser cover plate engraving with black filling for all wiring devices indicating panelboard name, circuit, and voltage.
 2. Wiring devices connected to emergency/stand-by generator or inverter shall include the word "EMERGENCY".
 3. Text orientation shall be upright, readable from left to right when cover plate is installed.
 4. Remotely located lighting switches shall also indicate the room or area and zone controlled by each switch. Coordinate specific wording with Owner/Architect.
 5. Blank face GFCI cover plates shall also intuitively indicate the load or equipment served, device, or area protected downstream ("EDF" for drinking fountains, "RM RECEPES", "HOOD RECEPES", "VENDING", "REFRIG", etc.) For other loads, Owner/Architect shall determine name plate wording.

2.8 EXTERIOR COVER PLATES

- A. Thomas & Betts CK Series, cast aluminum standard depth, locking mount, while-in-use, wet location, universal configuration.
1. Vertical mount receptacle: #CKSUV
 2. Horizontal mount receptacle: #CKMU
 3. Two-gang: #2CKU
 4. 30-60 Amp Devices: #CKLSUV

2.9 CORD REELS AND DROP CORDS

- A. Cord Reels:
1. Lighted cord reels: Industrial grade, LED hand Lamp only, 125V, 45-foot 16/3 SJO cord, white finish, LED hand lamp. Hubbell #HBLI45163LED with #HBLI340PB pivot base.
 2. 20 Amp (2) duplex receptacle cord reels: Industrial grade, 125V, (2) 20A duplex receptacles, GFCI protection, 45-foot 12/3 SJO cord, white finish, yellow outlet box. Hubbell #HBLI45123GF220 with #HBLI340PB pivot base.
 3. 30 Amp receptacle cord reels: Industrial grade, 125/250V, 30A, 45-foot 10/4 SJO cord, white finish, yellow outlet box. Hubbell #HBLI45104 with #HBLI340PB pivot base. 30 Amp NEMA receptacle termination as required by Owner.
 4. 50 Amp receptacle cord reels: Industrial grade, NEMA 4 wet location, 600V, 55A, 50-foot 6/4 SOOW cord, yellow finish, self-retracting, with NEMA 50-Amp maximum receptacle termination as required by Owner. KH-Industries RTMH4L-WW-K6K.
 5. Recessed enclosure for 20 and 30-Amp cord reels recessed above T-grid drop ceilings: Hubbell #HBLIPRBOX recessed cord reel enclosure, white finish, plenum rated.
- B. Drop cord receptacles:
1. 20A, 125V, 25-feet 600 VAC, 3-conductor 12 AWG SOOW cable, twist lock plug, two 125V, 20A duplex WR GFCI outlets, safety yellow rubber outlet box, mesh strain relief cord grips. KH Industries #PP4DD-520-B12F-520.
 2. 20A, 125/250V, 25-feet 600 VAC, 4-conductor 12AWG SOOW cable, twist lock plug, four 125/250V NEMA L1420P outlets, safety yellow rubber outlet box, mesh strain relief cord grips. KH Industries #PP7DD-520-B12F-L1420.
 3. 30-60 Amp, voltage, NEMA plug/receptacle as required by Owner, SOOW cable, number of conductors and length as required, mesh strain relief cord grips.

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2.10 FIRST RESPONDER EMERGENCY REMOTE POWER OFF (FREPO) STATION

- A. Knox Company Remote Power Rapid Access 4500 Series Shutdown Station
 - 1. Recessed mount for public spaces and new construction, surface mount for when mounted to equipment or existing construction.
 - 2. Single lock keyed for local Fire Department/AHJ, verify configuration and keying with Knox Company.
 - 3. Red Finish
 - 4. Tamper alert for integration with building security system.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Cover plates for receptacles and toggle switches shall be of the same manufacturer throughout unless otherwise noted.
 - 1. Key switches and keys shall be as specified and also as approved by Owner.
 - 2. Submit samples for each specified toggle switch and duplex receptacle color to Architect.
- B. Install wiring devices where shown and as required, in accordance with manufacturer's written instructions, requirements of NEC, and in accordance with industry practices. Do not install devices until wall construction and wiring is completed.
- C. Install receptacles and switches only in electrical boxes that are clean, free from building materials, debris, and similar matter.
- D. Install wiring devices plumb and aligned in the plane of the wall, floor, ceiling or equipment rack.
- E. Install switches in boxes on the strike side of doors as hung. Install so the up position will close the circuit or will be the highest level of illumination. Where more than one switch is in the same location, install switches in a multi-gang box with a single cover plate.
- F. Provide a cover plate for every wiring device and blank cover plates for unused rough-in-only boxes that matches the building standard. Fasten all plates outdoors with type 302 Allen Head "tamper-proof" screws.
- G. Mounting heights of all wiring devices shall comply with local accessibility standards and local codes, except where wiring devices are indicated for special purpose and access is only required by maintenance or service personnel.
- H. Refer to Architectural drawing and elevations, etc. for exact location of wiring devices. Coordinate location of all wiring devices with other trades, specialty items, and millwork and resolve all conflicts prior to rough-in. Field coordinate exact mounting location with all trades to avoid and resolve conflicts during construction.
- I. Locate receptacles for electric drinking fountains/coolers and bottle fill stations below equipment so that the receptacle is accessible and concealed as much as practical from public view by the equipment open cowling so that the receptacle remain readily accessible. For dual level basin equipment, locate receptacle under the upper basin.
- J. Provide convenience outlet receptacle within 25-feet of all new electrically operated mechanical equipment.

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- K. Where exterior receptacles are intended for continuous use, mount in horizontal position with while in use cover plate. (Exterior electric drinking fountains, ice makers, ice storage bins, landscape lighting low voltage transformers, seasonal decorative lighting, etc.)
- L. Install wall box dimmers to achieve full rating specified after de-rating for ganging as recommended by manufacturer.
- M. Do not share neutral conductor on load side of dimming switches.
- N. Install receptacles with grounding pole down, or as directed by Owner. If installed horizontally, install with neutral pole on top.
- O. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.
- P. Provide pigtail to each receptacle and each switch. Neutral and phase conductors shall be installed using side or rear entry lugs only. Do not wrap conductors around screw terminals. Tighten all screws and lugs as recommended by manufacturer.
- Q. All receptacles and switches shall have a minimum of two wraps of Scotch 33 or equivalent tape around terminal screws.
- R. Provide toggle switch within sight of all trap primers, circulation pumps, 120-Volt motors and motorized equipment to serve as the equipment disconnect switch.
- S. Mount cord reels and cord reel recessed enclosures to structure with galvanized steel struts and as recommended by manufacturer. Field verify exact location of cord reels with Owner/Architect. Mounting location shall avoid conflicts with piping, light fixtures and ductwork, etc. when cord reel is extended and retracted. Set ball stop as directed by Owner / Architect. Provide hand lamp only type cord reels in commercial / educational automotive garages with classified (hazardous) locations. Provide local toggle switch at standard switch height for hand lamp only cord reels.
- T. Mount drop cord suspension hook or j-box to structure to support the cord's weight and additional normal use pulling tension and as recommended by manufacturer. Use cable grips, either with cord grip hanging hook at open ceilings or with chrome plated escutcheon cover plate mounted to recessed j-box at finished ceilings. Field verify exact location, drop height, and NEMA outlet configuration of drop cords with Owner/Architect. Provide weatherproof receptacle cap or covers if located in wet location. Mounting location shall avoid conflicts with piping, light fixtures and ductwork, etc.

3.2 GROUND FAULT PROTECTION FOR PERSONNEL

- A. When GFCI personnel protection receptacles are not commercially available or cannot be installed at a readily accessible location or indicated otherwise on the drawings, GFCI personnel protection shall be provided by a remote blank face GFCI wiring device or by an up-stream GFCI receptacle that also provides downstream GFCI protection and located in a readily accessible location. When branch circuit breaker device with integral GFCI protection is required or specified, it shall be within the manufacture's recommended distance limitations of the connected receptacle(s) or load(s) for proper GFCI personnel protection at the farthest outlet.

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- B. GFCI personal protection locations include but are not limited to the following:
1. For other than dwelling units: All single phase 125-250-Volt (150-Volts to ground or less) receptacles 50-Amperes or less, and all three phase 125-250-Volt (150-Volts to ground or less) receptacles 100-Ampres or less in the locations indicated below.
 2. Dwelling units: All single phase 125-250-Volt receptacles installed in the following locations indicated below.
 3. Provide personnel GFCI protection as indicated above in the following locations and all additional locations as required by the NEC.
 - a. Outdoors (with exceptions for not readily accessible receptacles with dedicated branch circuits for snow melting, deicing, pipeline/vessel heat receptacles. Provide these loads with 30mA EGFI circuit breaker protection).
 - b. Bathrooms/toilets/restrooms
 - c. Janitors/custodial closets and mop sinks.
 - d. Laundry areas
 - e. Parking structures, service garages, garages and accessory buildings
 - f. Basements, crawl spaces (including 120-Volt lighting)
 - g. Within 6-feet of all water sources including sinks, mop-sinks, lavatories, bathtubs, shower stalls, faucets, eye wash stations, emergency shower stations
 - h. Indoor damp and wet locations
 - i. Locker rooms
 - j. Indoor swimming pools and natatoriums areas and adjacent corridor/hall convenience receptacle outlets located within 25-feet of all access doors.
 - k. Non-dwelling unit therapeutic tubs/pools/whirlpool areas and adjacent corridor/hall convenience receptacle outlets located within 25-feet of all access doors.
 - l. Receptacles serving dwelling unit kitchen counter tops
 - m. Vending machines
 - n. Elevators, dumb waiters, escalators, moving sidewalks: receptacles in pits, hoist ways, well ways or those mounted on the cars of elevators and dumb waiters.
 - o. Electric vehicle charging equipment.
 - p. All receptacles serving kitchen or food preparation counter tops.
 - q. Automotive vacuum machines
 - r. Drinking water fountains/coolers and bottle fill stations
 - s. Corded high-pressure spray washing machines
 - t. Tire inflation machines
 - u. Dish washers
 - v. Receptacles at end of cord reels or drop cords.
 - w. Boat houses, boat hoist, and all pier/dock receptacles and lighting (excludes shore power that requires GFPE).
 - x. Central plant, mechanical rooms and electrical rooms
 - y. Wood, metal, or other material fabrication or vocational training shops.
 - z. Receptacles that serve educational science and science prep room counter tops.
- C. Where a GFCI protected receptacle outlet is required or indicated behind vending machine, refrigerators or other equipment, provide remote GFCI blank face in same room as protected receptacle and at a readily accessible location with standard receptacle outlet behind equipment. Refrigerators shall be GFCI protected only where located within 6-feet of power cord distance from the edge of a sink to the surface of the refrigerator.

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- D. Unless indicated otherwise, locate blank face GFCI device near light switches at same height as light switches or ganged with the light switch. Provide GFCI protection for all receptacle outlets located below 42-inches in all infant through 2-year old day care and similar areas designated for occupancy by infant through 2-year old day care occupants so the GFCI device can easily be intentionally tripped or tested and reset.
- E. Provide branch circuit breaker 30mA (EDP) or 100mA (EPE) equipment protection for utilization equipment as required by the NEC and where indicated on the drawings.

3.3 FIRST RESPONDER REMOTE EMERGENCY POWER OFF (FREPO) STATION

- A. Provide Knox Company first responder remote emergency power off (FREPO) stations as indicated and/or where required by local AHJ. Mounting locations shall be as directed by the local AHJ and exact locations coordinated with the Architect. FREPOs shall be circuited only to shunt trip or shut-down control circuiting. FREPOs shall be recessed mounted in public locations and in all new construction when attached to building construction. Provide surface mount FREPOs when mounted to equipment or existing construction.
- B. Integrate the FREPOs to shut-down the building non-emergency and non-legally required power sources which include the main electrical utility service disconnect circuit breaker(s), other than non-life safety or non-legally required distribution scale UPS equipment, and non-life safety or non-legally required local power generation equipment.
- C. Provide FREPOs for fire pump, life safety, and legally required electrical generation equipment only when required by the AHJ. When required by the AHJ, fire pump, life safety, and legally required power generation and/or stored energy power supply equipment shall each have separate dedicated FREPOs that shut down only their associated power generation/stored energy equipment. FREPOs for emergency, and legally required systems shall have minimal 25-foot physical separation from the building main utility service FREPOs and clearly labeled with the equipment that they will shut down. FREPOs for fire pumps shall have minimal 25-foot physical separation from the any other FREPOs and from the building main utility service disconnect and clearly labeled with the equipment that it will shut down.
- D. Integrate the FREPOs tamper switch with the building security or building management control system (BMCS) as directed by Owner.

3.4 TESTING

- A. Before energizing, check for continuity of circuits, short circuits, and grounding connections.
- B. After energizing, check wiring devices to demonstrate proper operation and receptacles for correct polarization, voltage and phase orientation if intended 3-phase equipment is phase orientation dependent for proper motor rotation or operation.
- C. Test each individual GFCI receptacle and all downstream receptacles protected by an upstream GFCI device with simulated ground fault tester, make corrections as necessary.
- D. Operate each wall switch with circuit energized and verify proper operation.

END OF SECTION

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SECTION 264300

SURGE PROTECTION DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION/SCOPE

- A. The Surge Protection Device (SPD) covered under this section includes all service entrance type surge protection devices suitable for use as Type 1 or Type 2 Devices per UL1449 4th Edition, applied to the line or load side of the utility feed inside the facility. The unit shall be connected in parallel with the facility's wiring system. The unit shall be manufactured in the USA by a qualified manufacturer of suppression filter system equipment, which has been engaged in the commercial design and manufacture of such products for a minimum of five years.
- B. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to finish and install surge protection devices.

1.2 QUALITY ASSURANCE

- A. Reference Standard: Comply with the latest edition of the applicable provisions and recommendations of the following, except as otherwise stated in this document:
 - 1. UL 1449 Fourth Edition
 - 2. ANSI/IEEE C62.41, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
 - 3. ANSI/IEEE C62.45, Guide for Surge Testing for equipment connected to Low-Voltage AC Power Circuits.
 - 4. IEEE 1100 Emerald Book.
 - 5. National Fire Protection Association (NFPA 70 (NEC), 75, and 78).
 - 6. UL 1283 – Electromagnetic Interference Filters

1.3 SUBMITTALS

- A. Submit shop drawings complete with all technical information unit dimensions, detailed installation instructions, maintenance manual, and wiring configuration.
- B. Copies of Manufacturer's catalog data, technical information and specifications on equipment.
- C. Copies of documentation stating that the Surge Protection Device is listed from a Nationally Recognized Testing Laboratory (NRTL) (UL, ETL, etc.) and are tested and multi-listed to UL 1449 4th Edition and UL 1283.
- D. Copies of actual let through voltage data in the form of oscilloscope results for both ANSI/IEEE C62.41 Category C3 (combination wave) and B3 (Ring wave) tested in accordance with ANSI/IEEE C6245.
- E. Copies of test reports from a recognized independent testing laboratory, capable of producing 200kA surge current waveforms, verifying the suppressor components can survive published surge current rating on both a per mode and per phase basis using the ANSI/IEEE C62.41 impulse waveform C3 (8 x 20 microsecond, 20kV/10kA). Test data on an individual module is not acceptable.

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- F. Copy of warranty statement clearly establishing the terms and conditions to the building/facility owner/operator.
- G. Provide detailed marked-up copy of this specification with line-by-line compliance or exception statements to all provisions of this specification.

1.4 WARRANTY

- A. The manufacturer shall provide a minimum 20-year warranty for high and very high exposure SPDs. Very high exposure unit warranties shall include exposure to temporary over-voltage conditions. Provide a minimum 15-year warranty for all medium exposure SPDs, and a minimum 10-year warranty for all other SPDs for parts from date of substantial completion against failure. Contractor shall install in compliance with applicable national / local electrical codes and the manufacturer's Installation, Operation and Maintenance Instructions. Contractor shall assist the Owner with manufacturer warranty registration.

PART 2 – PRODUCTS

2.1 APPROVED MANUFACTURER

- A. Low exposure, minimum 10-year parts warranty, minimum 50k Amps per mode, 100k Amps per phase, Type 1 and Type 2.
 - 1. Recessed mount panelboard extension with brushed stainless-steel front:
 - a. ACT Communications:471- ###V-050-SS-F-PB flush series.
 - b. ABB Current Technology PX3-050-VVV- #X-SF-X-F- # series.
 - c. SSI Surge Suppression, Inc. CSMx12-FMPxSS series.
 - d. SST Southern Tier Technologies T45-VVVV-50-AWAJ2-C-RKSS (Stainless Steel front).
 - 2. Branch panelboard surface mounted:
 - a. ACT Communications 455 series.
 - b. ABB Current Technology CG3 60 series.
 - c. SSI Surge Suppression, Inc. CSMx12 series.
 - d. SST Southern Tier Technologies T45-VVVV-50-AWAJ2-C-RKSS (Stainless Steel front).
- B. Medium exposure, minimum 15-year parts warranty, minimum 120k Amps per mode, 240k Amps per phase, Type 2.
 - 1. ACT Communications 471 series.
 - 2. ABB Current Technology CGP3 125 series.
 - 3. SSI Surge Suppression, Inc. CSMx24 series.
 - 4. SST Southern Tier Technologies T45-VVVV-120A series
- C. High exposure, minimum 20-year parts warranty, minimum 200k Amps per mode, 400k Amps per phase, Type 2 SPD.
 - 1. ACT Communications 471 x200 series.
 - 2. ABB Current Technology TG3 200 series.
 - 3. SSI Surge Suppression, Inc. CHLxM series.
 - 4. SST Southern Tier Technologies T45-VVVV-200A series
- D. Very high exposure at service entrance 1,201 Amps and above: Minimum 20-year parts warranty; minimum 200k Amps per mode; 400k Amps per phase, Type 2 SPD:
 - 1. ACT Communications 471 SEL series.
 - 2. ABB Current Technology SEL3 200 series.

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The service entrance protector shall incorporate a combination of TPMOV and Selenium technology allowing for transient surge and temporary over voltage protection. The unit shall be able to prevent common temporary over voltages and high impedance faults from damaging the MOVs, increasing their longevity and ability to protect the critical load. Limited and Intermediate current TOVs can be caused by a loss of the neutral conductor in a split phase or three phase power system. The available fault current will be determined by the impedance of the loads connected to the phases opposite the SPD and are typically in the range of 30A to 1000A. Minimum 20-year parts warranty, extended over-voltage protection, minimum 200k Amps per mode, 400k Amps per phase, Type 2 SPD. The Selenium elements must limit voltage to the MOV as a percent of nominal as outlined below:

Overvoltage seen by MOVs as % of Nominal				
	available current			
time	30A	100A	500A	1000A
1 cycle	120%	130%	150%	160%
10 cycles	130%	150%	160%	160%
30 cycles	140%	150%	160%	160%

*To verify damage to the MOVs has been mitigated, the percent overvoltage seen at the MOV must be less than 200% for split-phase applications or 173% for three-phase applications (100% is nominal).

2.2 MANUFACTURED UNITS / ELECTRICAL REQUIREMENTS

- A. Declared Maximum Continuous Operating Voltage (MCOV) shall be greater than 115 percent of the nominal system operating voltage and in compliance with test and evaluation procedures outlined in the nominal discharge surge current test of UL1449, section 37.7.3. MCOV values claimed based on the component's value or on the 30-minute 115% overvoltage test in UL1449 will not be accepted.
- B. Unit shall have not more than 10% deterioration or degradation of the UL1449, Voltage Protection Rating (VPR) due to repeated surges.
- C. Protection Modes SVR (6kV, 500A) and UL1449 VPR (6kV, 3kA) for grounded WYE/delta and High Leg Delta circuits with voltages of (480Y/277), (208Y/120), (600Y/347). 3-Phase, 4 wire circuits, (120/240) split phase shall be as follows and comply with test procedures outlined in UL1449 section 37.6: Values Depicted are based on a system Without Disconnect / With Disconnect

System Voltage	Mode	MCOV	C3 Wave	UL 1449 VPR Rating
120/240	L-N	150	650/775	700/800
120/208	L-G	150	650/825	700/900
	N-G	0	500/500	900/1000
	L-L	300	950/1250	900/1200
277/480	L-N	320	1125/1225	900/1200
	L-G	320	1075/1225	1200/1200
	N-G	0	900/900	1200/1500
	L-L	550	1950/2200	1800/1800

- D. Electrical Noise Filter- each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric noise shall be as follows using the MIL-STD-220A insertion loss test method.
 1. 14 dB from 10 kHz to 1 MHz.

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- E. Each Unit shall provide the following features:
1. Phase Indicator lights, Form C dry contacts, counter and audible alarm.
 2. Field testable while installed.
 3. High performance interconnecting cable.
 4. The UL 1449 Voltage Protection Rating (VPR) shall be permanently affixed to the SPD unit.
 5. The UL 1449 Nominal Discharge Surge Current Rating shall be 20Ka
 6. The SCCR rating of the SPD shall be 200kAIC without requiring an upstream protection device for safe operation.
 7. The unit shall be listed as a Type 2 SPD per UL1449.
 8. Power wiring: SPD shall be equipped with mechanical lugs that can accept up to #2 AWG wire on High Exposure units and up to #6 on Medium and Low Exposure units

2.3 POWER CABLES FOR CONNECTION

- A. Power wiring: Conductors between all SPDs and switchgear shall be high performance interconnect system "Low Z Cable" cables with Ultra Low impedance characteristics at 10kHz and above.
- B. Low Impedance cable shall be #6 AWG minimum for Very High, High, and Medium Exposure SPDs and #10 AWG minimum for Low Exposure SPDs.

PART 3 – EXECUTION

3.1 GENERAL INSTALLATION

- A. The unit shall be installed as close as practical to the facility's wiring system in accordance with applicable national/local electrical codes and the manufacturer's recommended installation instructions. Connection shall be with high performance, low impedance cables in conduit and shall not be any longer than necessary, avoiding unnecessary bends. Minimum wire size and overcurrent protection shall be provided and as indicated or recommended by the manufacturer.
- B. Units specified for lighting and appliance panel boards as panelboard extensions (EGPE) shall be mounted directly above or below the first section of the panel board it is protecting. Any other mounting location will not be acceptable and shall be corrected, without exception, at no additional cost to the Owner.
- C. Units specified for panelboards, switchboards, or motor control centers shall be mounted directly above or adjacent to the panelboard, switchboard or motor control center using unistrut supports secured to structure as required. Conduit length between power distribution panelboard or switchboard shall be less than two inches. Mounting above equipment is not acceptable.
- D. Overcurrent device and conductors for devices shall be the maximum recommended by the manufacturer. Manufacturer's recommendations shall prevail over the information given in the plans and specifications.
- E. Provide recessed mounted panelboard extension type enclosures for devices protecting recessed panelboards. Enclosure front shall match panelboard front. Provide brushed stainless-steel front at kitchens and food processing areas.

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3.2 UNIT SELECTION BASED ON EXPOSURE LEVEL

- A. (SPDVH) Provide very-high exposure SPDs with Selenium and TPMOV technology for the following new electrical equipment or where indicated:
 - 1. Service entrance rated 1,201 Amps and above.
- B. (SPDH) Provide high exposure SPDs for the following new electrical equipment or where indicated:
 - 1. Service entrance rated 801 – 1,200 Amps.
 - 2. Switchboards located outside.
- C. (SPDM): Provide medium exposure SPDs at the following new electrical equipment or where indicated:
 - 1. Service entrance rated 401 - 800 Amps.
 - 2. Panelboards above 600 Amps.
 - 3. Motor control centers.
 - 4. Non-service entrance switchboards.
- D. (SPDL): Provide low exposure SPDs at the following new electrical equipment or where indicated:
 - 1. Service entrance rated 400 Amps and below.
 - 2. Panelboards 600 Amps and below.

3.3 TESTING

- A. Factory Trained Representative shall provide start-up to include initial verification of proper installation and initiate factory warranty. The technician will be required to do the following as a minimum:
 - 1. Verify overcurrent device rating
 - 2. Verify all wiring connections and installation conforms to manufacturer's recommendations.
 - 3. Record information for each product installed and include in O&M Manual
- B. A copy of the Factory diagnostic test report and written approval of the installation shall be included with the Electrical Operating and Maintenance Manual. The Contractor shall make all adjustments, changes, corrections, etc. as required by the Factory Trained Representative so that the installation follows the manufacturer's installation and operation instructions without additional charge to the Owner.

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SECTION 265113

LIGHTING FIXTURES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Work Included: Lighting fixture work is as shown, scheduled and specified.
- B. Applications: The applications of lighting fixtures required for the project include the following:
 - 1. General lighting
 - 2. Emergency lighting
 - 3. Outdoor area lighting

1.2 QUALITY ASSURANCE

- A. Provide interior building LED fixtures that comply with the Design Lights Consortium (DLC) standards and are DLC or DLC Premium listed as a Qualifying Product at time of proposal submittal date.
- B. UL Standards: Lighting fixtures shall conform to applicable UL standards, and be UL or ETL labeled.
- C. Light fixtures shall conform to the requirements of NFPA 101, and 70 (NEC).

1.3 SUBMITTALS

- A. Submit product data for light fixtures, and emergency lighting equipment, including generator transfer devices.
- B. Specification Compliance Review: Mark up a complete copy of the specification section for the product to indicate a) acknowledgement of the specification requirement (Comply), or b) acknowledgement that the particular specification requirement does not apply to this specific project (Not Applicable) or, c) acknowledgement that the specification requirement cannot be made or that a variance is being submitted for review to the Architect / Engineer / Owner (Does Not Comply, Explanation:) Do not submit an outline form of compliance, submit a complete copy with the product data.
- C. Submittal data shall include luminaire efficiency parameters.
- D. Submittal data for exterior luminaires shall include IESNA BUG ratings, backlight, uplight, and glare ratings of each unique luminaire for the orientation and tile specified. Indicate total absolute lumens per luminaire and absolute lumens emitted above horizontal based by each luminaire for the orientation and tile specified.

1.4 WARRANTY

- A. Provide 5-year warranty on all light fixtures, including internal or remote LED drivers, all other electrical internal electrical or electronic components except for emergency battery packs or emergency load control device relays. Refer to other specific component warranty requirements below.

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PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturers: Provide products produced by manufacturers shown or scheduled for each type of lighting fixture. Refer to drawings for additional approved manufacturers.
1. Light fixtures:
US LED
Extra Light
Hubbell
Signify
Cooper Lighting Solutions
Pinnacle
HE Williams
GE Current
LSI
 2. LED Drivers:
Philips
Osram Optotronic
Eldo LED
 3. Emergency Battery Packs with self-testing drivers/inverters: Shall be the same manufacturer as the low voltage lighting controls provided on this project. Where there are no low voltage lighting controls specified or provided, the manufacturer shall be Bodine.
Bodine
Chloride
Dual Lite
IOTA
 4. Emergency Generator/Inverter Load Control Bypass Relay (ELC); UL924 listed and 0-10Vdc compatible: Shall be the same manufacturer as the low voltage lighting controls provided on this project. Where there are no low voltage lighting controls specified or provided, the manufacturer shall be Bodine.
 5. Emergency Generator / Inverter Branch Circuit Transfer Switch, UL 1008 listed and 0-10Vdc compatible:
Bodine GTD20A

2.2 MATERIALS AND COMPONENTS

- A. General: Provide lighting fixtures of the size, type, and rating indicated, with all accessories for a complete aesthetic installation.
- B. Fixture Types:
1. General:
 - a. LED Lay-in edge lit or back flat panel / troffer fixtures: Opaque, edge or back lighted, 4000 Kelvin color temperature. 0-10 Vdc dimmable, L70: 60,000 minimum hours.
 - b. Safety chains and wire guards at fixtures in mechanical and electrical rooms, and high abuse areas. Provide safety chains only for gymnasium fixtures which shall be inherently vandal proof, no wire guards.
 - c. Fixtures located outdoors, in interior unconditioned spaces, and in wet locations shall be of aluminum construction.

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- d. Fixtures with door frames shall be of aluminum construction, white finish where located in kitchens, food prep areas, toilets, restrooms, locker rooms, dressing rooms, showers, and unconditioned spaces.
 - e. DLC, DLC Premium or Energy Star qualified unless specified otherwise.
 - f. Outdoor fixtures shall include a discrete / replaceable surge suppression device in addition to the surge suppression incorporated in the LED driver.
 - g. Operating temperature rating shall be between -40 degrees F and 120 degrees F.
 - h. Color Rendering Index (CRI): ≥ 80 Indoor; ≥ 65 Outdoor
 - i. The manufacturer shall have performed JEDEC (Joint Electron Devices Engineering Council) reliability tests on the LEDs as follows: High Temperature Operating Life (HTOL), Room Temperature Operating Life (RTOL), Low Temperature Operating Life (LTOL), Powered Temperature Cycle (PTMCL), Non-Operating Thermal Shock (TMSK), Mechanical Shock Variable Vibration Frequency, and Solder Heat Resistance (SHR).
 - 2. Downlight Fixtures: Provide recessed downlight fixtures with trim rings compatible with the ceiling material where fixture is to be installed.
 - 3. LED Exit Signs: Provide red lettering. Exit lighting fixtures shall meet the requirements of Federal, State, and Local Codes. Edge-lit exit signs shall have a silver background so that "EXIT" cannot be read backwards from the opposite side.
 - a. Gymnasiums, locker rooms, athletic/PE wing and associated corridors, black box theaters, auditorium stages, cafeteriums and kitchens: Vandal resistant, wet location cast aluminum with polycarbonate protective cover exit signs, Lithonia Extreme Series.
 - 4. Emergency Lighting Units: Lead Calcium batteries with self-diagnostics. Provide full light output at 90 minutes of battery operation. LED lamps.
 - 5. Gymnasium light fixtures, glass or acrylic refractors or lenses, round profile, single point swivel pendant or hook mounting, designed to be vandal proof without the need for wire guards, no wire guards.
- C. LED drivers:
- 1. NEMA 410 compliant for in-rush current.
 - 2. Starting Temperature: -40° F [-40° C].
 - 3. Input Voltage: 120 to 480 ($\pm 10\%$) V.
 - 4. Power Supplies: Class I or II output.
 - 5. Surge Protection: The system must survive 250 repetitive strikes of "C Low" (C Low: 6kV/1.2 x 50 μ s, 10kA/8 x 20 μ s) waveforms at 1-minute intervals with less than 10% degradation in clamping voltage. "C Low" waveforms are as defined in IEEE/ASNI C62.41.2-2002, Scenario 1 Location Category C.
 - 6. Power Factor (PF): ≥ 0.90 .
 - 7. Total Harmonic Distortion (THD): $\leq 20\%$.
 - 8. Comply with FCC Title 47 CFR Part 18 Non-consumer RFI/EMI Standards.
 - 9. Drivers shall be reduction of hazardous substances (ROHS)-compliant.
- D. Voltage: Equipment for use on 120V systems shall be suitable and guaranteed for voltage range of 100V to 130V. Equipment on 277V systems shall be suitable and guaranteed for voltage range of 225V to 290V. Universal voltage equipment shall be suitable and guaranteed for a voltage range of 100V to 290V.
- E. Light fixture housing for exterior use: Provide aluminum or stainless housing. Where stainless steel hardware is used, both male and female fasteners shall be stainless steel.

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- F. Emergency LED battery self-testing drivers and inverters; 5-year warranty. Basis of Design:
 - 1. Bodine BSL-ST Series for OEM installation
 - 2. Bodine BSL310-SI Series for field installation
 - 3. Bodine ELI-S Series for line voltage sine wave inverter field installation
- G. Emergency Battery Packs – Exit Signs: Nickel Cadmium battery with self- diagnostics; Minimum 3-year non-prorated replacement warranty.
- H. Emergency Generator / Inverter Load Control Device (ELC):
 - 1. 16 Amp minimum ballast / driver load
 - 2. Compatible with 0-10 Volt dimmer switches
 - 3. UL 924
 - 4. Minimum 3-year warranty
 - 5. Integral or remove test switch.
- I. Emergency Generator / Inverter branch circuit transfer switch:
 - 1. UL 1008
 - 2. 20 Amp ballast/driver load
 - 3. 0-10Vdc dimming compatible

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install lighting fixtures of the types indicated, where shown, and at indicated heights in accordance with the fixture manufacturer's written instructions and industry practices to ensure that the fixtures meet the specifications. Fixtures shall fit the type of ceiling system scheduled.
- B. Standards: Comply with NEMA standards, applicable requirements of NEC pertaining to installation of interior lighting fixtures, and with NECA Standard of Installation.
- C. Attachment: Fasten fixtures to the indicated structural support members of the building. Provide four separate wire supports for recessed ceiling mounted lighting fixtures, one at each corner of fixture. Check to ensure that solid pendant fixtures are plumb. Provide T-bar locking clips on all four sides for lay-in fixtures.
- D. Coordination: Field coordinate and locate lighting fixtures in open ceiling areas including mechanical and electrical rooms so that light is not obstructed by piping, ductwork, etc. Locate light fixtures in front of electrical and mechanical equipment to provide adequate illumination for testing and maintenance. Relocate installed light fixtures as directed by Owner / Architect at no additional cost.
- E. Final adjustment of all aimable exterior light fixtures shall be in coordination with, and to the satisfaction of, the Owner's designated representative. Pre-aim all fixtures prior to scheduled final aiming and adjustment with Architect / Owner. Verify that all rotatable optics are in their proper orientation prior to final aiming.
- F. Provide vandal resistant exit signs without wire guards in all physical education and athletic sports areas, including egress corridors adjacent to these areas, black box theaters, auditorium stages, vocational shops, cafeteriums and kitchens.

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- G. Provide exit sign directional arrows as required. Provide a minimum of two and a maximum of 10% spare exit signs to be installed as directed by Architect.
- H. Install in accordance with manufacturers instructions.
- I. Install suspended luminaires using pendants supported from swivel hangers. Provide pendant length required to suspend luminary at indicated height.
- J. Locate recessed ceiling luminaires as indicated on the Architectural reflected ceiling plan.
- K. Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prohibit movement.
- L. Exposed Grid Ceilings: Support surface mounted luminaires on grid ceiling directly from building structure. Provide auxiliary members spanning ceiling Ts to support surface mounted luminaires. Fasten surface mounted luminaires to ceiling T using bolts, screws, rivets, or suitable clips.
- M. Install recessed luminaires to permit removal from below.
- N. Install recessed luminaires using accessories and fire stopping materials to meet regulatory requirements for fire rating.
- O. Install wall-mounted luminaires at height as directed by Architect.
- P. Install accessories furnished with each luminary.
- Q. Connect luminaires to branch circuit outlets using flexible conduit as specified.
- R. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaires.
- S. Bond products and metal accessories to branch circuit equipment grounding conductor.
- T. Provide emergency transfer devices for light fixtures powered by generator or inverter emergency lighting circuits which are used for normal lighting and to be switched with the switched normal lighting circuit in the same room, corridor or area.
- U. Provide un-switched, constant-hot circuit to all battery powered emergency lighting equipment and emergency load control devices (ELC). Where normal light fixture circuit is switched or contactor controlled, non-switched battery charging or ELC circuit shall originate from same branch circuit breaker as switched lighting circuit.
- V. Provide emergency powered light fixture in front of all electrical switchgear, including but not limited to panelboards, switchboards, motor control centers, low voltage control panels, transfer switches, motor controllers and disconnect switches.
- W. Provide emergency battery operated light fixtures at all transfer switch locations and at all central battery emergency lighting inverters.

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- X. Provide automatic controls for exterior light fixtures. Exterior building mounted light fixtures shall be circuited through lighting contactors. Lighting contactors shall be controlled by the Building Management System. Provide separate lighting contactors for:
 - 1. Parking Lot Lighting
 - 2. Building Mounted Lighting
 - 3. Exterior Signage
- Y. Lighting contactors shall not be installed above ceiling and shall be readily accessible, located in same room as panelboard serving load.
- Z. Wall mounted light fixtures shall be attached to the studs in the walls. Attachment to gypsum board only is not acceptable. Where wall mounted fixtures attach to junction box only, firmly secure junction box to adjoining studs in wall.
- AA. Lighting Fixture Supports:
 - 1. Shall provide support for all of the fixtures. Supports may be anchored to channels of the ceiling construction to the structural slab or to structural members within a partition, or above a suspended ceiling.
 - 2. Shall maintain the fixture positions after cleaning and relamping.
 - 3. Shall support the lighting fixtures without causing the ceiling or partition to deflect.
- BB. Hardware for surface mounting fixtures to suspended ceilings:
 - 1. In addition to being secured to any required outlet box, fixtures shall be bolted to a grid ceiling system at four points spaced near the corners of each fixture. The bolts shall be not less than 1/4 inch secured to channel members attached to and spanning the tops of the ceiling structural grid members. Non-turning studs may be attached to the ceiling structural grid members or spanning channels by special clips designed for the purpose, provided they lock into place and require simple tools for removal.
 - 2. In addition to being secured to any required outlet box, fixtures shall be bolted to ceiling structural members at four points spaced near the corners of each fixture. Pre-positioned 1/4-inch studs or threaded plaster inserts secured to ceiling structural members shall be used to bolt the fixtures to the ceiling. In lieu of the above, 1/4-inch toggle bolts may be used on new or existing ceiling provided the plaster and lath can safely support the fixtures without sagging or cracking.
- CC. Lighting Fixture Supports for aluminum canopies:
 - 1. Light fixtures mounted under aluminum canopies shall be UL wet location from above listed without a protective ceiling or cover. Light fixture shall not have conduit penetrations or mounting hole penetrations field made in the top of the fixture. Conduit penetration shall be at the end of the fixture only.

3.2 TESTING

- A. General: Upon installation of lighting fixtures, and after building circuits are energized, apply electrical energy to demonstrate proper operations of lighting fixtures, emergency lighting, and controls. When possible, correct malfunctioning units at the site, then retest to demonstrate proper operation; otherwise, remove and replace with new units, and proceed with retesting.

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- B. Pre-Inspection Tasks: Immediately before final inspection, clean fixtures inside and out, including plastics and glassware, adjust trim to fit adjacent surfaces, replace broken or damaged parts, and lamp and test fixtures for electrical and mechanical operations. Any fixtures, or parts of fixtures that show signs of rust or corrosion at the time of completion, shall be removed, and replaced with protected metal parts.
- C. Final aiming and adjustment: Aim and adjust lighting fixtures for their intended purpose as specified or as required. Adjustments may include but not be limited to directional aiming, adjusting selectable lumen output, selectable correlative color temperature (CCT), selectable beam pattern, replacing/installing fixture manufacture's optional optical lens used for adjusting beam patterns or for softening beam edges, replacing/installing manufacture's optional theatrical/specialty color lens colors. Re-aim and re-adjust as required to the satisfaction of the Architect / Owner, including nighttime adjustment of exterior lighting in the presence of the Architect / Owner.

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SECTION 265600

SITE LIGHTING

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The extent of site lighting required is indicated on the drawings and schedules and by the requirements of this Section and Section 26 05 00 General Electrical Provisions.
- B. Poles and Standards specified in this Section are for outdoor use for the support of luminaires and include the following: Aluminum and/or steel
- C. Related Sections: Refer to other sections for the following:
 - 1. Lighting Fixtures and Lamps

1.2 QUALITY ASSURANCE

- A. Codes and Standards: Provide luminaires, poles standards and appurtenances conforming to the following:
 - 1. Conform to applicable sections of American Association of State Highway and Transportation Officials (AASHTO): LTS-1 Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals.
 - 2. American National Standards Institute (ANSI):
 - a. C2 National Electrical Safety Code.
 - 3. Conform to applicable sections of American Society for Testing and Materials (ASTM)B 429, Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
 - 4. National Electrical Manufacturers Association (NEMA):
 - a. FA 1 Outdoor Floodlighting Equipment.
 - b. OD 3 Physical and Electrical Interchangeability of Photo Control Devices and Mating Receptacles.
 - 5. Conform to applicable sections of National Fire Protection Association (NFPA) 70, National Electrical Code.
 - 6. Underwriters Laboratories, Inc. (UL):
 - 7. Design Lights Consortium (DLC)

1.3 SUBMITTALS

- A. Refer to Section 26 05 00 General Electrical Provisions. Submittal must include photometric reports, otherwise they will be rejected as incomplete.
- B. Contractor shall not rough-in, build concrete foundations, etc. for site lighting until all site lighting submittals have been approved. Contractor shall submit site lighting photometrics with product data. The review of site lighting submittals may include the relocation, addition or deletion of lighting fixtures, poles and standards due to the photometric performance of substituted manufacturers. Any changes required due to the contractor's substitution shall be at no cost to the Owner.
- C. Submittal sheets shall be sequentially numbered with the format: Sheet number of number total. Example 1 of 3.

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- D. Submit manufacturer's product data including the following:
1. Line-by-line compliance of the specification indicating compliance or description of deviation.
 2. Submit a computer generated point-by-point calculations for all outside lighting.
 3. Dimensioned and detailed drawings in booklet form with separate sheet or sheets for each fixture, assembled in luminaire "type" alphabetical order and showing: materials of construction; arrangement of components and wiring; gasketing for weather tightness; means of mounting luminaire and adjusting aspect; finishes; photometric data with lamp or lamps specified; electrical data including volts, amperes and watts; and for roadway type luminaires, distribution data according to Illuminating Engineering Society (IES) roadway classification type.
 4. LED Driver and light engine, initial and mean lumen output, and color rendering index. LED drivers and related electrical characteristics and operating conditions.
 5. Poles and standards dimensions, details of hand holes and wire entries, mast or bracket arms and connection to poles, wind load and deflection, and finishes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers acceptable contingent upon Product's compliance with the specifications: refer to Lighting Fixture Schedules on the drawings for acceptable manufacturers of light fixtures. Acceptable Pole Manufacturers: Valmont, KW, WJM.
- B. Where lighting regulations exist by the Authority Having Jurisdiction, the Contractor shall be responsible for submission of all documentation and approval from the Authority Having Jurisdiction of the exterior lighting were alternate manufacturers are proposed other than specified. Where approval from an Authority Having Jurisdiction is required, Contractor shall submit, with those product data, confirmation of approval from the Authority Having Jurisdiction.

2.2 LUMINAIRES

- A. Refer to Section 26 51 13 Lighting Fixtures and Lamps, for ballast, drivers, and lamp requirements.
- B. Provide luminaires of the sizes, type and ratings indicated, complete with housings, lenses, refractors, lamps, lamp holders, reflectors, ballasts, starters, igniters, mounting brackets or hardware with adjusting means and wiring.
- C. Provide luminaires with rigidly formed, weather and light tight enclosures that will not warp, sag, or deform in use. Provide housings free from burrs, sharp edges or corners.
- D. Provide captive hardware hinged doors, operating freely, to allow lamp installation and removal without the use of tools. Equip door mechanism to preclude accidental falling of the door when opening or closing or when secured in the closed position. Provide for door removal for cleaning or replacing lens.
- E. Provide stainless steel hinges, latches, fasteners, and hardware to prevent corrosion of hardware or the staining of adjacent surfaces.
- F. Use interior formed and supported light reflecting surfaces having reflectances of not less than 85 percent for white surfaces, 85 percent for specular surfaces, and 75 percent for specular diffuse surfaces.

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- G. Use borosilicate tempered glass, lenses and refractors. Use heat and aging resistant resilient gaskets to seal and cushion lens and refractor mounting in luminaire doors.
- H. Provide finishes of the color and type indicated and having the following properties:
 - 1. Protection of metal from corrosion - 5 year warranty against perforation or erosion of the finish from weathering.
 - 2. Color retention – 5-year warranty against fading, staining, or chalking from weathering, including solar radiation.
 - 3. Provide finish of uniform thickness and color, free from streaks, stains or orange peel texture.
- I. LED sources shall meet the following requirements:
 - 1. Operating temperature rating shall be between -40 degrees F and 120 degrees F.
 - 2. Color Rendering Index (CRI): ≥ 65 .
 - 3. The manufacturer shall have performed JEDEC (Joint Electron Devices Engineering Council) reliability tests on the LEDs as follows: High Temperature Operating Life (HTOL), Room Temperature Operating Life (RTOL), Low Temperature Operating Life (LTOL), Powered Temperature Cycle (PTMCL), Non-Operating Thermal Shock (TMSK), Mechanical Shock Variable Vibration Frequency, and Solder Heat Resistance (SHR).
- J. LED drivers shall meet the following requirements:
 - 1. Drivers shall have a minimum efficiency of 85%.
 - 2. Starting Temperature: -40° F.
 - 3. Input Voltage: 120 to 480 ($\pm 10\%$) V.
 - 4. Power Supplies: Class I or II output.
 - 5. Surge Protection: The system must survive 250 repetitive strikes of "C Low" (C Low: 6kV/1.2 x 50 μ s, 10kA/8 x 20 μ s) waveforms at 1-minute intervals with less than 10% degradation in clamping voltage. "C Low" waveforms are as defined in IEEE/ASNI C62.41.2-2002, Scenario 1 Location Category C.
 - 6. Power Factor (PF): ≥ 0.90 .
 - 7. Total Harmonic Distortion (THD): $\leq 20\%$.
 - 8. Comply with FCC Title 47 CFR Part 18 Non-consumer RFI/EMI Standards.
 - 9. Drivers shall be reduction of hazardous substances (ROHS)-compliant.

2.3 POLES AND STANDARDS

- A. Provide poles of the types and heights indicated. Provide internal raceway for underground power supply, with luminaire support pole base indicated. Provide poles that will carry the indicated supports, luminaires and appurtenances, at the required heights above grade, without excessive defection or whipping of the luminaire when subjected to 120 mph basic wind speed with 1.3 gust factor. Pole structural integrity shall rely solely on the anchor bolts, nuts and washers. Pole shall not be in direct contact with concrete base or mortar.
- B. Provide metal lighting poles with steel or aluminum shaft; equipped for post top or mast arm luminaire mounting. Provide wiring access hand hole with welded $\frac{1}{2}$ " NC ground lug, readily accessible from hand hole opening. Provide features as follows:
 - 1. Provide a one-piece pole shaft fabricated from a weldable grade carbon structural steel tubing with a uniform thickness as required. Material shall conform to ASTM A-500, Grade C.
 - 2. Provide anchor base of the same material and finish as the pole, welded to the pole. Provide adequately sized (at least 15 square inches) hand hole with screwed cover. Provide galvanized steel hold-down or anchor bolts and leveling nuts. Provide full base cover.

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3. Factory prime coat with polyester powder-coat paint. Steel poles shall be hot dipped galvanized, with prime coat, with 8 mil minimum polyester powder-coat paint. Color to match light fixture.
- C. Anchor bolts:
 1. Provide zinc coated anchor bolts and nuts. Length shall be per pole manufacturer's shop drawings, complete with 3 inch right angle bend on one end and 6 inches of thread on the other end. Provide zinc coated flat washers, lock washers, and hexagonal nuts for each pole.
 2. Provide template for positioning of anchor bolts.
- D. Accessories:
 1. Full base covers, finish to match pole
 2. Hand hole with cover plate and vandal resistant hardware.

2.4 LUMINAIRE MOUNTING

- A. Provide corrosion resistant metal luminaire mounting compatible with the poles and fixtures that will not cause galvanic action at contact points. Provide mounting that will correctly position the luminaire to provide the required light distribution. Provide drill mounting to pole shaft unless specified otherwise.
- B. Provide brackets, cantilevered and without under brace, of the sizes, styles, and finishes indicated with straight tubular end section to accommodate the luminaire.
- C. Provide steel tenon only for single fixture yoke or spider post top mounting securely fastened to the top of the pole shaft, fabricated to accept and rigidly support the luminaire to be mounted thereon. Set screws shall have pole shaft drilled to prevent rotational movement.

PART 3 - EXECUTION

3.1 LIGHTING POLE INSTALLATION

- A. Contractor shall not rough-in conduit, drill or pour concrete foundations for site lighting until review of the site lighting submittals is complete. This is to ensure coordination with the current site plan paving and utilities and photometric performance of the submitted product.
- B. Install lighting poles as follows:
 1. Install lighting poles and standards as indicated, in accordance with manufacturer's written instructions, and in compliance with ANSI C2.
 2. Provide excavation and poured concrete bases using 3,000 pound 28-day concrete, and provide anchor hook-bolts, nuts and washers in conformance with the details and manufacturer's requirements. Refer to Division 3 for concrete work. Project anchor bolts 2-inches minimum above base. Use double nuts for adjustment.
 3. To protect finish, use fabric web slings (not chain or cable) to raise and set finished poles and standards.
 4. Install pole clear of contact of concrete base or mortar.

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- C. Grounding: Provide equipment bonding and grounding connections, sufficiently tight to assure permanent and effective grounds. Bond all metal, non-current carrying parts to ground. Provide 25-foot #2 solid ground electrode from pole base hand holes encased in concrete pier, to bottom of concrete pier with excess ground electrode coiled at bottom of concrete pier. Secure the ground electrode to the reinforcement steel to prevent movement during concrete pour. Bond all metal parts of the pole shaft ground lug. Provide #6 electrode grounding conductor from pole base ground lug to the ground conductor, using thermal fusion (exothermic) methods.
- D. Wiring:
1. Provide Type SO cord from base of pole lights to top of poles. Do not use single conductors.
 2. Install inline fuse holders, fuses, at base of pole lights on each lighting circuit. Provide Bussman Insulating boot Catalog # 2A0660 installed over conductor terminations. Fuse size shall be as follows:

WATTAGE	# OF Fixtures	208V	240V	277V	480V
0-400	1	5	5	5	5
0-400	2	8	8	5	5
0-400	3	10	10	8	5
0-400	4	15	10	10	8
401-1000	1	10	8	8	5
401-1000	2	15	15	15	8

3. Provide Styrofoam wedge at midpoint of pole to stabilize conductor.
4. Provide strain/stress relief on SO cord at top of pole.

3.2 LUMINAIRE INSTALLATION

- A. Install exterior luminaires at locations and heights as indicated, in accordance with the manufacturer's written instructions, applicable requirements of NFPA 70, ANSI C2 and with recognized industry practices to ensure that lighting installation fulfills requirements.
- B. Fasten luminaires securely to indicated structural supports and check to ensure that the required degree of freedom is provided to allow alignment or aiming of the fixtures for indicated light distribution.
- C. Clean exterior luminaires of dirt and debris upon completion of installation. Do not damage finishes or lens or refractor surfaces.
- D. Provide equipment grounding connections using branch circuit equipment and connected sufficiently tight to assure a permanent and effective ground.

3.3 TESTS AND DEMONSTRATIONS

- A. Upon installation of lighting fixtures, and after building circuits are energized, apply electrical energy to demonstrate proper operations of lighting fixtures, emergency lighting, and controls. Correct malfunctioning units, then retest to demonstrate proper operation; otherwise, remove and replace with new units, and proceed with retesting. Verify correct reflector types and orientation prior to final aiming.

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- B. Pre-Inspection Tasks: Immediately before final inspection, clean fixtures inside and out, including reflectors, plastics and glassware, adjust trim to fit adjacent surfaces, replace broken or damaged parts, and lamp and test fixtures for electrical and mechanical operations. Any fixtures, or parts of fixtures that show signs of rust or corrosion at the time of completion, shall be removed, and replaced with protected metal parts. Pre-aim lighting fixtures as practical prior to final aiming and adjustment.
- C. Final aiming and Adjustment: Aim and adjust aimable and adjustable lighting fixtures for their intended purpose, as specified, as indicated and/or recommended by Manufacturer's photometric report. Re-aim and re-adjust as required to the satisfaction of the Architect/Owner, including nighttime adjustment of exterior lighting in the presence of the Architect/Owner. Provide five business day notification of proposed night-time review by Owner / Architect.
- D. The installing contractor shall provide an "As-Built" photometric report of the site lighting to 25' beyond the property line at 3' above grade and 15' intervals after a continuous 200 hour burn-in of the fixtures. Photometrics shall be submitted with final closeout documents and bear the seal and signature of a registered professional engineer licensed in the state in which the project has been constructed and in the employ of the installing contractor or the lighting fixture manufacturer or lighting fixture manufacturer's representative.

3.4 LAMP REPLACEMENT AND PROVISION OF SPARE LAMPS

- A. At time of substantial completion, replace lamps in luminaires that are observed to be not functioning properly after Contractor's use and testing. Provide spare replacement non-LED lamps amounting to 10 percent (but not less than ten lamps in each case) of each type and size lamp used in each type fixture.

END OF SECTION

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SECTION 270100

OPERATION AND MAINTENANCE (O&M) MANUALS
OF COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Compile product data and related information appropriate for Owner's operation and maintenance of products furnished under Contract. Prepare operating and maintenance data as specified in this Section and as referenced in other sections of specifications.
- B. Instruct Owner's personnel in operation and maintenance of equipment and systems.
- C. Submit three (3) electronic copies, on separate devices (USB Flash Drive or some type of pre-approved solid-state storage device), of complete O&M manuals in final form. The submitted manual shall be the system manufacturer's operations manual, supplemented with operations and maintenance instructions custom tailored for the system installed. Electronic documentation shall be provided in a non-proprietary PDF format, without password restrictions.
- D. Hard copies shall be provided upon request of the Owner, Architect, and/or Consultant.
- E. Recorded video of all training sessions shall be included in each copy, of each system's final submitted O&M.
- F. The final submitted manual shall include a sign-in sheet and owner/consultant signed acceptance of all training sessions.

1.2 ELECTRICAL OPERATING AND MAINTENANCE MANUAL SUBMITTAL SCHEDULE

- A. Thirty (30) days after receipt of reviewed submittals bearing the Project Technology Consultant's stamp of acceptance (including re-submittals), submit for review, an electronic copy of the first draft of the System's O&M Manual. This copy shall contain as applicable to the specific system, a minimum of the following:
 - 1. Table of Contents for each element
 - 2. Contractor information
 - 3. All shop drawings, coordination drawings and product data, bearing the Project technology Consultant's stamp of acceptance.
 - 4. All parts and maintenance manuals for items of equipment
 - 5. Warranties (without starting dates)
 - 6. Certifications that have been completed; submit forms and outlines of certifications that have not been completed
 - 7. Operating and maintenance procedures.
 - 8. Form of Owner's Training Program Syllabus (including times and dates)
 - 9. Control operations / equipment wiring diagrams
 - 10. Coordination Drawings
 - 11. Schedule of Speakers, Amplifiers, Sound Equipment, Etc.
 - 12. Schedule of Handsets and other Peripheral Devices, Etc.
 - 13. Schedule of Cable, Jacks, Outlets, Etc.
 - 14. Access Control Door Schedules

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15. Video Surveillance Camera Schedules
 16. Other required operating and maintenance information that are complete.
 17. Cable pathway layout drawings and station map, including through wall and floor penetration locations and sleeve sizes.
- B. Copy will be returned to the Contractor within 15 days with comments for corrections.
- C. Submit the electronic completed manuals (hard copies upon request) in final form to the Project's Technology Consultant.
1. Prior to substantial completion for Owner's use after the Owner accepts facility maintenance.
 2. Include all specified data, test reports, drawings, dated warranties, certificates, training videos. along with other materials and information.
- D. The Project's Technology Consultant shall review the manuals for completeness within 15 days.
- E. The Contractor shall be notified of any missing or omitted materials. The Manuals shall be reworked by the Contractor, as required, in the office of the Project's Technology Consultant. The manuals will not be retransmitted.
- F. Electronic and/or hard copies of the accepted manuals shall be delivered to the Owner prior to substantial completion.

PART 2 - PRODUCTS

2.1 BINDERS

- A. Upon the request for hard copies of the O&M manuals, the binders shall consist of the following configuration:
1. Commercial quality black, 3-ring binders with clear, durable, cleanable plastic covers.
 2. Minimum ring size: 1"; Maximum ring size: 3".
 3. When multiple binders are used, correlate the data into related groupings.
 4. Label contents on spine and face of binder with full size insert. Label under plastic cover.

PART 3 - EXECUTION

3.1 SYSTEM OPERATION AND MAINTENANCE MANUAL

- A. Form for Manuals Submitted in Hard Copy Format:
1. Prepare data in form of an instructional manual for use by Owner's personnel.
 2. Format:
 - a. Size: 8-1/2" x 11"
 - b. Text: Manufacturer's printed data or neatly typewritten.
 3. Drawings:
 - a. Provide reinforced punched binder tab and bind in text.
 - b. Fold larger drawings to size of text pages.
 4. Provide flyleaf indexed tabs for each separate product or each piece of operating equipment.

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5. Cover: Identify each volume with typed or printed title "Operating and Maintenance Instructions". List:
 - a. Title of Project
 - b. Identity of separate structures as applicable
 - c. Identity of general subject matter covered in the manual.
 6. Binder as specified
- B. Content of Manual:
1. Neatly typewritten Table of Contents for each volume arranged in systematic order as outlined in the specifications.
 - a. Contractor, name of responsible principal, address and telephone number
 - b. A list of each product required to be included, indexed to content of the volume.
 - c. List with each product, name, address and telephone number of:
 - 1) Subcontractor or installer
 - 2) Maintenance contractor as appropriate
 - 3) Identify area of responsibility of each.
 - 4) Local source of supply for parts and replacement
 - d. Identify each product-by-product name and other identifying symbols as set forth in Contract Documents.
 2. Product Data:
 - a. Include those sheets pertinent to the specific product.
 - b. Annotate each sheet to:
 - 1) Identify specific product or part installed.
 - 2) Identify data applicable to installation.
 - 3) Delete references to inapplicable information.
 3. Drawings:
 - a. Supplement product data with drawings as necessary to illustrate:
 - 1) Relations of component parts of equipment and systems
 - 2) Control and flow diagrams
 - b. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
 - c. Do not use Project Record Documents as maintenance drawings.
 4. Written text as required to supplement product data for the particular installation:
 - a. Organize in consistent format under separate headings for different procedures.
 - b. Provide logical sequence of instructions for each procedure.
 5. Copy of each warranty, bond and service contract issued
 - a. Provide information sheet for Owner's personnel, giving:
 - 1) Proper procedures in event of failure
 - 2) Instances that might affect validity of warranties or bonds
 6. Shop drawings, coordination drawings and product data as specified.
- C. Sections for Equipment and Systems
1. Content for each unit of equipment and system as appropriate:
 - a. Description of unit and component parts:
 - 1) Function, normal operating characteristics, and limiting conditions.
 - 2) Performance curves, engineering data and tests.
 - 3) Complete nomenclature and commercial number of replaceable parts.

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- b. Operating procedures:
 - 1) Start up, break-in, routine / normal operating instructions
 - 2) Regulation, control, stopping, shut down and emergency instructions
 - 3) Special operating instructions
 - c. Maintenance procedures:
 - 1) Routine operations
 - 2) Guide to trouble-shooting
 - 3) Disassembly, repair and reassembly
 - 4) Alignment, adjusting and checking
 - 5) Routine service based on operating hours
 - d. Manufacturer's printed operating and maintenance instructions.
 - e. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
 - f. Complete equipment field accessible wiring diagrams
 - g. Each Contractor's coordination drawings
 - h. Other data as required under pertinent sections of the specifications
- 2. Prepare and include additional data when the need for such data becomes apparent during instruction of Owner's personnel.
 - 3. Additional requirements for operating and maintenance data as outlined in respective sections of specifications
 - 4. Provide complete information for products specified in Division 27.
 - 5. Provide certificates of compliance as specified in each related section.
 - 6. Provide start up reports as specified in each related section.
 - 7. Provide signed receipts for spare parts and material.
 - 8. Provide training report and certificates.

END OF SECTION

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SECTION 270500

COMMUNICATIONS BASIC MATERIALS, METHODS, AND GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Except as modified in this Section, General Conditions, Supplementary Conditions, applicable provisions of Division 01 General Requirements, and other provisions and requirements of the Contract Documents apply to work of Division 27 Communications.
- B. Applicable provisions of this section apply to all sections of Division 27, Communications.
- C. The general provisions of the Contract and the requirements of the following Sections apply to the Work specified in this Section. See following sections for related general and specific requirements following sections shall associate with this specification as applicable.
 - 1. Division 26 in its entirety.
 - 2. Division 27 in its entirety.
 - 3. Division 28 in its entirety.
- D. The entire drawing and specification package apply to the work specified in the communication specifications and shall be complied with in every respect. The Contract Documents are comprised of the drawings and specifications. The Contractor shall examine these Contract Documents, and coordinate required work indicated in each.

1.2 CODES AND STANDARDS

- A. All equipment and work performed shall comply with current and applicable Codes, Standards, Rules, Ordinances, Regulations, and Best Practices (both published and best practices) as well as any other authorities that may have lawful jurisdiction pertaining to the work specified. None of the terms or provisions of this specification shall be construed as waiving any of the rules, regulations, or requirements of these authorities (including those not specifically listed in this Specification). Applicable Codes and Standards shall consist of, but not be limited to the following:
 - 1. Americans with Disabilities Act (ADA)
 - 2. Authorities Having Jurisdiction (AHJ) - Local
 - 3. American National Standards Institute (ANSI)
 - 4. American Society of Testing and Materials (ASTM) *Communications Cables - B694, B736, D4565, D4566, D4730, D4731, D4732*
 - 5. Building Industry Consulting Services International (BICSI)
 - 6. Code of Federal Regulations - Title 47
 - 7. Electronics Industries Association (EIA) *Standard Test Procedures for Fiber Optic Fibers, Cables, Transducers, Connecting and Terminating Devices - EIA-455 Series*
 - 8. Federal Communications Commission (FCC) - Communications Act and FCC Rules
 - 9. Federal Information Processing Standards (FIPS) *Federal Building Standard for Telecommunications Pathways and Spaces - FIPS PUB 175, FIPS PUB 176*
 - 10. The Insulated Cable Engineers Association (ICEA) *Communications Cable Stands - P-47-434, S-56-434, S-80-576, S84-608, S-85-625, S-86-634, S-87-640, S-89-648, S-90-661, S-98-688, S-99-689, S-100-685*

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11. International Electro-technical Commission (IEC)
 12. Institute of Electrical and Electronic Engineers (IEEE) *Local Area Networks/Metropolitan Networks Standards Collection - LAN/MAN 802 Series*
 13. International Organization for Standardization (ISO) (ISO/IEC) *Premise Wiring Core and LAN/MAN Core Equivalents-11801, 8802, 14763-1*
 14. International Telecommunication Union (ITU-T) *Telecommunications Standardization*
 15. National Electrical Code (NEC) *National Electrical Code - NFPA 70*
 16. National Electrical Contractor's Association (NECA) *Standards of Installation*
 17. National Electrical Manufacturers Association (NEMA) *Performance Standard for Twisted Pair Premise Voice and Data Communications Cable-WC 63.1, WC 63.2, WC 66*
 18. National Electrical Safety Code (NESC)
 19. National Fire Protection Association (NFPA) - *National Fire Alarm Code NFPA 72, Life Safety Code NFPA 101*
 20. Society of Cable Telecommunications Engineers (SCTE)
 21. Local Accessibility Standards
 22. Telecommunications Industries Association (TIA) *(ANSI/TIA/EIA) Wiring and Cabling Standards - 526, 568, 569, 570, 571, 598, 606, 607, 758, TSB 31-B, 63, 67, 72, 75 and 95*
 23. Uniform Building Code (UBC)
 24. Underwriters Laboratories, Inc. (U.L.) - *497A, 910, 1077, 1863, 1283, 1459, 1604, 1651, 1681, 1690, 1778, 1977*
- B. Resolve any code violations discovered in contract documents with the Engineer prior to award of the contract. After Contract award, any correction or additions necessary for compliance with applicable codes shall be made at no additional cost to the Owner.
- C. This Contractor shall be responsible for being aware of and complying with asbestos NESHAP regulations, as well as all other applicable codes, laws and regulations.
- D. Obtain all permits required.

1.3 SUMMARY

- A. The work covered by the specifications includes furnishing materials, labor, transportation, tools, permits, fees, utilities, and incidentals necessary for the complete installation of work required in the Contract Drawings.
- B. It is the intent of the Contract Documents to provide a new and/or an extension of the existing installation, as shown in the associated specifications and drawings, complete in every respect.
- C. Provide complete and working Communications Systems including equipment, conduit, wiring, material, labor and training as described in this Specification and the Drawings. The Communications Systems Drawings and Specifications are the sole property of the Architect and are not to be duplicated, scanned, loaned or in any way made available to persons not designated as authorized by the Architect. All Communications Systems plans, and specifications are to be returned to the Architect following completion of bid.

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1.4 CONTRACTOR'S QUALIFICATIONS

- A. An approved contractor for the work under this division shall be:
 - 1. A specialist in this field and have the personnel, experience, training, and skill, and the organization to provide a practical working system.
 - 2. Able to furnish evidence of having contracted for and installed not less than ten (10) systems of comparable size and type that have served their Owners satisfactorily for not less than 3 years.
 - 3. Perform work by persons qualified to produce workmanship of specified quality. Persons performing work shall be required to be licensed. Onsite supervision shall have minimum of the following:
 - a. Licenses, as applicable to the system being installed
 - b. Manufacturer's Certifications
 - 1) Firm Certification
 - 2) Installer Certification
 - 3) Programmer's Certification
 - 4) System Designer Certification.

1.5 DRAWINGS AND SPECIFICATIONS

- A. The drawings and these specifications are complementary to each other, and what is required by one shall be as binding as if required by both.
- B. If variations or departures from the drawings are deemed necessary by the Contractor, details of such departures and the reasons therefore shall be submitted to the Consultant for review. No departures shall be made without prior written acceptance of the Consultant.
- C. Should the drawings or specifications disagree in themselves or with their counterpart, the better quality or greater quantity of work or materials shall be estimated upon, and unless otherwise directed by the Consultant in writing, shall be performed or furnished. In the case that the specifications should not fully agree with the Schedules, the latter shall govern. Figures indicated on drawings govern scale measurements and large-scale details govern small scale drawings.
- D. The approximate locations of system equipment and components are indicated on the Drawings. These Drawings are not intended to give complete and accurate details in regard to location of equipment, field devices, etc. Exact locations are to be determined by actual measurements at the building and will in all cases be subject to the Review of the Owner or Consultant, who reserves the right to make any reasonable changes in the locations indicated without additional cost to the Owner.
- E. Items specifically mentioned in the Specifications but not shown on the Drawings and/or items shown on Drawings but not specifically mentioned in the Specifications shall be installed by the Contractor under the appropriate section of work as if they were both specified and shown.
- F. Any discrepancies between the Contract Documents and actual job site conditions shall be reported to the Owner or Consultant, so that they will be resolved prior to the bidding, where this cannot be done at least 7 working days prior to bid; the greater or costlier of the discrepancy shall be bid. All labor and materials required to perform the work described shall be included as part of this Contract.

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- G. It is the intention of this Section of the Specifications, and associated drawings, to outline minimum requirements to furnish the Owner with a turnkey and fully operating system in cooperation with other trades.
- H. The contract documents are schematic in nature in that they are only to establish scope and a minimum level of quality. They are not to be used as actual working construction drawings. The actual working construction drawings shall be the shop drawings accepted by project's consultant.
- I. The Contractor shall be responsible for coordination and proper relation of his work to the building structure and to the work of all trades. The Contractor shall visit the premises and thoroughly familiarize himself with the existing site conditions, details of the work and the working conditions, and verify dimensions in the field. The Contractor shall advise the project's consultant of any discrepancy prior to bidding. The submission of bids shall be deemed evidence of the Contractor's site visit; coordination of existing conditions and include consideration for existing conditions.
- J. These documents are conceptual in nature. It shall be the responsibility of the approved installer to furnish a complete and functional system, including the items shown on the drawings, in the specifications, and items not designated in either. The installer's shop drawings and product data submittals shall represent a complete system and documents accepted by the project's consultant shall not relieve the installer from being required to provide any materials, equipment, or labor to furnish a complete and functional system as recognized by the Project's Technology Consultant and the Owner.

1.6 BUILDING CONSTRUCTION AND LAYOUT OF WORK

- A. General: It shall be the responsibility of the Contractor to consult the Engineering Drawings and Details so as to thoroughly familiarize himself with the type and quality of construction to be provided on this project.
- B. The drawings are diagrammatic in nature and do not show every connection in detail or every line or conduit in its exact location. These details are subject to the requirements of all codes, ordinances, and standards; as well as all structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in closed ceiling space and/or furred chases unless specifically noted or indicated to be exposed. Work shall be installed to avoid crippling of structural members. All work shall be run parallel or perpendicular to the lines of the building unless otherwise noted.
- C. The approximate location of equipment items is indicated on the drawings. Exact locations are to be determined by coordination of dimensions from approved equipment submittals and site-verified field measurements and will in all cases be subject to the approval of the Consultant. The Consultant reserves the right to make any reasonable changes in the indicated locations prior to installation for no additional cost.
- D. In areas of existing special ceiling construction, the removal and restoration must be carefully planned such that the existing condition of the ceilings is maintained. It may be necessary for the Contractor to procure a Subcontractor familiar with this work to achieve this requirement.

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- E. Consider space limitations imposed by contiguous work in selection and location of equipment and material. Do not provide equipment or material that is not suitable in this respect.

1.7 RELATION WITH OTHER TRADES

- A. Carefully study all matters and conditions concerning the project. Submit notification of conflict in ample time to prevent unwarranted changes in any work. Review other Divisions of these specifications to determine their requirements. Extend electrical services and final connections to all items requiring same.
- B. Because of the complicated relationship of this work to the total project, conscientiously study the relation and cooperate as necessary to accomplish the full intent of the documents.
- C. Where cabling pass through walls or floors, metal sleeves shall be provided and shall be sealed to prevent spread of fire and smoke. In walls, they shall extend 3" beyond the finished surface. In pipe chases, they shall extend 8" inches above floor slab and be cemented in a watertight manner. Size of these sleeves shall be at least as required to maintain a maximum 40% conduit fill ratio. 1/2 inch greater than outside diameter of the conduit.
- D. Locate and size openings required for installation of work specified in this Division in sufficient time to prevent delay in the work.
- E. Refer to other Divisions of the specifications for the scope of required connections to equipment furnished under other Division. Determine from the General Contractor / Construction Manager for the various trades, the Owner, and by direction from the Architect / Engineer, the exact location of all items. The construction trades involved shall furnish all roughing-in drawings and wiring diagrams required for proper installation of the electrical work.
 - 1. Make final connections to all communications equipment indicated on the drawings, except as noted.
- F. Request all Shop Drawings required in ample time to permit proper installation of all electrical provisions.
- G. Extend services as indicated to the various items of equipment furnished by others. Rough-in for the various items and make final connections ready for operation upon placing of the equipment.

1.8 CONCEALED AND EXPOSED WORK

- A. When the word "concealed" is defined as hidden from sight as in chases, furred spaces or above ceilings. "Exposed" is defined as open to view, in plain sight.

1.9 GUARANTEE

- A. Guarantee work for a minimum of two years or as noted longer elsewhere from the date of substantial completion of the project. During that period make good any faults or imperfections that may arise due to defects or omissions in material, equipment or workmanship. At the Owner's option, replacement of failed parts or equipment shall be provided.

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1.10 MATERIAL AND EQUIPMENT

- A. Furnish new and unused materials and equipment meeting the requirements of the paragraph specifying acceptable manufacturers. Where two or more units of the same type or class of equipment are required, provide units of a single manufacturer.

1.11 NOISE AND VIBRATION

- A. Select equipment to operate with minimum noise and vibration. If noise or vibration is produced or transmitted to or through the building structure by equipment, piping, ducts or other parts of work, and judged objectionable by the Owner, Architect, or Engineer, rectify such conditions at no additional cost to the Owner. If the item of equipment is judged to produce objectionable noise or vibration, demonstrate at no additional cost that equipment performs within designated limits on a vibration chart.

1.12 ACCEPTABLE MANUFACTURERS

- A. Manufacturers names and catalog number specified under sections of Division 27 are used to establish standards of design, performance, quality and serviceability and not to limit competition. Equipment of similar design, equal to that specified, manufactured by a named manufacturer shall be acceptable on approval. A request for prior approval of equipment not listed must be submitted ten (10) days before proposal due date. Submit complete design and performance data to the Architect. The Architect and Owner issue approvals of acceptable manufacturers as addenda to the Construction Proposal Documents.
- B. Where acceptable manufacturers are listed, only products of those manufacturers may be provided. Additionally, the product must meet all the detailed requirements of the specifications.
- C. If no manufacturer's name is mentioned, the Contractor shall provide equipment and material which meet the specifications.

1.13 UTILITIES, LOCATIONS AND ELEVATIONS

- A. Locations and elevations of the various utilities included within the scope of this work:
 - 1. Obtained from utility maps and other substantially reliable sources.
 - 2. Are offered separate from the Contract Documents as a general guide only without guarantees to accuracy.
- B. Examine the site and verify the location and elevation of all utilities and of their relation to the work. Existing utilities indicated on the site plans are for reference only and shall be field verified by the Contractor with the respective public or private utility.

1.14 CONTRACT DRAWINGS

- A. Contract drawings are diagrammatic only and do not give fully dimensioned locations of various elements of work. Determine exact locations from field measurements.
- B. It is the responsibility of the Contractor to compare the scale of all electrical drawings with the scale of the architectural drawings and make adjustments to all electrical drawings which have the incorrect drawing scale so that his material takeoffs are not in error due to an incorrectly labeled drawing scale and his proposal is complete.

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1.15 ABBREVIATIONS AND DEFINITIONS

A/V	Audio/Visual
AWG	American Wire Gauge
BCR	Building Communications Room
CATV	Cable Antenna Television
CCTV	Closed Circuit Television
CMP	Communications Media Plenum
CMR	Communications Media Riser
dB	Decibel
EMI	Electromagnetic Interference
ER	Equipment Room
FACP	Fire Alarm Control Panel
FCR	Floor Communications Room
Gbps	Giga Bits Per Second
Hz	Hertz
IC	Intermediate Cross-connect
IDF	Intermediate Distribution Frame
IM	Information Management
IS	Information Systems or Information Services (also see MIS)
IT	Information Technology
Km	Kilometer
LCD	Liquid Crystal Display
LED	Light Emitting Diode
M	Micron
MATV	Master Antenna Television (<i>A.K.A. Main Antenna Television</i>)
Mbps	Mega Bits Per Second
MC	Main Cross-connect
MDF	Main Distribution Frame
MHz	Megahertz
MIS	Management Information Systems or Services
NEXT	Near-End Cross Talk
nm	Nanometer
OFN	Optical Fiber Non-conductive
OFNP	Optical Fiber Non-conductive Plenum
OFNR	Optical Fiber Non-conductive Riser
OTDR	Optical Time Domain Reflectometer
PBX	Private Branch Exchange
POS	Point of Sale
PSELFEXT	Power Sum Equal Level Far-End Cross Talk
PSNEXT	Power Sum Near-End Cross Talk
SMATV	Satellite Main Antenna Television
TC	Telecommunications Closet (<i>Now referred to as TR</i>)
T.O.	Telecommunications Outlet
TR	Telecommunications Room (<i>A.K.A. TC - Telecommunication Closet</i>)
UTP	Unshielded Twisted Pair Wire

Definitions:

Administration Subsystem - Cable, connectors, cross-connect and inter-connect hardware, patch cords, and other equipment that allows easy reconfiguration of the telecommunications system to accommodate personnel and floor plans changes.

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Campus Backbone Subsystem - Connects telecommunications processing equipment in different buildings on the same campus.

Communications Cabling - Any fiber optic, copper, coaxial or other transmission media used for transmitting or receiving communications systems data.

Communications System - Communications Systems and associated wired or wireless interconnection.

Communications Drawings - All floor plans, elevations, details, schematics, block diagrams, legends, tables, notes or attachments associated with any or all of the Communications Systems.

Distribution Cable - The telecommunications UTP wiring between the telecommunications room and the outlet connectors.

Equipment Subsystem - Telecommunications cable, connectors, support hardware, blocks, and protective devices that serve to connect the network interface and the backbone subsystem through the administrative subsystem.

Horizontal Subsystem - Telecommunications cable, outlets and distribution cords that extend the riser backbone from the administrative points in the TRs to workstations.

Information Systems - Software systems including operating systems, programs, data manipulation and management systems, control software and various forms of proprietary and off-the-shelf software.

Information Technology - The practical application of knowledge associated with designing, installing and maintaining the equipment, hardware and infrastructure utilized for control, distribution, or display of telecommunications, audio, video and data signals. Because computers are central to information management, computer departments within companies and universities are often called (IT Departments) and are responsible for MIS or IS personnel and services.

Low Voltage Wire - Wire or cable used for one or more systems that operate on 24 volts or less. Low Voltage Wire is used to install and interconnect one or more of the Communications Systems. Low Voltage Wire includes patch cords, jumpers and all portions of cable or wire used to make the Communications Systems operational or for system communications.

Management Information Systems - A class of software that provides managers with tools for organizing and evaluating their department. Typically, MIS systems are written in COBOL and run on mainframes or minicomputers. Within companies and large organizations, the department responsible for computer systems is sometime called the MIS department. Another name for MIS is Information Services (IS).

Multiplexer - A communications device that multiplexes (combines) several signals for transmission over a single medium. A multiplexer is sometimes called a "mux". A demultiplexer is required to complete the process by separating multiplexed signals from a transmission line. Frequently a multiplexer and demultiplexer are combined into a single device capable of processing both outgoing and incoming signals.

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Riser Backbone Subsystem - Telecommunications cable, splice enclosures, and associated hardware that provide the main cable routes in a building. It interconnects building floors and larger areas of a single floor. It also interconnects administrative points in satellite TRs to the administrative points in the building main equipment room.

Station Cable - The wiring between the outlet connections and the work area equipment.

Communications Systems - One or more of the following and associated equipment: Data/Networking Systems, Telecommunications Systems, Paging / Intercom Systems, Clock/Control Systems, Master Antenna Television Systems, Cable Antenna Television Systems, Broadcast Video Systems, Audio/Visual Presentations Systems, Microwave/Wireless Systems.

Telecommunications - The transmission, emission or reception of signs, signals, images, sound or intelligence of any nature by wire, radio, optical or other technical transmission system.

Work Area - Location of an employee or student and their data/telecommunications equipment or devices.

Work Area Subsystem - Station mounting cords, extension cords, connectors, adapters, and interface units that provide physical and electrical connectivity between workstation equipment and the horizontal subsystem.

1.16 QUALITY ASSURANCE

- A. Equipment Standards:
 - 1. System and all components shall be brand new stock from manufacturer.
 - 2. All electronics shall be 100% solid state.
 - 3. System and all components shall bear a UL Label.
- B. Contractor Qualifications:

At the time of Proposal, the Contractor shall:

 - 1. Have manufactured, supplied or installed at least three (3) other systems of similar size, complexity, and general operation as the systems described in these specifications. The Contractor shall furnish in writing to Architect proof of compliance with this paragraph at the time of proposal.
 - 2. Hold all legally required Texas State Contractor's licenses necessary to accomplish the installation and activation of the described system at the facilities indicated. The Contractor shall submit copies of licenses to the Architect prior to the start of work
 - 3. Hold all legally required state registrations to meet local requirements for submittal drawings.
 - 4. Have a local office within fifty (50) miles of the project site staffed with factory trained technicians who have experience on systems of similar complexity and function as the systems described in these specifications. These technicians shall be fully capable of system engineering support, installation supervising, system start-up, and providing the Owner with training and service on both hardware and software for the systems specified.
 - 5. Certify complete and total compliance with the provisions of these specifications by letter or submittal of the proposal response forms, signed by an officer of the corporation, or a principal if other ownership currently exists. In addition, the letter or forms shall include a complete listing of exceptions, if any.

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1.17 SUBMITTALS

- A. Provide SUBMITTALS according to Division 01 and the following.
- B. Requirements:
 - 1. Submit paragraph-by-paragraph specification review indicating compliance or deviation with explanation.
 - 2. Submit proof that all system components and cables are U.L. Listed.
 - 3. An equipment list with names of manufacturers, model numbers, and technical information on all equipment proposed. Clearly mark exact model number proposed to be installed.
 - 4. Product technical information sheets for each principal component in the proposed system, including cable, wire, terminal marking, and wire marking material.
 - 5. Certification from the manufacturer stating that the system Contractor is an authorized distributor or installer of the proposed system when such certifications exist.
 - 6. A statement listing every technical and operational parameter wherein the submitted equipment varies from that which was originally specified. If the submitter fails to list a particular variance and his submittal is accepted but is subsequently deemed to be unsatisfactory because of the unlisted variance, the submitter shall replace or modify such equipment at once and without cost to the Owner.

1.18 EXAMINATION OF SITE

- A. The Contractor shall have visited the site and familiarized himself with all existing conditions prior to submitting his proposal and shall be prepared to carry out the work within the existing limitations. Failure or neglect to do so shall not relieve the Contractor of his responsibilities not entitle him to additional compensation for work overlooked and not included in his proposal.
- B. The Contractor shall confirm the availability of the proper power source for each piece of specified equipment, through site visits and Drawings as necessary. Where proper power does not exist, the Contractor shall provide the required power, circuits, outlets, conduits, and wire as specified under Division 26.

1.19 DATA ACCURACY

- A. Absolute accuracy of information regarding existing conditions cannot be guaranteed. The Drawings and Specifications are for the assistance and guidance of the Contractor and exact locations, distances, elevations, etc., shall be governed by actual field conditions. Where variations from the contract documents are required, such variations shall be approved by the Architect / Owner.

1.20 SECURITY

- A. The Contractor is responsible for complying with all of the Owner's and facility security's requirements to prevent theft or damage to equipment, tools and materials. If any deviation from facility security requirements is necessary, approval for such deviation shall be coordinated with the Owner.

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- B. The Contractor shall not disclose any confidential information of the Owner. The Contractor acknowledges that such action is highly injurious and can do damage to the Owner. The Contractor will agree to and comply with the standard policies and provisions of the Owner regarding outside Contractors and Consultants.

1.21 UTILITIES

- A. It shall be the responsibility of the Contractor to provide all temporary connection and cables, lighting, light stands and power. The facilities shall be used in accordance with all applicable regulations regarding operations, safety and fire hazards of the governmental Authorities Having Jurisdiction, provided they are not used in a wasteful manner.

1.22 PERMITS

- A. All permits required for the specified performance and completion of the work shall be secured by the Contractor. These permits shall be presented and reviewed at the initial project progress meeting.

1.23 NOTIFICATION

- A. The Contractor shall not shut off any existing systems. The Contractor shall give the Owner at least ten (10) calendar day's notice of any requirements to shut off or interference with existing alarm, regulating, computer or other service systems. The Owner will arrange and execute any shutdown. All work such as splicing, connections, etc., necessary to establish or re-establish any system shall be completed by the Contractor in close coordination with the Owner.

1.24 INTERFERENCES WITH THE OWNER

- A. Transportation and storage of materials at the facility, work involving the facility, and all other matters affecting the habitual use by the Owner of its buildings, shall be conducted so as to cause the least possible interference, and at times and in a manner acceptable to the Owner. The Contractor shall make every effort to delivery equipment per the schedule required by the project.

1.25 PROJECT RECORD DOCUMENTS

- A. Maintain at the job site a separate set of white prints (blue line or black line) of the contract drawings for the sole purpose of recording the "as-built" changes and diagrams of those portions of work in which actual construction is significantly at variance with the contract drawings. Mark the drawings with a colored pencil. Prepare, as the work progresses and upon completion of work, reproducible drawings clearly indicating locations of various major and minor feeders, equipment, and other pertinent items, as installed. Record underground and under-slab cables installed, dimensioning exact location and elevation of such installations.
- B. At conclusion of project, obtain without cost to the Owner, electronic AutoCAD 2014 or later / Revit CAD files of the original drawings and transfer as-built changes to these. Provide the following as-built documents including all contract drawings regardless of whether corrections were necessary and include in the transmittal: "2 sets of CDs and prints for Owner's use, one set of CDs, prints, and mylars for Architect / Engineers Records". Delivery of these as-built electronic, reproducible and prints is a condition of final acceptance.

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1. 3 sets of electronic AutoCAD (2014 dwg or later) / Revit CAD drawing files, on CD-ROM media, of each contract as-built drawing.
 2. One reproducible Dayrex mylar film positive of each contract as-built drawing.
 3. Three sets of blue or black-line prints of each contract as-built drawing.
- C. As-Built Drawings should indicate the following information as a minimum:
1. Indicate all addendum changes to documents.
 2. Remove Engineer's Seal, name, address, and logo from drawings.
 3. Mark documents AS-BUILT DRAWINGS.
 4. Clearly indicate: DOCUMENT PRODUCED BY:
 5. Indicate all changes to construction during construction. Indicate actual routing of all conduit and cables, etc that were deviated from construction drawings.
 6. Indicate exact location of all underground communications raceways, and elevations.
 7. Correct schedules to reflect (actual) equipment furnished and manufacturer.
 8. During the execution of work, maintain a complete set of Drawings and specifications upon which all locations of equipment, devices, and all deviations and changes from the construction documents in the work shall be recorded.
 9. Exact location of all communications equipment in building. Label panel schedules to indicate actual location.
 10. Exact location of all communications equipment in and outside of the building.
 11. Location, size and routing of all communications cables, conduits, equipment, etc. shall be accurately and neatly shown to dimension.
 12. Exact location of all roof mounted equipment, wall, roof and floor penetrations.
 13. Cloud all changes.

1.26 OPERATING TESTS

- A. After all communications systems have been completed and put into operation, subject each system to an operating test under design conditions to ensure proper sequencing and operation throughout the range of operation. Tests shall be made in the presence of the Architect / Engineer and Owner. Provide minimum 24-hour advance notice of scheduling of all tests. Make adjustments as required to ensure proper functioning of all systems. Special tests on individual systems are specified under individual sections. Submit 3 copies of all certifications and test reports adequately in advance of completion of the work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

1.27 WARRANTY

- A. All equipment shall be covered for the full manufacturers warranty period and systems shall be warranted by the Contractor for a period of two years commencing with the filing date of substantial completion. The Warranty shall cover all costs for warranty service, including parts, labor, prompt field service, pick-up, transportation, delivery, reinstallation, and retesting. A contract for service shall cover the period starting with the first expected activation of each system and shall continue without interruption to cover the period to the end of the two-year warranty as defined above. The end of the warranty period shall be handled such that a smooth transition to a maintenance agreement with the Owner shall be achieved with no lapse in coverage.
- B. Submit 3 copies of all warranties and guarantees for systems, equipment, devices and materials. These shall be included in the Operating and Maintenance Manuals.

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1.28 BUILDING CONSTRUCTION

- A. It shall be the responsibility of the sub-contractor to consult the Architectural and Engineering drawings, details and specifications and thoroughly familiarize himself as to the construction and all job-related requirements. All construction trades shall cooperate with the General Contractor / Construction Manager job site superintendent and lay out work so that all piping, cables, pathways, raceways, and other items are placed in the walls, furred spaces, chases, etc., so that there shall be no delay in the job.

1.29 TEMPORARY FACILITIES

- A. General: Refer to Division 01 for general requirements on temporary facilities.
- B. Temporary Wiring: Temporary power and lighting for construction purposes shall be provided under Division 26. Installation of temporary power shall be in accordance with NEC Article 305.
- C. Temporary facilities, wire, lights and devices are the property of this Contractor and shall be removed at the completion of the Contract.

1.30 EXTRA MATERIALS

- A. Keys: Provide three (3) sets of all keys for system cabinets.

PART 2 - PRODUCTS

2.1 WORK INCLUDED

- A. All materials listed in PART 2 - PRODUCTS of this Division Sections and on the Drawings shall be provided by the Contractor unless specifically excluded or modified in other portions of this Specification or Addendums.

2.2 GENERAL MATERIALS AND EQUIPMENT REQUIREMENTS

- A. Materials, in general, shall conform to the National Electrical Code requirements and shall be listed, inspected, and approved by the Underwriters Laboratories and shall bear the UL label where labeling service is available. The label or listing of the Underwriters Laboratories, Inc. will be accepted as evidence that the materials or equipment conform to the applicable standards of that agency. In lieu of this listing, the Contractor may submit a statement from a nationally recognized, adequately equipped testing agency, indicating that the items have been tested in accordance with required procedures, and that the materials and equipment comply with all Contract requirements.

2.3 STANDARD PRODUCTS

- A. Materials and equipment shall be the standard catalog products of manufacturers regularly engaged in the manufacture of products conforming to these specifications and shall essentially duplicate materials and equipment that have been in satisfactory use at least two (2) years prior to bid opening. Where custom or special items are required, these shall be fully described using drawings, material lists, etc., which fully describe in detail the item proposed for use on this project.

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2.4 MANUFACTURE'S INSTRUCTIONS

- A. The Contractor is responsible for furnishing the proper Communication equipment and/or material and for seeing it is installed as intended by the manufacturer. The Contractor shall, wherever necessary, request advice and supervisory assistance from equipment manufacturers as required for the proper installation, operation, or start-up. The Contractor shall notify the Consultant, in writing, of any conflict between the Contract Documents and the manufacturer's recommendations and shall obtain, from the Consultant, instructions/direction before proceeding with the work. The Contractor shall pay for all costs resulting from deficiencies created by installation not in accordance with the manufacturer's recommendations or the instructions of the Consultant.

2.5 RUST PREVENTION

- A. Metallic materials shall be protected against corrosion. Exposed metallic parts of equipment exposed to the elements shall be given a rust inhibiting treatment and standard finish by the manufacturer. Components such as boxes, bodies, fittings, guards, and miscellaneous parts shall be protected in accordance with the ASTM A123 or A153, except where other equivalent protective treatment is specifically approved in writing.

2.6 STORAGE AT SITE

- A. The Contractor shall not receive material or equipment at the job site until ready for installation or until there is suitable space provided to properly protect equipment from rust, weather, humidity, dust, or physical damage.
- B. All electronic equipment, containing sealed lead acid batteries or gel cells, shall be stored in climate-controlled area until installed or reinstalled. Do not store in non-climate controlled connex storage units.
- C. Storage is to be provided and secured by the contractor. In the event that the Owner should agree to furnish storage space, security of the space and its contents shall remain the responsibility of the contractor.

2.7 CONDITION OF MATERIALS

- A. All materials required for the installation of the Communication systems shall be new and unused. Any material or equipment damaged in transit from the factory, during delivery to premises, while in storage on premises, while being installed, or while being tested, until time of final acceptance, shall be replaced by this Contractor without extra cost to Owner.

2.8 NAMEPLATES

- A. Factory assembled components and equipment shall be provided with be factory stamped labeling. Labeling will have information required to specifically identify the component and/or equipment in the future such as the manufacturer's name, catalog number, serial number, etc. All data on the labels shall be legible at the time of final inspection.

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2.9 ACCESS DOORS

- A. Wherever access is required in walls or ceilings to concealed junction boxes, pull boxes, equipment, etc., installed under this Division, furnish a hinged access door and frame with flush latch handle to another Division for installation. Doors shall be as follows:
 - 1. Plaster Surfaces: Milcor Style K.
 - 2. Ceramic Tile Surfaces: Milcor Style M.
 - 3. Drywall Surfaces: Milcor Style DW.
 - 4. Install panels only in locations approved by the Architect.

2.10 SPACE LIMITATIONS

- A. Equipment shall be chosen which shall properly fit into the physical space provided and shown on the drawings, allowing ample room for access, servicing, removal and replacement of parts, etc. Adequate space shall be allowed for clearances in accordance with applicable codes and standards. Physical dimensions and arrangement of equipment shall be subject to the approval of the Consultant.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. This project has a critical path, which must be closely followed in order to meet the completion date. The Contractor shall review the proposed schedule at the Award of Contract meeting and be prepared to staff his work force according to the schedule constraints presented at that time.
- B. Aesthetics are an important consideration in this installation. All components shall be installed so as to have aesthetically pleasing results as determined by the Owner and Architect. Actual locations of all visible components shall be coordinated in advance with the Owner and Architect.
- C. Install, make fully operational and test the system as indicated on the Drawings and in the Specifications. Where information is not available the worst-case condition must be assumed to ensure a complete, functional system.
- D. Any interfacing with other systems shall be the Contractor's responsibility under this contract, and the details, both logical and physical, of such interfaces shall be reflected in the Submittals and As-Built drawings.
- E. If appropriate, interfaces with the Owner's Data Network, Telecommunications and Communications System shall be coordinated with the Owner and Architect.
- F. All necessary back boards, back-boxes, pull-boxes, connectors, supports, conduit, cable and wire shall be furnished and installed to provide a complete and reliable system. Exact location of all backboards, boxes, conduit and wiring runs shall be presented to the Owner / Architect for approval in advance of any installation. Provide as required and as specified in Division 26.
- G. Where required provide 120-VAC, 60 Hz power from nearest electrical panel through a junction box, to the system devices. Provide as required and as specified in Division 26.

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- H. Where required, install conduit, cable and wire parallel and square with building lines, including raised floor areas. Conduit fills shall not exceed 40%.
- I. Ground busses shall be provided in each any room with communication equipment.
- J. All equipment shall be mounted with sufficient clearance to minimize EMI as well as meet all applicable codes and facilitate observation and testing. Securely hand and/or fasten with appropriate fittings to ensure positive grounding, free of ground loops, throughout the entire system. Units shall be installed parallel and square to building lines.
- K. Communications grounding system shall be a single point grounding from the building entrance electrical ground to each Communications room.
- L. All Conduit systems, cabinets' racks, cable trays, protector blocks, SCTP patch panels and/or miscellaneous equipment, etc. shall be grounded by being connected to the common communications grounding system. The conductors shall be a # 6awg solid with a green jacket
- M. Quiet and vibration-free operation of all equipment is a requirement of this installation. Properly adjust, repair, balance or replace any equipment producing objectionable (in the judgment of the Owner or Architect) noise or vibration in any of the occupied areas of any building and provide additional brackets and bracing if necessary. Any such additions or changes shall be at no additional cost to the Owner.
- N. Installation shall comply with the CODES AND STANDARDS portion of this Section. Where more than one code or regulation if applicable, the more stringent shall apply.
- O. Where new equipment is replacing old equipment, the Contractor is responsible for removing and disposing of the old equipment and doing whatever repair work is necessary as specified by the Owner / Architect.
- P. Install firestopping, as specified in Division 26 for all penetrations in slabs and firewalls to meet code at the completion of work and prior to final testing demonstration to the Owner.
- Q. The installation shall be performed in a professional manner.
- R. On a daily basis, clean up and deposit in appropriate containers all debris from work performed under the appropriate specification sections. Stack and organize all parts, tools and equipment when not being used.
- S. Preparation, handling and installation shall be in accordance with the Manufacturer's written instructions and technical data appropriate to the product specified.
- T. All work shall conform to the National Electrical Contractor's Association "Standard of Installation" for general installation practice.
- U. At the conclusion of the installation, all work areas, including all enclosures and boxes, shall be vacuumed and cleaned to remove all debris and grease.

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3.2 COORDINATION WITH OWNER / ARCHITECT

- A. Close coordination with the Owner / Architect is vital to achieve a complete, aesthetically pleasing job. The Contractor shall ensure that the Owner / Architect is kept fully apprized of job progress.

3.3 CUTTING, PAINTING, AND PATCHING

- A. Structural members shall not be drilled, bored or notched in such a manner that shall impair their structural value. Cutting of holes in structural members, if required, shall be done with core drills and only with the specific approval of the Owner / Architect for each instance.
- B. All walls that require cutting or repair during the installation process shall be returned to their original condition, including the matching of colors and finishes to the satisfaction of the Owner / Architect, and at no additional cost to the Owner.

3.4 WIRE AND CABLE

- A. All low voltage cable shall be low smoke plenum rated, limited energy, with 300-volt insulation.
- B. All wires in exposed areas shall run through conduit as specified in Division 26.
- C. Provide conduits, cable trays, raceways, wireways, boxes and outlets as specified in Division 26.
- D. After installation, and before termination, all wiring shall be checked and tested to insure there are no grounds, opens, or shorts on any conductors. In addition, all wires between buildings or underground and all coax cables shall have insulation tested with a megohmmeter (megger) and a reading of greater than 20 megohms shall be required to successfully complete the test.
- E. Run wires continuously from termination to termination without splices.
- F. Wire and cable shall be supported in each equipment and terminal cabinet and in each terminal and pull box in vertical risers and horizontal runs with wire duct and strap-type supports. At any point where wire duct is required for good wire management, whether shown on elevations or not, install appropriate duct. Where terminal boards are used, wire ducts shall be supplied on both sides and at no time shall wires cross over terminal boards. Arrange cables neatly to allow inspection, removal and replacement. Lace cables as required. Spot tie wire bundles with plastic cable ties and securely affix to panels. If screw type terminals are specified, terminal strip connections shall be locking, tongue style, pressure crimp, and solderless spade lug.
- G. Visually inspect wire and cable for faulty insulation prior to installation. Protect cable ends at all times with acceptable end caps except during actual termination. At no time shall any coaxial cable be subjected to a bend less than a 6-inch radius. Protect wire and cable from kinks. Install 1 pull rope for all 2" or larger sized conduits.
- H. Provide plastic bushings and strain relief material at all conduit exit points and where necessary, to avoid abrasion of wire and excess tension on wire and cable.

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- I. Cables above accessible ceilings shall not rest on ceiling tiles. Use Velcro tie wraps, J-hooks or D-rings to hold cables. Provide independent support for all cables. Support is to be from building structure (do not support from pipes or conduits). Communications cables shall not tie off on HVAC supports, all-thread, ceiling grid hanger wire or electrical / mechanical piping system.
- J. Ground and bond equipment and circuits in accordance with NEC and Division 26.

3.5 IDENTIFICATION AND TAGGING

- A. All cables, wires, wiring forms, terminal blocks and terminals shall be identified by labels, tags to other permanent markings in accordance with TIA/EIA-606. The markings shall clearly indicate the function, source, or destination of all cabling, wiring and terminals. All cables and wires shall be identified, utilizing heat-shrink, machine printed, polyolefin wire markers (Brady Type B-32 *or equal*). Handwritten tags are not acceptable.
- B. Should a situation arise where the wire tagging format as shown on the drawings cannot be used, a substitute format shall be submitted which complies with the intent to provide documentation that will permit end-to-end tracing of all Communications Systems wiring.
- C. All panels shall be provided with permanently attached engraved lamaroid labels with identifying names and functions. All terminal points shall be appropriately labeled. Labels shall be consistent in form, color, and typeface throughout the system and all must contain the name of the system or subsystem as part of the label textual information. Design, color, font and layout shall be coordinated with, and approved by, the Owner.
- D. Identification of Equipment:
 - 1. All major equipment shall have a manufacturer's label identifying the manufacturer's address, equipment model and serial numbers, equipment size, and other pertinent data. Take care not to obliterate this nameplate. The legend on all nameplates or tags shall correspond to the identification shown on the Operating Instructions.
 - 2. A black-white-black 3 layer laminated plastic engraved identifying nameplate shall be permanently secured to each wireway, terminal cabinet, and communications (voice, data, video) cabinet or rack.
 - a. Identifying nameplates shall have 1/2-inch high, engraved letters. For equipment designation and 1/4-inch letters indicating source circuit designation, (i.e.: "IDF(FCR) XXYY –served from MDF (BCR) XXGG).
 - 3. Permanent, waterproof, black markers shall be used to identify each communications grid junction box, clearly indicating the type of system available at that junction box.
 - 4. Pull Boxes: Field work each with a nameplate showing identity, and identifying equipment connected to it. Nameplates shall also indicate where pull box is fed from.
 - 5. Communication hardware located above accessible ceilings: Provide 1/2-inch high black name plate with white 1/4-inch letters glued to bottom of t-grid ceiling below hardware located above ceiling. Identification shall be as short as possible yet identifying device above ceiling, i.e. "A/V-EQ".

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- E. Prohibited Markings: Markings intended to identify the manufacturer, vendor, or other source from whom the material has been obtained are prohibited for installation in public, tenant, or common areas within the project. Also prohibited are materials or devices that bear evidence that markings or insignias have been removed. Certification, testing (example, Underwriters Laboratories), and approval labels are exceptions to this requirement.
- F. Warning Signs: Provide warning signs where there is hazardous exposure associated with access to or operation of communications facilities. Provide text of sufficient size to convey adequate information at each location; mount permanently in an appropriate and effective location. Comply with industry standards for color and design.
- G. Wire and Cable Labeling: Provide wire markers on each conductor in all boxes, pull boxes, gutters, wireways. Identify with drop/circuit number.
- H. Underground Warning Tape: Thomas and Betts or approved equal. Six-inch wide plastic tape, colored red or orange with suitable warning legend describing buried communications lines. All underground conduits shall be so identified. Tape shall be buried at a depth of 6-inches below grade and directly above conduits or ductbanks. Provide magnetic marking tape below all underground conduits.

3.6 CUTTING AND PATCHING

- A. General: Comply with the requirements of Division 01 for the cutting and patching of other work to accommodate the installation of electrical work. Except as authorized by the Architect / Engineer, cutting and patching of electrical work to accommodate the installation of other work is not permitted.

3.7 INSTRUCTION OF OWNER'S PERSONNEL

- A. Before proceeding with the instruction of Owner Personnel, prepare a typed outline in triplicate, listing the subjects that will be covered in this instruction, and submit the outline for review by the Owner. At the conclusion of the instruction period obtain the signature of each person being instructed on each copy of the reviewed outline to signify that he has a proper understanding of the operation and maintenance of the systems and resubmit the signed outlines.
- B. Prior to substantial completion, conduct an on-site training program to instruct Owner's operating personnel in the operation and maintenance of the communications systems.
 - 1. Provide the training during regular working day.
 - 2. The Instructors shall be experienced in their phase of operation and maintenance of the systems and with the project.
- C. Time to be allocated for instructions.

The Contractor shall furnish the services of factory trained specialists to instruct the Owner's operating personnel. The Owner's operator training shall include training as specified per system specification,

 - 1. Minimum of four (4) hours dedicated instructor time
 - 2. 2-hour sessions on different, non-consecutive days
 - 3. Additional instruction time for specific systems as specified in other Sections.

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- D. Before on-site training, submit the program syllabus; proposed time and dates; for review and approval, minimum 48 hours prior to proposed training time and date.
 - 1. One copy to the Owner
 - 2. One copy to the Architect / Engineer
- E. The Owner shall provide a list of personnel to receive instructions and shall coordinate their attendance at the agreed upon times.
- F. Use operation and maintenance manuals as the basis of instruction. Review manual with personnel in detail. Explain all aspects of operation and maintenance.
- G. Demonstrate start-up, operation, control, adjustment, troubleshooting, servicing, maintenance, and shut down of each item of equipment.
- H. Demonstrate equipment functions (both individually and as part of the total integrated system).
- I. Prepare and insert additional data in the operating and maintenance manuals when the need for additional data becomes apparent during instructions.
- J. Submit a report within one week after completion of training. List time and date of each demonstration, hours devoted to the demonstration, and a list of people present, with their respective signatures.
- K. At the conclusion of the on-site training program, have the person designated by the Owner sign a certificate to certify that he/she has a proper understanding of the system, that the demonstrations and instructions have been satisfactorily completed, and the scope and content of the operating and maintenance manuals used for the training program are satisfactory.
- L. Provide a copy of the report and the certificate in an appropriately tabbed section of each Operating and Maintenance Manual.

3.8 OPENINGS

- A. Framed, cast or masonry openings for boxes, equipment or conduits are specified under other divisions. Drawings and layout work for exact size and location of all openings are included under this division.

3.9 OBSTRUCTIONS

- A. The drawings indicate certain information pertaining to surface and subsurface obstructions, which has been taken from available drawings. Such information is not guaranteed, however, as to accuracy of location or complete information.
 - 1. Before any cutting or trenching operations are begun, verify with Owner's representative, utility companies, municipalities, and other interested parties that all available information has been provided.
 - 2. Should obstruction be encountered, whether shown or not, alter routing of new work, reroute existing lines, remove obstruction where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of the new work and leave existing services and structures in a satisfactory and serviceable condition.

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- B. Assume total responsibility for and repair any damage to existing utilities or construction, whether or not such existing facilities are shown.

3.10 VANDAL RESISTANT DEVICES

- A. Where vandal resistant screws or bolts are employed on the project, deliver to the Owner 2 suitable tools for use with each type of fastener used.
- B. Proof of delivery of these items to the Owner shall be included in the Operating and Maintenance Manuals.

3.11 PROTECTION

- A. Protect work, equipment, fixtures, and materials. At work completion, work must be clean and in original manufacturer's condition.
- B. Do not deliver equipment to this project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather shall be rejected, and the contractor is obligated to furnish new equipment of a like kind at no additional cost to the Owner.

3.12 EQUIPMENT BACKBOARDS

- A. Backboards: $\frac{3}{4}$ inch, fire retardant, exterior grade plywood, painted gray, both sides.
 - 1. Provide minimum of two 4-ft. by 8-ft. sheets of plywood for each location shown.
 - 2. Provide minimum of two 4-ft. by 4-ft. sheets of plywood for each communications location.

3.13 SITE MANAGEMENT RESPONSIBILITY

- A. The Contractor shall provide an on-site Project Manager as defined in CONTRACTOR'S QUALIFICATIONS portion of this Section.

3.14 DEMOLITION AND RELOCATION

- A. The Contractor shall modify, remove, and relocate all materials and items so indicated on the drawings or required by the installation of new facilities. All removals and/or dismantling shall be conducted in a manner as to produce maximum salvage. Salvage materials shall remain as directed by the Owner. Materials and items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to the approval of the Owner. The Contractor may substitute new materials and items of like design and quality in lieu of materials and items to be relocated, if approved by the Owner.
- B. All items scheduled for relocation and/or reuse shall be inspected by the Contractor and the Owner or his authorized representative. A written report of the condition of each item shall be made and provided to the Consultant. Where items scheduled for relocation and/or reuse are considered unsuitable for reuse, the Contractor shall so notify the Consultant and await reinstallation instructions before proceeding with removal. Items damaged in reinstallation shall be repaired or replaced by the Contractor as directed by the Owner at no additional cost to the Owner or the Consultant.

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- C. All items which are to be relocated shall be carefully removed in reverse to original assembly or placement and protected until relocated. The Contractor shall clean, repair, and provide all new materials, fittings, and appurtenances required to complete the relocation and to restore the items to good operative order. All relocations shall be performed by workmen skilled in the work and in accordance with standard practice of the trades involved.
- D. Service lines and wiring to items to be removed, salvaged, or relocated shall be removed to points as indicated on the drawings, specified, or acceptable to the Owner. Service lines and wiring not scheduled for reuse shall be removed to the points at which reuse is to be continued or service is to remain. Such services shall be sealed, capped, or otherwise tied off or connections into the existing facilities in such a manner as to result in minimum interruption of services to adjacent occupied areas. Services to existing areas or facilities which must remain in operation during the construction period shall not be interrupted without prior specific written approval of the Consultant.

3.15 EXISTING SYSTEM TESTING

- A. Contractor shall have each low voltage system tested prior to the commencement of construction. Systems shall include all systems that fall under the Division 27 umbrellas, as identified in the Division 27 of the Construction Specifications Institute (CSI) current Master Format. Test shall include the functionality of all field devices and equipment. Any failures or items found to be functioning not to specification, shall be reported prior to construction. Any items found to be improperly or non-functioning upon the completion of the project, shall be replaced and/or repaired, by the contractor, at no additional cost to the project or the owner.
- B. Contractor shall document the location and any ID tag, MAC address, IP address, or bar code of any existing device that is to be removed from its current location. Devices that are to remain, shall be reinstalled in the exact location that they reside in prior to construction, unless noted otherwise.
- C. Any individual/firm that will be removing, relocating, reinstalling, or tampering with any devices; shall be licensed by the state and certified by the manufacturer of the system.
- D. Contractor shall remove any devices where construction occurs to prevent possible damage to the device. Removal of any devices which support user connection or other systems, shall be coordinated with the owner prior to removal and/or taking offline.

3.16 START-UP RESPONSIBILITY

- A. The Contractor shall initiate System operation. The Contractor shall provide competent Start-Up personnel on each consecutive working day until all Communications Systems are functional and ready to start the acceptance test phase. If the Contractor, in the Owner / Architect's judgment, is not demonstrating progress in solving any technical problems, the Contractor shall supply Manufacturer's factory technical representation and diagnostic equipment at no cost to the Owner, until resolution of those defined problems. Where appropriate, the Contractor shall bring the Systems on-line in their basic state (i.e., alarm reporting, facility code access control, etc.) It is the responsibility of the Owner to provide the specific database information that will be utilized for initial system programming.

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- B. Properly ground each piece of electronic equipment prior to applying power. Properly ground all shielded wire shields to the appropriate earth ground at the hub end only, not at the remote or device end.
- C. Use a start-up sequence that incrementally brings each portion of the system on-line in a logical order that incorporates checking individual elements before proceeding to subsequent elements until the entire system is operational. The basic steps should include:
 - 1. Establish ground planes at the equipment rooms and hub end of the systems as specified in Division 26.
 - 2. Disconnect power, connect the first device, reconnect power, and verify operational correctness. Repeat until the entire system is verified and operational.

3.17 PREPARATION FOR ACCEPTANCE (SUBSTANTIAL COMPLETION)

- A. All systems, equipment, and devices shall be in full and proper adjustment and operation, and properly labeled and identified.
- B. All materials shall be neat, clean and unmarred, and parts securely attached.
- C. All extra material as specified shall be delivered and stored at the premises as directed.
- D. Test reports of each system and each system's components and As-Built Project Drawings shall be complete and available for inspection and delivery as directed by the Owner.

3.18 SYSTEM ACCEPTANCE REQUIREMENTS

- A. Before final acceptance or work, the Contractor shall perform and/or deliver each of the following in the order stated.
- B. The Contractor shall deliver three (3) composite "System Operations and Maintenance" manuals in three-ring binders, sized to hold the material below, plus 50% excess. Each manual shall contain in appropriately tabbed sections:
 - 1. A statement of Guarantee including date of termination and the name and phone number of the persons to be called in the event of equipment failure.
 - 2. A set of Operating procedures for the overall System that includes all required Owner activities, and that allows for the Owner operation of all attributes and facilities of the System.
 - 3. A section for each specific type of equipment containing the vendor manuals, instruction sheets, and any related literature that came in the original shipping container for that piece of equipment. Include all warranty cards.
- C. Testing:
 - 1. The Contractor shall perform all tests required by Division 26 and those submitted as part of this Section.
 - 2. The Contractor shall activate all devices for proper system operation, including supervisory and trouble circuit tests. Similarly, audible alarms will not be activated except on a one-time, coordinated basis, to check the actual sounding devices.

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3. A test report for each piece of equipment shall be prepared by the Contractor and submitted to the Owner. This report shall include a complete listing of every device, the date it was tested, by whom and the results. The final test reports shall indicate that every device tested successfully. Failure to completely test and document the tests will result in a delay of final testing and acceptance.
- D. As-Built Drawings:
 1. After completion of all the tests listed above, and prior to the final acceptance test, The Contractor shall submit the complete As-Built drawings as identified in PART 1 – PROJECT RECORD DRAWINGS.
 2. The final As-Built Drawings shall consist on one set of reproducible prints, two (2) sets of Point-to-Point Detail Drawings, Equipment Schedules, and the complete detailed technical data that was shipped by the manufacturer with all installed equipment.
- E. Final Acceptance Test: The Final Acceptance Test shall demonstrate the installed and activated System's performance and compliance with System Specifications. However, before this testing can begin the following must have received and reviewed by the Owner.
 1. System Operations and Maintenance Manuals
 2. System Test Reports
 3. As-Built Drawings

3.19 FINAL ACCEPTANCE

- A. The date of final acceptance shall be the date of owner occupancy, or the date all punch list items have been completed or final payment has been received. Refer to Division 1 for additional requirements
- B. When the Final System Acceptance Requirements described above including the Final Acceptance Test described above have been satisfactorily completed. The Owner / Architect shall issue a Letter of Completion to the Contractor indicating the date of such completion. The Notice of Completion shall be recorded by the Contractor upon receipt of the Owner / Architect completion letter. This date of record shall be the start of the warranty period.

END OF SECTION

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SECTION 270507

COMMUNICATIONS SHOP DRAWINGS, COORDINATION DRAWINGS & PRODUCT DATA

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Prepare submittals as required by Division 01 and as outlined below.
- B. Submit product data shop drawings only for the following and for items specifically requested elsewhere in the Contract Drawings and Specifications. Architect / Engineer reserves the right to refuse shop drawings not requested for review and to imply that materials shall be provided as specified without exception.
- C. The term submittal, as used herein, refers to all:
 - 1. Shop Drawings
 - 2. Coordination Drawings
 - 3. Product data
- D. Submittals shall be prepared and produced for:
 - 1. Distribution as specified
 - 2. Inclusion in the Operating and Maintenance Manual, as specified, in the related section

1.2 SHOP DRAWINGS

- A. Present drawings in a clear and thorough manner. Identify details by reference to sheet and detail, schedule, or room numbers shown on Contract Drawings.
- B. Show all dimensions of each item of equipment on a single composite Shop Drawing. Do not submit a series of drawings of components.
- C. Identify field dimensions; show relation to adjacent or critical features or work or products.

1.3 COORDINATION DRAWINGS

- A. Present in a clear and thorough manner. Title each drawing with project name. Identify each element of drawings by reference to sheet number and detail, or room number of contract documents. Minimum drawing scale: 1/4"=1'-0".
- B. Prepare coordination drawings to coordinate installations for efficient use of available space, for proper sequence of installation and to resolve conflicts. Coordinate with work specified in other sections and other divisions of the specifications.
- C. For each room containing technology equipment and each rack with technology equipment, submit plan and elevation drawings. Show:
 - 1. Actual technology equipment and components to be furnished.
 - 2. NEC working space and NEC access to NEC working space.
 - 3. Relationship to other equipment and components and openings, doors and obstructions
 - 4. Rack location and dimensions

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- D. Identify field dimensions. Show relation to adjacent or critical features of work or products.
- E. Verify location of communications station devices, telephone outlets and other work specified in this Division.
 - 1. Coordinate with drawing details, site conditions and millwork shop drawings prior to installation.
 - 2. Where required for clarification, submit shop drawings prior to rough-in and fabrication.
- F. Submit shop drawings in plan, elevation and sections, showing outlets and other devices in casework, cabinetwork and built-in furniture.

1.4 PRODUCT DATA

- A. All product options specified shall be indicated on the product data submittal. All options listed on the standard product printed data not clearly identified as not part of the product data submitted shall become part of the Contract and shall be provided.
- B. Mark each copy of standard printed data to identify pertinent products, referenced to specification section and article number.
- C. Show reference standards, performance characteristics and capacities; wiring and piping diagrams and controls; component parts; finishes; dimensions and required clearances.
- D. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete information not applicable.
- E. Mark up a copy of the specifications for the product to indicate a) acknowledgement of the specification requirement (Comply), or b) acknowledgement that the particular specification requirement does not apply to this specific project (Not Applicable) or, c) acknowledgement that the specification requirement cannot be made or that a variance is being submitted for review to the Architect / Engineer / Owner (Does Not Comply, Explanation:)

1.5 MANUFACTURERS INSTRUCTIONS

- A. Submit Manufacturer's instructions for storage, preparation, assembly, installation, start-up and adjusting.

1.6 CONTRACTOR RESPONSIBILITIES

- A. Review submittals prior to transmittal.
- B. Determine and verify:
 - 1. Field measurements
 - 2. Field construction criteria
 - 3. Manufacturer's catalog numbers
 - 4. Conformance with requirements of Contract Documents
- C. Coordinate submittals with requirements of the work and of the Contract Documents.
- D. Notify the Architect / Engineer in writing at time of submission of any deviations in the submittals from requirements of the Contract Documents.

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- E. Do not fabricate products, or begin work for which submittals are specified, until such submittals have been produced and bear contractor's stamp. Do not fabricate products or begin work scheduled to have submittals reviewed until return of reviewed submittals with Architect / Engineer's acceptance.
- F. Contractor's responsibility for errors and omissions in submittals is not relieved whether Architect / Engineer reviews submittals or not.
- G. Contractor's responsibility for deviations in submittals from requirements of Contract Documents is not relieved whether Architect / Engineer reviews submittals or not, unless Architect / Engineer gives written acceptance of the specific deviations on reviewed documents.
- H. Submittals shall show sufficient data to indicate complete compliance with Contract Documents:
 - 1. Proper sizes and capacities
 - 2. That the item will fit in the available space in a manner that will allow proper service
 - 3. Construction methods, materials and finishes
- I. Schedule submissions at least 15 days before date reviewed submittals will be needed.

1.7 SUBMISSION REQUIREMENTS

- A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the Project or in the work of any other Contractor.
- B. Number of submittals required:
 - 1. Shop Drawings and Coordination Drawings: Submit four opaque reproductions.
 - 2. Product Data: Submit the number of copies the contractor requires, plus those to be retained by the Architect / Engineer.
- C. Accompany submittals with transmittal letter, in duplicate, containing:
 - 1. Date
 - 2. Project title and number
 - 3. Contractor's name, address and telephone number
 - 4. The number of each Shop Drawing, Project Datum and Sample submitted
 - 5. Other pertinent data
- D. Submittals shall include:
 - 1. The date of submission
 - 2. The project title and number
 - 3. Contract Identification
 - 4. The names of:
 - a. Contractor
 - b. Subcontractor
 - c. Supplier
 - d. Manufacturer
 - 5. Identification of the product
 - 6. Field dimensions, clearly identified as such
 - 7. Relation to adjacent or critical features of the work or materials
 - 8. Applicable standards, such as ASTM or federal specifications numbers
 - 9. Identification of deviations from contract documents

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- 10. Suitable blank space for General Contractor and Architect / Engineer stamps
- 11. Contractor's signed and dated Stamp of Approval

- E. Coordinate submittals into logical groupings to facilitate interrelation of the several items.
 - 1. Finishes which involve Architect / Engineer selection of colors, textures or patterns
 - 2. Associated items requiring correlation for efficient function or for installation

1.8 SUBMITTAL SPECIFICATION INFORMATION

- A. Every submittal document shall bear the following information as used in the project manual:
 - 1. The related specification section number
 - 2. The exact specification section title
- B. Submittals delivered to the Architect / Engineer without the specified information will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.9 RESUBMISSION REQUIREMENTS

- A. Make resubmittals under procedures specified for initial submittals.
 - 1. Indicate that the document or sample is a resubmittal
 - 2. Identify changes made since previous submittals
- B. Indicate any changes which have been made other than those requested by the Architect / Engineer.

1.10 CONTRACTOR'S STAMP OF APPROVAL

- A. Contractor shall stamp and sign each document certifying to the review of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the work and of Contract Documents.
- B. Contractor's stamp of approval on any submittal shall constitute a representation to Owner and Architect / Engineer that Contractor has either determined and verified all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data or assumes full responsibility for doing so, and that Contractor has reviewed or coordinated each submittal with the requirements of the work and the Contract Documents.
- C. Do not deliver any submittals to the Architect / Engineer that do not bear the Contractor's stamp of approval and signature.
- D. Submittals delivered to the Architect / Engineer without Contractor's stamp of approval and signature will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.11 ARCHITECT / ENGINEER REVIEW OF IDENTIFIED SUBMITTALS

- A. The Architect / Engineer will:
 - 1. Review identified submittals with reasonable promptness and in accordance with schedule. Specific equipment submittals that may be required to be expedited shall be submitted separately without other submittal items not requiring the same prompt attention.

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2. Affix stamp and initials or signature, and indicate requirements for resubmittal or approval of submittal
 3. Return submittals to Contractor for distribution or for resubmission
- B. Review of submittals will not extend to design data reflected in submittals that is peculiarly within the special expertise of the Contractor or any party dealing directly with the Contractor.
- C. Architect / Engineer's review is only for conformance with the design concept of the project and for compliance with the information given in the contract.
1. The review shall not extend to means, methods, sequences, techniques or procedures of construction or to safety precautions or programs incident thereto.
 2. The review shall not extend to review of quantities, dimensions, weights or gauges, fabrication processes or coordination with the work of other trades.
- D. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

1.12 SUBSTITUTIONS

- A. Do not make requests for substitution employing the procedures of this Section.
- B. The procedure for making a formal request for substitution is specified in Division 1.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 SHOP DRAWINGS AND PRODUCT DATA

- A. Submittals shall not be combined or bound together with any other material submittal.
- B. Submit individually bound shop drawings and product data for the following when specified or provided:
1. Structural Cabling
 2. Communications System
 3. Sound Reinforcement System
 4. CATV System

3.2 COORDINATION DRAWINGS

- A. Submit coordination drawings as specified.

END OF SECTION

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SECTION 270509

CONTRACT QUALITY CONTROL

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Contract quality control including workmanship, manufacturer's instructions, mock-ups and demonstrations.

1.2 QUALITY CONTROL PROGRAM

- A. Maintain quality control over supervision, subcontractors, suppliers, manufacturers, products, services, site conditions and workmanship to produce work in accordance with contract documents.

1.3 WORKMANSHIP

- A. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.
- B. Perform work by persons qualified to produce workmanship of specified quality.
- C. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking. Under no conditions shall material or equipment be suspended from structural bridging.
- D. Provide finishes to match approved samples; all exposed finishes shall be approved by the Architect / Engineer. Submit color samples as required.

1.4 MANUFACTURER'S INSTRUCTIONS

- A. Comply with instructions in full detail, including each step in sequence.
- B. Should instruction conflict with Contract Documents, request clarification from Architect / Engineer before proceeding.

1.5 MANUFACTURER'S CERTIFICATES

- A. When required in individual Specification Sections, submit manufacturer's certificate in duplicate, certifying that products meet or exceed specified requirements.

1.6 MANUFACTURER'S FIELD SERVICES

- A. When required in individual Specification Sections, manufacturer shall provide a manufacturer's qualified personnel to observe:
 - 1. Field conditions.
 - 2. Condition of installation.
 - 3. Quality of workmanship.
 - 4. Start-up of equipment.
 - 5. Testing and adjusting of equipment.

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- B. Manufacturer's qualified personnel shall make written report of observations and recommendations to Architect/Engineer.

1.7 MOCK UPS

- A. Assemble and erect the specified equipment and products complete, with specified anchorage and support devices, seals and finishes.
- B. Do not proceed with any work involving a mock-up, until the related mock up has been approved in writing.
- C. Acceptable mock-ups in place shall be retained in the completed work where possible.
- D. Perform tests and submit results as specified.

1.8 SCHEDULING OF MOCK-UPS

- A. Schedule demonstration and observation of mock-ups, in phases, with Architect / Engineer.
 - 1. Rough-in
 - 2. Finish with all appurtenances in place
 - 3. Demonstrations

PART 2 - PRODUCTS

2.1 REFERENCE APPLICABLE SPECIFICATION SECTIONS.

PART 3 - EXECUTION

3.1 ADJUSTMENTS AND MODIFICATIONS

- A. Contractor shall provide all adjustments and modifications as requested by the manufacturer's qualified personnel at no additional cost to Owner.

3.2 MOCK-UPS

- A. Mock-up a typical classroom, science lab of each type, and computer lab with all wiring devices, cover plates, rough-in boxes, conduits, etc. Provide all conductors from all wiring devices to above ceiling space to demonstrate conduit routing and conductor fill.

END OF SECTION

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SECTION 270510

FIRESTOPS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide firestop as required, and as specified. Refer to Architectural drawings for all fire and smoke rated partitions, walls, floors, etc.
- B. Types: Firestop required for the project includes smoke stop.

1.2 QUALITY ASSURANCE

- A. UL Label: Firestops shall be UL labeled.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Nelson.
- B. 3M (Minnesota Mining Manufacturing).
- C. Hilti
- D. Specified Technologies, Inc.

2.2 MATERIAL AND COMPONENTS

- A. General: Except as otherwise indicated, provide firestop manufacturer's standard materials and components as indicated by published product information, designed and constructed as recommended by the manufacturer, and as required for installation.

2.3 FIRESTOP

- A. Conduits: Provide a soft, permanently flexible sealant for 1-1/2 to 2 hour rated fireproofing for steel conduits (up to 4" diameter).
- B. Low Voltage Cables, Fiber Optic Cable and Innerduct: Provide Specified Technologies, Inc. EZ-Path single, double, or triple pathways as required.

PART 3 - EXECUTION

3.1 INSTALLATION OF FIRESTOPS

- A. General: Install firestops in accordance with the manufacturer's installation instructions and industry practices to ensure that the firestops comply with requirements. Comply with UL and NFPA standards for the installation of firestops.

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SECTION 271000

STRUCTURED CABLING SYSTEM (SCS)

PART 1 - GENERAL

1.1 RELATED WORK

The following, in their entirety and as applicable, shall apply to this section. Including any associated drawings.

- A. Conditions of the Contract
- B. Division 1
- C. Division 26
- D. Division 27
- E. Division 28

1.2 DESCRIPTION

A. Summary of Work:

1. Provide a complete and tested Structured Cabling System (SCS) for the interconnections of the Local Area Network (LAN). The SCS shall include fully terminated unshielded twisted pair cables, fiber optic cabling, raceways, conduit, back boxes, copper/fiber optic termination components, station mounting hardware, fiber optic enclosures, patch panels, copper/fiber optic patch cables, relay cabinets/cabinets, and other incidental and miscellaneous premises wiring system hardware as required for a complete, tested, and usable system that is in compliance with the latest NEC, ANSI/EIA/TIA, BICSI, and Authorities Having Jurisdiction codes and standards. The installation shall comply with all applicable requirements, design guidelines, and standards in effect at the job site and as indicated in the Drawings and Specifications.
2. An IDF will be required when the distance between outlet terminations and MDF/IDF exceeds 280', including service loops. IDF's shall be selected and organized to be minimum in number while still reaching all locations to be wired.
3. If there are any discrepancies between the drawings and specification or among themselves, the contractor shall request clarification prior to providing pricing for the scope of work. If a request is not issued and a response not provided via a posted addendum, the contractor shall provide pricing for the costliest scenario and obtain clarification during the project.
4. These documents are conceptual in nature. It shall be the responsibility of the approved installer to furnish a complete and functional system, including the items shown on the drawings, in the specifications, and items not designated in either. The installer's shop drawings and product data submittals shall represent a complete system and documents accepted do not relieve the installer from being required to provide any materials, equipment, or labor to furnish a complete and functional system as recognized by the Project's Technology Consultant and the Owner.

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1.3 QUALITY ASSURANCE

A. Acceptable manufacturers:

1. The equipment/products described herein and furnished per these specifications shall be the product of one manufacturer or must be able to obtain the full warranty of the combined solution. All references to model numbers and other detailed descriptive data is intended to establish standards of design performance, and quality, as required. The contractor shall not deviate from the part numbers listed. Any deviation from specified part numbers will result in the removal of non-specified materials and reinstallation of approved materials at no cost to the project.
2. The approved manufacturers shall provide a complete End-to-End solution with the maximum product and performance warranty offered by the specified manufacturer.
3. Only products listed in Attachment 'B' or approved in compliance with the project manual's approval requirements will be accepted.

B. Installer Qualifications:

1. The Data Cable System Installer shall be licensed and shall meet all applicable regulations of the State Department of Labor insofar as they apply to this type of system. The proposer shall be a firm normally employed in the low voltage and data cabling industry and shall provide a reference list of ten (10) large-scale projects and contact names confirming successful Structure Cabling System installations.
2. The SCS Installer shall be a Certified, local area, integrator of the manufacturer's product and must be able to provide the manufacturer's maximum available warranty for the solution on the entire SCS. The contractor's certification must have been obtained and held within 75 miles of the project's location.
3. The installing contractor must have a full-time employed RCDD (Registered Communications Distribution Designer) on staff. Current RCDD certification shall be provided in the product submittals.
4. All individuals installing the SCS must be employees of the certified installer and at least 25% of the installing staff shall have undergone a training class given by the manufacturer. Current certification indicating the successful completion of the training course shall be available upon request at the project and submitted in the contractor's product submittals.
5. The proposing contractor and the installing contractor must be the same company. No subcontractor to the proposing SCS contractor will be allowed for any portion of the SCS scope of work.

C. Low Voltage Meeting Requirements:

1. The successful Contractor shall attend a mandatory pre-construction meeting with the project's consultant individuals deemed necessary by the Owner's representative prior to the start of the work. No SCS work shall begin prior to this meeting.
2. The successful contractor shall attend a mandatory bi-weekly meeting to discuss the project progress to help aid coordination with the Owner and Other contractors.
3. Prior to the installation of any items required for this scope of work the contractor must provide a purchase order with a detailed material list for all materials to be installed. The purchase order is not required to show cost, but part numbers must be provided. The purchase order will be reviewed during one of the regularly scheduled low voltage meetings.

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- D. Acceptance: The Owner's representative reserves the right to reject all or a portion of the work performed, either on technical or aesthetic grounds.
- E. Warranty:
1. The selected system installer shall be a certified installing contractor of product and hold current certification. Contractor shall provide the specified manufacturer's maximum end-to-end performance warranty on all products installed. The proposer shall provide current certification documentation. The performance warranty shall be issued by the manufacturer and shall warrant that ALL cable links have been tested bi-directionally (end to end) using a Level IIIe or better tester, per TSB-67, and that all test results conform to the most current ANSI/TIA-568.2-D.
 2. The warranty will also cover multimode fiber optic cabling. Performance testing shall be conducted in accordance with ANSI/EIA/TIA-526-14 Standard, method B.
 3. The warranty will stipulate that all products used in this installation meet the prescribed mechanical and transmission specifications for such products as described in ANSI/TIA/EIA-568.3-D. Quality and workmanship evaluation shall be solely by the Owner/Designer and designated representatives.

1.4 REGULATORY REQUIREMENTS

- A. Standards: All work shall be performed in accordance with the latest revisions of the following standards and codes:
1. Latest Local Codes and Amendments
 2. National Electrical Code, current version
- B. Other References:
1. ANSI/TIA-568-C.0 – Generic Communications Cabling for Customer Premises...
 2. ANSI/TIA-568-C.1 – Commercial Building Communications Cabling Standard Part 1: General Requirements.
 3. ANSI/TIA 568-C.2 – Balanced Twisted-Pair Telecommunications Cabling and Components Standards
 4. ANSI/TIA 568-C.3 – Optical Fiber Cabling Components Standard
 5. ANSI/TIA-568-C.4, Coaxial Cabling Component Standard
 6. ANSI/TIA-569-C – Commercial Building Standard for Telecommunications Pathways and Spaces.
 7. ANSI/TIA-492.AAAC-B – Detail Specification for 850-nm Laser-Optimized, 50-um Core Diameter/125-um Cladding Diameter Class 1a Graded-index Multimode Optical Fibers (OM3/OM4). Current Edition
 8. ANSI/ICEA S-83-596, Fiber Optic Premises Distribution Cable.
 9. ANSI/TIA/EIA-598, Color Coding of Optical Fiber Cables
 10. ANSI/ICEA S-87-640, Fiber Optic Outside Plant Distribution Cable.
 11. ANSI/TIA/EIA-758: Customer-Owned Outside Plant Telecommunications Cabling Standard.
 12. ANSI/TIA/EIA-526-7, Optical Power Loss Measurements of Installed Single mode Fiber Plant: OFSTP-7.
 13. ANSI/TIA/EIA-526-14-A, Optical Power Loss Measurements of Installed Multimode Fiber Plant: OFSTP-14A
 14. ANSI/TIA/EIA-TSB-125, Guidelines for Maintaining Optical Fiber Polarity Through Reverse-Pair Positioning
 15. ANSI/TIA/EIA-TSB-140, Additional Guidelines for Field Testing Length, Loss, and Polarity of Optical Fiber Cabling Systems.
 16. ANSI/TIA-606-B – Administration Standard for the Commercial Telecommunications Infrastructure

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17. TIA/EIA-607-B - 2011 - Commercial Building Grounding and Bonding Requirements for Telecommunications
18. Institute of Electrical and Electronic Engineers (IEEE 802.xLAN)
19. TIA/EIA 942 Data Center Standards
20. Current BICSI Telecommunications Distribution Methods Manual
21. NFPA 70 – National Electrical Code (NEC).
22. BICSI – TDMM, Building Industries Consulting Services International, Telecommunications Distribution Methods Manual (TDMM).

- C. Governing Codes and Conflicts: If the requirements of these specifications or the Project Drawings exceed those of the governing codes and regulations, then the requirements of these specifications and the Drawings shall govern. However, nothing in the Drawings or Specifications shall be construed to permit work not conforming to all governing codes, regulations, and manufacturer installation requirements.

1.5 ABBREVIATIONS

- A. The following abbreviations are used in this document:
- | | |
|------|---|
| IDF | Intermediate Distribution Frame |
| MDF | Main Distribution Frame |
| UTP | Unshielded Twisted Pair |
| SCS | Structured Cabling System |
| RCDD | Registered Communications Distribution Designer |

1.6 SUBMITTALS

- A. Project Initiation: Within fourteen (14) days of Notice to Proceed, the data network system installer shall furnish the following in a single consolidated submittal:
1. Permits: The Contractor shall obtain all required permits and provide copies to the Owner / Architect / Engineer.
 2. Product Literature: Complete manufacturer's product literature for all cable, patch panels, cross-connect blocks, cable supports, cable labels, outlet devices, and other products to be used in the installation. In addition, whenever substitutions for recommended products are made, samples (when requested by the Owner / Designer) and the manufacturer's supporting documentation demonstrating compatibility with other related products shall be included. The submittal shall have some type of distinguishing marker or pointer to indicate what specific product is to be provided.
 3. Construction Schedule: A time-scaled Construction Schedule, using PERT/CPM, indicating general project deadlines and specific dates relating to the installation of the cable distribution system.
 4. Testing: Proposed Contractor UTP cable test result forms, fiber optic cable test result forms and a list of instrumentation to be used for systems testing.
 5. Specification Compliance: A letter shall be provided stating, by section and subsection, that the SCS installer complies with the entire specification section. If the installer intends to deviate from any portion of the specifications, a detailed explanation of reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter. No deviations shall be acceptable until they have been approved by the Owner.
 6. Each Submittal must have a detailed parts list with quantities.

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7. Certifications: The contractor shall submit all certifications for approved products and the certifications must contain dates which are valid from the date of proposal and not expire any sooner than 12 months after substantial completion of the project.
 - a. BICSI RCDD Certification: This certification must be held by an on-staff, full-time employee of the SCS installer. The holder must be staffed out of the office that is located within 75 miles of the project.
 - b. Certifications must be obtained by the SCS installer's office that is located within 75 miles of the project and shall be a company certification, not an individual certification.
 - c. Certifications must be held by at least 25% of the, on-site, staff and be made available at the site if requested by the owner, architect, and/or project's technology consultant.
 - d. Fiber Optic Technician Certification: This certification must be held by the on-staff/on-site individual that is supervising the fiber optic installation and performing the fiber optic terminations and testing.
- B. Shop Drawings: Submit the following items, for Owner review and approval, within twenty-eight(28) days of notice to proceed:
 1. Proposed circuit routing and circuit grouping plan prepared by a BICSI certified RCDD (Registered Communications Distribution Designer). The RCDD certification must be current. Identifiable, separate routing shall be shown for both the station cabling and the MDF-to-IDF tie cabling.
 2. In addition to the cable routing, the submitted drawings shall indicate the following, even if the following is expected to be provided by the project's electrical or general contractor:
 - a. Location of wall penetrations (all penetrations shall be sleeved and contain protective bushings at both ends)
 - b. Location of sleeved wall pass-thru
 - c. Size of sleeve at each location installed
 - d. Quantity of cable passing through each sleeve
 - e. Location of drops in each room (quantity or labeling of drops are not required in the submittal plans. Labeling shall be provided in the closeout plans and quantities shall be as per the contract documents, addendums, and issued changes. Each drop shall be labeled for the type of outlet that it is)
 - f. Conduit routing, size, quantity, and stub-up locations for all floor mounted outlets.
 3. Drawing Compliance: A letter shall be provided stating that the SCS installer complies with the entire project drawing, including all general, keyed, and notes to contractor. If the installer intends to deviate from any portion of the specifications, a detailed explanation of reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter. No deviations shall be acceptable until they have been approved by the Owner.
 4. All subcontractors shall provide submittals to general contractor for normal distribution to Architects, Engineers and the Owner's project managers.
- C. At Substantial Completion: Provide drawings, to the Owner, to reflect installed cabling with correct labeling and cable routing.
- D. Close-out Procedures: Two (2) copies of the following documents shall be delivered to the building owner's representative at the time of system acceptance. Close out technology documents shall be separated from all other trade's documents. The close out finals shall include:

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1. Inspection and Test Reports: During the course of the Project, the Contractor shall maintain an adequate inspection system to ensure that the materials supplied, and the work performed, conform to contract requirements. The Contractor shall provide written documentation that indicates that materials acceptance testing was conducted as specified. The Contractor shall also provide documentation, which indicates that all cable termination testing was completed and that all irregularities were corrected prior to job completion.
2. Provide complete test reports for all cabling and devices that comprise system as outlined in this document.
3. Include the Name, address and telephone of the authorized factory representative with a 24-hour emergency service number.
4. The manual shall also include Manufacturer's data sheets and installation manuals/instructions for all equipment installed a list of recommended spare parts.
5. Generic or typical owner's instruction and operation manual shall not be acceptable to fulfill this requirement.
6. An up-to-date record ("as-built") set of approved shop drawing prints that have been revised to show each and every change made to the structure cabling system from the original approved shop drawings. Drawings shall consist of a scaled plan of each building showing the placement of each individual item of the technical cabling system equipment as well as raceway size and routing, junction boxes, and conductor size, quantity, and color in each raceway.
7. As-built Drawings shall include cable pathways, camera locations with correct labeling and MDF/IDF locations. A copy of the As-Built drawings reflecting the final locations of all cabling shall be given to the designated Owner's representative. The as-built drawings shall be prepared using AutoCAD 2012 or later. Provide the Owner with electronic versions of the as-builts on CD media.
8. All drawings must reflect final graphic numbering, point to point wiring, device address and programmed characteristics as verified in the presence of the engineer and/or the end user unless device addressing is electronically generated, and automatically graphically self-documented by the system.
9. A copy of the manufacturer's warranty on the installed system.
10. Any keys to cabinets and/or equipment and special maintenance tools required to repair, maintain, or service the system.
11. Operating and Maintenance Instructions for all devices within the system. These instructions shall reflect any changes made during the course of construction, and shall be provided to the Owner, for their use, in a three-ring binder labeled with the project name and description. (4 copies)
12. Upon completion of the work and at a time designated by the Architect or owner, provide formal training sessions for the Owner's operating personnel to include location, operation, and maintenance of all included systems and equipment. Minimum amount of training time shall be at least 4 hours.
13. One (1) 30" x 42" laminated floor plan sheets illustrating technology drops and cable designation with final graphic numbering. Contractor shall provide one complete floor plan sheet for each telecommunications room (MDF or IDF)

PART 2 - PRODUCTS

2.1 GENERAL

- A. Installation: The cabling shall be installed per requirements of the manufacturer and the Project Documents utilizing materials meeting all applicable TIA/EIA standards. The Contractor is responsible for providing all incidental and/or miscellaneous hardware not explicitly specified below as required for a complete and operational system. Cabling system shall be plenum rated Panduit Category 6 solution.

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- B. Materials: Materials shall be as listed or shall be approved equivalent products of other manufacturers meeting the intent and quality level of the TIA/EIA specifications.
- C. Testing: All installed cabling shall be tested 100% good after installation by the Contractor. All final test results shall be delivered to owner at completion of project. Refer to closeout requirements.
- D. Ratings: All products shall be new and brought to the job site in the original manufacturer's packaging. Electrical components (including innerduct) shall bear the Underwriter's Laboratories label. All communications cable shall bear flammability testing ratings as follows:
 - CM Communications Cable
 - CMP Plenum Rated Communications Cable
 - CMR Riser-Rated Communications Cable
- E. Initial Cable Inspection: The Contractor shall inspect all cable prior to installation to verify that it is identified properly on the reel identification label, that it is of the proper gauge, containing the correct number of pairs, etc. Note any buckling of the jacket that would indicate possible problems. Damaged cable or any other components failing to meet specifications shall not be used in the installation.
- F. Cable Lubricants:
 - 1. Lubricants specifically designed for installing communications cable may be used to reduce pulling tension as necessary when pulling cable into conduit.
 - 2. Approved Products
 - a. Twisted-pair cable: Dyna-Blue
 - b. American Polywater
- G. Fire Wall Sealant:
 - 1. Any penetration through firewalls (including those in sleeves) will be resealed with an Underwriter Laboratories (UL) approved sealant.
 - 2. Approved Products
 - a. 3M or
 - b. Pre-approved equal

2.2 DATA CLOSET (MDF/IDF) HARDWARE

- A. Equipment Cabinets/Cabinets: Provide and install equipment cabinets and/or cabinets in locations indicated on the attached drawings for the following areas.
 - 1. For all MDF/IDF locations:

Contractor shall provide and install a new floor mounted cabinet/rack system or a wall mounted cabinet where indicated on plans. Refer to floor plan and enlarged MDF/IDF room layouts for number of cabinets/racks to provide at each location. If an enlarged detail is not available, the contractor shall provide the required number of racks to accommodate 100% of all termination components and an equal amount of owner equipment; as well as (1) spare rack. If an MDF/IDF is located in shared space, the contractor shall provide a floor supported, wall mounted cabinet system with all required doors and side panels to secure the equipment and termination components.

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- B. Distribution Cabinet/Cabinet Grounding: All Cabinets and/or Cabinets shall be grounded using stranded #6 AWG insulated copper conductor. Connect to service entrance grounding electrode. Provide all required bonding materials and hardware and bond to building grounding electrode subsystem at building electrical service entrance.
- C. Fiber Optic Patch Panels:
 - 1. The enclosures used shall provide termination panels for the specified type of connectors and be of sufficient size and capacity to terminate 110% of the fiber count of the inside of outside fiber optic cables. Patch panels must be 19" cabinet mountable. Provide all termination accessories, fiber patch cords, enclosures and test for a complete fiber optic distribution system.
 - 2. Provide closet connector housing panels, size for 110% of total fiber count to be terminated.
 - 3. ALL fiber strands must be terminated in fiber housing.
- D. Patch Panels:
 - 1. All patch cables shall be modular type patch panels to allow individual jacks to be inserted. All patch panels shall be fully populated with Jacks. Provide dust caps for all unused jacks. Furnish units that adhere to the performance requirements TIA/EIA-568A standards.
 - 2. Provide cable support bars at the back of all patch panels to provide additional support at rear of panels. Provide one (1) support bar for each row of 24-ports. Support bars will not be required if the closet design consist of rear horizontal cable management above and below each patch panel.
- E. Rack Electrical:
 - 1. A power strip shall be installed vertical at the back of each data relay rack.
 - 2. Project electrical contractor to provide and install one electrical receptacle for each UPS installed on the entire project. Coordinate receptacle type and location with the installed product requirements and the technology consultant prior to installation.
- F. Cable Management Panels:
 - 1. Provide cable management panels as required for vertical cable management on ends and in between all racks on entire project.
 - 2. Provide Velcro straps for cable dressing in MDF/IDF rooms.
- G. MDF/IDF Patch Cables:
 - 1. Cabling Contractor shall provide owner with one (1) patch cable for each data drop on entire project. These cables will provide connectivity from the front of the network patch panels to the network equipment. The patch cables are to be terminated properly with RJ-45 connections on each end with the proper pin-out assignments per project configuration.
 - 2. All patch cables shall be factory terminated. NO EXCEPTIONS.

2.3 CABLE ROUTING/PATHWAY

- A. Cable Tray:
 - 1. Metal cable tray shall be provided to affix to the top of all floor mount cabinets. Cable tray shall be used to brace cabinets to walls and to route cable from walls to cabinets in communication closets.
 - 2. Contractor to provide and install all applicable installation accessories.

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- B. Cable Support System:
 - 1. All low voltage cabling shall be installed and supported using an approved cable support system installed at 48" intervals unless installed in conduit. Do not exceed manufacturer's recommendation for the quantity of cables supported in an individual support.
 - 2. Cable supports shall not connect to any ceiling grid wire or on any support attached to the ceiling grid.
 - 3. Cable supports shall not exceed a serviceable height of more than 5', but no closer than 2', above the finished ceiling.
 - 4. Cable supports can be attached to vertical walls or the building's structure.
 - 5. If attached to the building's structure, 3/8" threaded rod shall be utilized to extend down within the serviceable heights mentioned above. Grid wire hangers will not be accepted.
- C. All cable bundles shall be grouped together using plenum rated Velcro for the entire run above and below the ceilings.
- D. Conduit Bushings shall be installed prior to the installation of any cable. If cable is found to be installed without the bushing the cable will have to be removed and re-installed. No cut bushings will be accepted. If cable damage occurs during any portion of the installation, the cable will be removed and replaced at no cost to the project. This item will be strictly enforced and adhered too.
- E. The projects electrical contractor shall provide and install all metallic conduit and backboxes indicated to be installed on the drawings. It is the SCS installer's responsibility to coordinate all conduit requirements with the electrical contractor to ensure that all conduit sizes and locations are correctly installed. If box locations and conduit sizes are found to vary from the project documents after installation the SCS installer will bare all financial responsibility to ensure these items are installed correctly. The RCDD for the SCS will be responsible for ensuring conduit sizes are sufficient for cable count while maintaining a 40% fill ratio. If there is not electrical contractor on the project, the SCS Installer shall bear responsibility for the provision and installation of all required raceways.

2.4 STATION WIRING

- A Wire: The data and voice wire provided for all outlets shall be four-pair, solid copper conductor, meeting the intent and quality level of the TIA/EIA-568 Commercial Building Wiring Standard.
- B. Testing: The four-pair UTP cable must be UL Performance Level tested. Each 1000-foot spool must be individually tested with test results affixed to the spool. All cable must be provided on new 1000-foot spools. No shorts will be allowed.
- C. Rating: Cable installed in conduit shall be non-plenum rated. Cable not installed in conduit shall be plenum rated if installed in plenum ceiling space, non-plenum rated otherwise.
- D. All cable shall be routed to the center of the room in which it is serving and then route to the outlet location that it is intended for. Provide a 5' service loop in the center of the room and 5' service loop at each workstation outlet properly supported above ceiling. All workstation service loops shall be made in figure eight configurations, no exceptions.
- E. Provide minimum of 10' service loop at all headend locations properly supported above ceiling.

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- F. Provide indoor/outdoor, plenum rated category cable at any outdoor data outlet or data outlets served by cabling that travels through subsurface conduit. This applies to station or horizontal cable runs only.

2.5 STATION HARDWARE

- A. Information Outlet / Jack Modules:
1. Shall be high quality 8p/8c modular jacks with circuit board construction and IDC style or 110-style wire, T568B terminations. Jacks shall meet EIA/TIA TSB40 recommendations for connecting hardware
 2. Shall be standard 8-position, RJ-45 Style, FCC compliant
 3. Shall be designed for 4-pair, 100 Ohm balanced UTP Cable
 4. Shall terminate 26-22 AWG solid or stranded conductors
 5. Shall accept FCC compliant 6 position plugs.
 6. Shall have attached wiring instruction labels to permit either T568A or T568B wiring configurations.
 8. Shall meet or exceed transmission requirements for connecting hardware, as specified in ANSI/TIA/EIA-568-C2, Transmission Performance Specifications for 4-Pair 100 Ohm.
 9. Shall be UL Listed and CSA certified.
 10. Each jack shall have category rating identified on the front face.
- B. Faceplates:
1. Faceplates shall be a minimum of 4-port. 1. Standard faceplates shall be a minimum of 4-port.
 2. Wall mounted telephone faceplates shall be 1-port.
 3. All faceplates shall be single gang.
 4. All blank inserts color shall be coordinated prior to procurement.
- C. Outlet Patch Cables: Cabling Contractor shall provide owner with patch cable for each data drop on entire project. Each cable will be terminated properly with RJ45 connections on each end with appropriate pin-out assignments per project configuration.
1. Cabling Contractor shall provide owner with patch cable for each data drop on entire project. Each cable will be terminated properly with RJ45 connections on each end with appropriate pin-out assignments per project configuration.
 2. Patch cords shall be stranded copper, matching the category of the installed cable.
 3. All patch cables shall be factory terminated. No exceptions

2.6 FIBER OPTIC PRODUCTS

- A. Multimode: Multi mode fibers, each with a color-coded PVC tight buffer shall be 50/125.

PART 3 - EXECUTION

3.1 GENERAL

- A. Fire Wall Penetrations: The contractor shall avoid penetration of fire-rated walls and floors wherever possible. Where penetrations are necessary, they shall be sleeved with metallic conduit and resealed with an Underwriter Laboratories (UL) approved sealant. Contractor shall also seal all floor, ceiling and wall penetrations in fire or smoke barriers and in the wiring closet.

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- B. Allowable Cable Bend Radius and Pull Tension: In general, communications cable cannot tolerate sharp bends or excessive pull tension during installation. Refer to the cable manufacturers allowable bend radius and pull tension data for the maximum allowable limits.
- C. Cable Lubricants: After installation, exposed cable and other surfaces must be cleaned free of lubricant residue.
- D. Pull Strings: Provide pull strings in all new conduits, including all conduits with cable installed as part of this contract. Pull test is not to exceed 200 pounds. Data and video cables can be pulled together with pull strings.
- E. Conduit Fill shall not exceed 40%.
- F. Damage:
 - 1. The Contractor shall replace or rework cables showing evidence of improper handling including stretches, kinks, short radius bends, over-tightened bindings, loosely twisted and over-twisted pairs at terminals and cable sheath removed too far (over 1-1/2 inches).
 - 2. The Contractor shall replace any damaged ceiling tiles that are broken during cable installation.
- G. Clean Up: All clean up activity related to work performed will be the responsibility of the Contractor and must be completed daily before leaving the facility.
- H. Conduit and Back Boxes:
 - 1. The Contractor shall ensure that the appropriate back boxes and conduits, for the project, are provided as required.
 - 2. One (1) 1" conduit will be required each outlet that serves one to a maximum six (6) category 6 or a maximum of four (4) category 6A cables. Provide additional conduit for cable counts that exceed this number.
 - 3. One (1) double gang deep box will be required for each technology outlet. All boxes except Presentation outlets will be required to have a single gang reducer ring.

3.2 EQUIPMENT CABINET CONFIGURATION

- A. Equipment Cabinets: Equipment racks shall be assembled and mounted in locations shown on the Drawings and as detailed. Each rack shall be securely mounted to the floor and braced to the wall with cable tray in accordance with the manufacturer's instructions and recommendations. Racks shall be mounted such that the side rails are plumb with vertical cable management panels. Racks to be located such that future expansion can occur without relocating existing racks. Racks shall be grounded in accordance with NEC requirements.
- B. Wire Management Components: Horizontal cable management panels shall be installed directly above and below each patch panel. Vertical cable management panels shall be installed on each side of the cabinet.
- C. Cable Placement: Cable installation in the Wiring Closet must conform to the Project Drawings. All cabling shall be routed so as to avoid interference with any other service or system, operation, or maintenance location. Avoid crossing area horizontally just above or below any riser conduit. Lay and dress cables to allow other cables to enter the conduit/riser without difficulty at a later time by maintaining a working distance from these openings.

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- D. Cable Routing: Cable shall be routed as close as possible to the ceiling, floor or corners to ensure that adequate wall or backboard space is available for current and future equipment. All cable runs within the Wiring Closet shall be horizontal or vertical within the constraints of minimum cable bending radii. Minimum bend radius shall be observed. Cables shall not be tie-wrapped to electrical conduit or other equipment.
- E. Installation: All incoming cables shall be routed on the cable tray and neatly dressed down to the patch panels. Cable bundles shall not exceed more than 48 cables to patch panel.
- F. Hardware: Provide cabinet and jack panel hardware as required for all data station wiring.

3.3 STATION WIRING INSTALLATION

- A. General:
 - 1. Cabling between wiring closet and workstation locations shall be made as individual home runs. No intermediate punch down blocks or splices may be installed or utilized between the wiring closet and the communications outlet at the workstation location.
 - 2. All cable must be handled with care during installation so as not to change performance specifications. Factory twists of each individual pair must be maintained up to the connection points at both ends of the cable. There shall never be more than one and one-half inches of unsheathed UTP cable at either the wiring closet or the workstation termination locations.
 - 3. All cable shall be routed to the center of the room in which it serves before routing to the outlet location and a 5' service loop shall be provide. An addition 5' service loop shall be provided above ceiling at the outlet location. All service loops shall be figure 8 loops.
- B. Exposed Cable:
 - 1. All cabling shall be installed inside walls or ceiling spaces whenever possible. Exposed cables and/or cables routing through mechanical rooms, electrical rooms, or restrooms shall be installed inside conduits, unless noted otherwise on the project drawings.
 - 2. Additional exposed cable runs will require Owner approval and will only be allowed when no other options exist.
 - 3. All cable routing through conduits and sleeves shall maintain a 40% maximum conduit fill ratio.
- C. Placement: All cabling and associated hardware shall be placed so as to make efficient use of available space. All cabling and associated hardware shall be placed so as not to impair the Owner's efficient use of their full capacity.
- D. Cable Routes:
 - 1. All cabling placed in ceiling areas must be in conduit, or Panduit Corp. J-MOD modular cable support with Velcro cable wrap at each location. Cable supports shall be permanently anchored to building structure or substrates. Provide attachment hardware and anchors designed for the structure to which attached and that are suitably sized to carry the weight of the cables to be supported. Do not route cable through webbing of structural steel. Cabling must be supported in dedicated supports intended to support cabling as described in this section. Contractor shall adhere to the manufacturer's suggested fill ratio for each size cable support installed. No support shall have more than 48 cables.

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2. Attaching cable to pipes or other mechanical items is not permitted. Communications cable shall be rerouted so as to provide a minimum of 18 inches spacing from light fixtures, sources of heat, power feeder conduits and EMI sources. Cabling shall not be attached to ceiling grid support wires. Cable runs shall be routed down the corridors; parallel or perpendicular to building structure. Multiple cables to be bundled together at and between each cable support installed.
3. Contractor shall be responsible for coordinating with other trades on the project so that the installed cable pathway does not interfere with the installation of other systems to insure that mechanical ducts, pipes, conduits, or any other above ceiling systems are not putting unnecessary stress on any portion of the install SCS.
4. All (48) cable bundles shall be routed directly to the MDF or IDF that serves the area. All bundles shall remain separated for the length of the cable run.
 - a. Provide data outlet for irrigation controllers. Coordinate location with landscape consultant.
 - b. Provide data outlet for time clock appliance in main custodian office.
 - c. Provide OSP or flooded/gel filled cat6 cable at any outdoor data outlet or data outlets served by cabling that travels through subsurface conduit. This applies to station or horizontal cable runs only.

3.4 STATION HARDWARE

- A. Flush Mount Jacks shall be mounted in a faceplate with back box.
- B. Placement:
 1. Where possible, the communications outlet shall be located so that its centerline is 18 inches above floor level or 12 inches above permanent bench surfaces. Outlets shall not be mounted on temporary, movable, or removable surfaces, doors, or access hatches.
 2. Outlets shall be installed within 3'-0" of power outlets
- C. RJ-45 Jack Pin Assignments:
 1. Pin connections for data station cable outlets and patch panels shall match EIA/TIA 568 modular jack wiring recommendation T568B.
 2. Pin connections at data jack panels shall match pin connections at outlets (straight through wiring)

3.5 CABLE TESTING REQUIREMENTS

- A. Notification: The Owner and Engineer shall be notified one week prior to any testing so that the testing may be witnessed.
- B. Inspection: Before requesting a final inspection, the Contractor shall perform a series of end-to-end installation performance tests. The Contractor shall submit for approval a proposal describing the test procedures, test result forms and timetable for all copper and fiber optic cabling.
- C. Procedures:
 1. Trained personnel shall perform all testing. Acceptance of the test procedures discussed below is predicated on the Contractor's use of the recommended products and adherence to the inspection requirements and practices set forth. Acceptance of the completed installation will be evaluated in the context of each of these factors.

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2. Acceptance shall be subject to completion of all work, successful post-installation testing which yields 100% PASS rating, and submittal and approval of full documentation as described above. Tests with the "** PASS" (asterisk) will not be acceptable. These circuits must be repaired to meet "PASS".
- D. Errors: When errors are found, the source of each shall be determined, corrected and the cable retested. All defective components shall be replaced and retested. Re-test results must be provided on Owner approved forms and witnessed by Owner.
- E. Twisted Pair Cable Testing:
 1. At a minimum, the Contractor shall test all station drop cable pairs from Data Closet termination patch panels to outlet device RJ45 jacks. Products shall be tested for compliance with ANSI/TIA/EIA 568A and ISO/IES 11801. Test equipment used shall meet TIA/EIA TSB-67, Level II accuracy. Further, the contractor shall have a copy of TSB-67 in their possession and be familiar with its contents.
 2. Each wire/pair shall be tested at both ends for the following:
 - a. Wire map (pin to pin connectivity)
 - b. Length (in feet)
 - c. Attenuation
 - d. Near end cross talk (NEXT)
 - e. Power Sum
 3. Test equipment shall provide an electronic and printed record of these tests.
 4. Test results for each four-pair UTP cable must be submitted with identification to match labels on all patch panel ports and RJ45 jacks and must match as-builts associated with that cable.
- F. Fiber Optic Cable Testing:
 1. Testing device for fiber optic cables shall be a high quality OTDR (Optical Time-Domain Reflectometer) equipped with a printer. The printed data shall show, in addition to any summary information, the complete test t0 and all relevant scale settings. The OTDR must have the capability to take measurements from bare fiber strands as well as SC connector terminations.
 2. All fiber optic cable shall be tested on the reel before installation to ensure that it meets the specifications outlined herein.
 3. After installation the Contractor shall test each fiber strand in accordance the EIA 455-171 Method D procedures (bi-directional testing) at both 850nm and 1300nm for multimode or 1310nm and 1550nm for single mode. A form shall be completed for each cable showing data recorded for each strand including length, total segment (end-to-end) loss (dB) and connector losses (dB) at each end. In addition, the printed data strip for each strand shall be attached to the form. Patch cables shall also be tested.
 4. Acceptable fiber optic connector loss shall not exceed .75dB per mated pair. The Contractor is responsible for obtaining minimum loss in fiber connections and polishing per manufacturer specifications.

3.6 INSPECTION

- A. Conformance to the installation practices covered above is to be verified when completed. In some cases, the Owner/Designer may inspect before acceptance.
 1. Written Test Report:
 - a. Complete test results, including actual values associated with tests.
 - b. Show all certifications for telecommunications wiring systems.

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- c. Include cable maps showing each cable route and keyed to cable labels. Provide owner with complete floor plans identifying outlet location and cable routing drawing in AutoCAD format. Provide electronic copy of drawings to owner in AutoCAD version 2012 or greater.
 - d. Documentation of outlet, cable and cabinet labeling system.
- B. After performing all tests, tabulate results and bind together in format acceptable to Owner. Installer shall provide written certification in the test report that telecommunications cable is properly installed, and test results certify system to all specified standards.

END OF SECTION

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ATTACHMENT 'A'

PROJECT SPECIFIC SCOPE OF WORK AND INSTRUCTIONS

PART 1 – SUMMARY OF WORK

1.1 DESCRIPTION OF WORK

- A. The work includes provision and installation of a complete Cabling System (SCS) in compliance with these specifications and associated drawings, pre-proposal addenda, change orders, change directives and any other documents issued both pre-proposal and during the project.
- B. The SCS Installer shall comply with all conditions of the contract and "Division 1 –General Requirements" as they apply to the SCS Scope of Work. It shall be the responsibility of the SCS Contractor to make themselves familiar with all documents.
- C. It should not be assumed that any portions of a complete and functional system are to be *furnished and/or provided by anyone, other than the SCS installer, unless specifically stated otherwise.*
- D. Division of responsibilities:
OFOI = OWNER FURNISHED AND OWNER INSTALLED
CFCI = CONTRACTOR FURNISHED AND CONTRACTOR INSTALLED
 - 1. CATEGORY 6A CABLING – OFOI
 - 2. MDF/IDF NETWORK EQUIPMENT – OFOI
 - 3. VOIP TELEPHONES – OFOI
 - 4. WIRELESS ACCESS POINTS – OFOI
 - 5. UNINTERRUPTIBLE POWER SUPPLIES – OFOI
 - 6. RACEWAY: CONDUIT, BACK BOXES, SLEEVES, ETC – CFCI

1.2 STRUCTURED CABLING SYSTEM – ADDITIONAL INSTRUCTIONS

- A. Base Proposal:
 - 1. The SCS Installer shall provide and install a Commscope/Systimax End-to-End Structured Cabling System as per these specifications and associated drawings. The Base bid SCS shall consist of:
 - a. Category 6A cable and connectivity to each Video Surveillance Camera, Voice/Data Outlet, Access Controlled Door, and any other locations requiring Local Area Network Connectivity.
 - b. Category 6A cable and connectivity to each Wireless Access Points.
 - c. Each connectivity solution be a complete Channel Solution; consisting of jacks, patch panel, and patch cables.
 - d. Each channel solution shall be color coded to the system in which it serves.
 - 2. The products specified in Attachment 'B' are intended to establish quality, functionality, color, and standards. The following shall be considered preapproved equivalent for each specific portion of the SCS.
 - a. Category 6A copper cable
 - 1) Commscope/Systimax
 - b. Category 6A copper cabling, termination components, and patch cables
 - 1) Commscope/Systimax

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- c. Fiber Optic Cabling and Components:
 - 1) Commscope
- d. Metals (racks, cable managers, and cable tray):
 - 1) Commscope
- e. Manufacturer approval request must be submitted in compliance with the Division 1 instructions and must be received no less than ten (10) business days prior to the posted proposal submission date. No substitutions will be allowed if not submitted per these instructions and approved via official pre-bid addendum.

1.3 COPPER PATCH PANELS

- A. The SCS Installer shall provide and install patch panels as per the instructions below.
 - 1. 24-port patch panels shall only be used for copper tie cables and demarcation extensions.
 - 2. Provide dedicated, 48-port patch panels for each of the following system (reference color code chart for designated insert and patch panel color coding per system):
 - a. LAN and IP Telephones
 - b. Wireless Access Points
 - c. IP Intercom
 - d. Video Surveillance Cameras

1.4 COPPER AND FIBER OPTIC PATCH CABLE LENGTHS

- A. The SCS Installer shall provide copper and fiber optic patch cables as per the instructions below. All patch cables shall be factory terminated and warranted for the copper and fiber solutions specified.
 - 1. MDF/IDF Copper Patch Cables:
 - a. Patch cables shall be category 6A
 - b. Provide one patch cable for each port on the entire project
 - c. Patch cables to be installed by network equipment installer/programmer
 - d. Patch cable lengths
 - 1) 95% shall be 5'
 - 2) 5% shall be 7'
 - 2. Work Area Outlet Copper Patch Cables:
 - a. Patch cables shall be category 6A
 - b. Provide one patch cable for each port on the entire project
 - c. Patch cables to be installed by the owner.
 - d. Patch cable lengths
 - 1) 90% shall be 10'
 - 2) 10% shall be 15'
 - 3. Wireless Access Point Copper Patch Cables:
 - a. Patch cables shall be category 6A
 - b. Provide one patch cable for each port on the entire project
 - c. Patch cables to be installed by wireless system installer.
 - d. Patch cable lengths
 - 1) Interior Ceiling Access Points: 100% shall be 1.5'
 - 2) Interior Wall Mounted Access Points: 100% 1'
 - 3) Exterior Access Points: 100% shall be 15'
 - 4. Video Surveillance Camera Copper Patch Cables:
 - a. Patch cables shall be category 6A
 - b. Provide one patch cable for each port on the entire project
 - c. Patch cables to be installed by the Video Surveillance System Installer.

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- d. Patch cable lengths
 - 1) Interior Ceiling Cameras: 100% shall be 1.5'
 - 2) Interior Wall Mounted Cameras: 100% 3'
 - 3) Exterior Cameras: 100% shall be 15'
- 5. IP Intercom Copper Patch Cables:
 - a. Patch cables shall be category 6A
 - b. Provide one patch cable for each IP Intercom device on the entire project, plus an additional twenty (20) for future use.
 - c. Patch cables to be installed by the IP Intercom System Installer.
 - d. Patch cable lengths
 - 1) Interior Ceiling Speakers: 100% shall be 1.5'
 - 2) Interior Wall Mounted Speakers: 100% 1'
 - 3) Exterior Speakers: 100% shall be 15'
- 6. MDF/IDF Fiber Optic Patch Cables:
 - a. Patch cables shall be OS2 (Single-mode).
 - b. Patch cable shall be duplex, LC to LC
 - c. Provide quantity sufficient for connecting all network equipment plus 20% for growth.
 - d. Patch cables to be installed by network equipment installer/programmer
 - e. Patch cable lengths
 - 1) 100% shall be 3 meters
- 7. Prior to submittal and procurement of fiber optic and copper patch cables, the contractor shall coordinate with the project Consultant and Owner of final requirement for cable lengths on the specific project.

1.5 SYSTEM SPECIFIC COLOR REQUIREMENTS

- A. The following information shall apply to the complete SCS Channel. All cable, patch cables, outlet terminations, and closet terminations shall be provided in the colors designated below:

Item	Description	Horizontal Cable	Insert	Patch Cables
1	Data	Blue	Blue	Blue
2	VoIP Telephone	Blue	Blue	Blue
3	Wireless	Orange	Orange	Orange
4	Camera	Lilac	Lilac	Lilac
5	Access Control	Lilac	Lilac	Lilac
6	Intrusion Detection	Lilac	Lilac	Lilac
7	PA System	White	White	White

1.6 DOCUMENTATION

- A. Labels:
The Contractor will label all outlets using permanent / legible typed or machine engraved labels approved by the Owner (no handwritten labels permitted). Label patch panels in the wiring closet to match those on the corresponding data outlets. The font shall be at least one-eighth inch (1/8") in height, block. All labels shall correspond to as-builts and to final test reports.
- 1. The following nomenclature shall be used when labeling data/voice jacks:
 - a. All cables being served by MDF closet shall begin with 'A' all IDF served cables shall begin with numerical digit 'B' thru 'Z') designating the specific IDF's identification.

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- b. Next identification character shall be a numeric digit identifying the specific patch panel that is serving outlet (1, 2, 3...)
- c. Next identification shall note what # data port on patch panel (01 thru 48).

Example:

Label of an outlet from 23rd port of the third patch panel from top of rack located at IDF-2 shall read: C-3-23

Label of an outlet from the 5th port of the second patch panel from the top of rack located in the MDF shall read: A-2-05

- B. Floor Plan:
A floor plan clearly labeled with all outlet jack numbers shall be included in the as-built plans.
- C. Cables: All cables shall be labeled at both ends. This includes but not limited to horizontal voice and data cabling, copper backbone tie cables, and fiber optic cables.
- D. Fiber Optics: Fiber optic strands shall be labeled at both ends on the fiber distribution panel.
- E. Equipment racks: Equipment racks shall bear at least one indicating label indicated MDF or IDF. If rack is installed in IDF, label shall include IDF #.
- F. Access Points: Label ceiling grid with digital label according to location installed and a bright orange $\frac{3}{4}$ " round dot sticker.

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ATTACHMENT 'B'
MANUFACTURER AND MATERIAL LIST

The Communications Contractor shall perform no portion of the work requiring submittal and review of record drawings, shop drawings, product data, or samples until the respective documentation has been approved by project's Technology Consultant.

MATERIAL LIST

MANUFACTURER	DESCRIPTION	PRODUCT NUMBER	NOTES
Commscope	4-post Equipment Rack (45U) 12-24 Tapped Rails, Black	760082560 RK4P45-36A	Provide as shown on Drawing, minimum of one (1) in the Building's MDF.
Commscope	2-post Equipment Rack (45U) 12-24 Tapped Rails, Black	760082479 RK3-45A	Provide as shown on Drawing, minimum of one (1) in the Building's MDF and each IDF.
Chatsworth	12U-21U wall mount cabinet	11996-7**	CUBE-iT wall-mount cabinet. Replace ** with 24 for tempered glad door for Press box application. Replace ** with 36 for IDF application.
Commscope	Vertical Cable Management Kit, 8in W X 84in H Single Sided, Black	760244816	Provide and install between each rack and at both ends of all rack systems
Commscope / Systimax	GigaSPEED X10D® XL® M4800 1U Modular Panel, 48 port, for SYSTIMAX Category 6A and 6 Jacks	760105429 M4800-1U-GS	Provide in quantities as required to terminate 100% of all distribution structured cabling, plus 25% for future growth. Reference project drawings. Voice/Data, Security, and WLAN shall have dedicated panels per system.
Commscope / Systimax	GigaSPEED X10D® XL® M2400 1U Modular Panel, 24 port, for SYSTIMAX Category 6A and 6 Jacks	760118323 M2400-1U-GS	Provide in quantities as required to terminate 100% of all distribution structured cabling, plus 25% for future growth. Reference project drawings. Voice/Data, Security, and WLAN shall have dedicated panels per system.
Commscope	Copper Ground Buss Bar, 1/4 in x 4 in x 12 in	UGBKIT-0412	Provide one (1) in each MDF and IDF on the entire project
Commscope / Systimax	High Density 1U modular cassette sliding Panel, accepts (4) G2 modules or MPO panels, providing up to 48 duplex LC ports, or up to 32 MPO ports	760209940 HD-1U	Provide as per the project drawings. Or as required, to accommodate all fiber optics in the IDFs, if not shown on drawings
Commscope / Systimax	High Density 2U modular cassette sliding Panel, accepts (8) G2 modules or MPO panels, providing up to 96 duplex LC ports or up to 64 MPO ports	760209957 HD-2U	Provide as per the project drawings. Or as required, to accommodate all fiber optics in the MDF/IDFs, if not shown on drawings

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MANUFACTURER	DESCRIPTION	PRODUCT NUMBER	NOTES
Commscope / Systimax	High Density 4U modular cassette sliding Panel, accepts (16) G2 modules or MPO panels, providing up to 192 duplex LC ports or up to 128 MPO ports	760209965 HD-4U	Provide as per the project drawings. Or as required, to accommodate all fiber optics in the MDF/IDFs, if not shown on drawings
CommScope	Rear cable management, rack mountable	360-RCM-RM (760104737)	
CommScope	Rear cable manager bar, 19in, 5in deep	NETCONNECT (557548-1)	
Commscope / Systimax	360 Distribution Adapter Pack, Singlemode, 12 LC with internal shutters	760109389 360DP-12LC-SM	Provide as required to accommodate 110% of all fiber terminated in each MDF/IDF
Commscope / Systimax	360 Distribution Adapter Pack, Singlemode, 24 LC with internal shutters	760115915 360DP-24LC-SM	Provide as required to accommodate 110% of all fiber terminated in each MDF/IDF
Commscope / Systimax	Category 5e PowerSUM 1100 U/UTP Patch Pane, 24-port	760182907 1100-U-PS-24	Provide in quantities as required to terminate 100% of all copper backbone cable. Reference project drawings.
Commscope / Systimax	GigaSPEED X10D® 360GS10E Solid Cordage Modular Patch Cord	CPCSSX2-0xFyyy	x' to be replaced with alpha or numeric character depicting the color of the patch cable. 'yyy' to be replaced with a numeric value depicting the patch cable length, in feet. Colors shall comply with designated color of the system each cable is provided for. Length to comply as stated in these specifications and coordinated with the Owner's Technology department
Commscope / Systimax	CommScope® Category 6A U/UTP Cord, Plenum , RJ45 to Ceiling connector, 1.5 ft, WHITE	CCA-CAT6A- PLENUM-WHITE- N018	Provide for all above ceiling terminations (IP Intercom Speakers, Wireless Access Points, Video Surveillance Cameras, etc.)
Commscope	10 ft. x 12 in Ladder Rack Straight Section, Black	760085647 CR-SLR-10L12W	Provide as shown on drawings. Tray shall route to and between all racks, in each MDF/IDF, on the entire project.
Commscope	Ladder Rack, 90° radius, Horizontal E-Bend Section, 12", Black	760085530 CR90FCB-12W	
Commscope	Ladder Rack Inside Curved Section, 12", Black	760085688 CR90ICB-12W	

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MANUFACTURER	DESCRIPTION	PRODUCT NUMBER	NOTES
Commscope	Ladder Rack Outside Curved Section, 12", Black	760086082 CR90OCB-12W	
Commscope	Rack-to-Runway Mounting Kit, black in color	760084053 CRR2RRMK	Provide one (1) at the top of each rack and/or cabinet on the entire project.
Commscope	Ladder Rack wall angle support kit, 12", black	760084145 CR6-12WSK	Provide one (1) at each location where the ladder tray system terminates at a wall
Commscope	Ladder Tray Triangle Support Bracket, 12", Black	760084095 CRTWSBK-12W	Provide every 5' of horizontal ladder tray section routing along the communication room walls.
Commscope	Vertical Wall Bracket	760084137 CRVWBK	Provide one kit every 5' of vertical wall ladder rack, minimum of two kits at top and bottom. Contractor to provide vertical wall cable tray section at locations where the service entrance and backbone thru-floor sleeves are located
Commscope	Ladder Rack protective end cap kit (2 caps), black	760084012 CRPECK	Provide one kit at each exposed end of ladder rack
Commscope	Ladder Tray, junction splice kit, black	760084046 CRTJSK	
Commscope	Ladder Rack, butt splice kit, black	760083899 CRBSK	
Commscope	Ladder Tray Radius Drop Kit, 12", Black	760083956 CRDK-12W	Provide one (1) at each location where cable drops to the rack associated rack.
Commscope	Ladder Rack Retaining Post Kit	760083980 CRRP-8H	Provide one (1) set at all ladder rack junctions and horizontal bends to prevent cable from dropping off thru ladder rack system.
Commscope / Systimax	GigaSPEED X10D® 2091B ETL Verified Category 6A U/UTP Cable, 4 pair count, 1000 ft length, WE TOTE® box	2091B ** 4/23 W1000	** to be replaced with numeric character depicting the color of the cable. Colors shall comply with designated color of the system each cable is provided for. **=Blue for voice/data **=Purple for security cameras, door access **=Orange for wireless **=White for intercom
Commscope / Systimax	GigaSPEED X10D® MGS600 Series Information Outlet	MGS600-yyy	yyy' to be replaced with numeric character depicting the color of the Information Outlet (IO). Colors shall comply with designated color of the system each IO is provided for. Yyy=262 for white for intercom Yyy=318 for blue for data

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MANUFACTURER	DESCRIPTION	PRODUCT NUMBER	NOTES
			yyy=361 for violet for cameras, access control yyy=112 for orange for wireless
Commscope / Systimax	Single Gang, Stainless Steel, M-Series Faceplate	M1*SP	* to be replaced with a numeric character that depicts the port quantity of the faceplate. All faceplates shall be a minimum of 4-ports, with the exception of specialty outlets such as Wall Phones, Wireless Access Points, Video Surveillance Cameras, etc.
Commscope	TeraSPEED® Plenum Distribution Cable, interlocking aluminum armored with plenum jacket, 12 fiber	760127803 P-012-DZ-8W-FSUYL	
Commscope	48 Fiber, Single Jacker/Single Armor, Gel-Free, Outdoor stranded Loose Tube Cable, Single Mode	760053280 D-012-LA-8W-F12NS	
Commscope	12 Fiber, Riser Rated, Distribution cable, SM	760086371 R-012-LN-8W-F12BK/25D	
Commscope	Field Installable LC Connector, SM-UPC, Blue, for 250/900u	760117895 SFC-LCF-09-8X	1 per pack
Commscope	Field Installable LC Connector, SM-UPC, Blue, for 250/900u	760117895 SFC-LCF-09-8X-25	25 per pack
Commscope	Singlemode LC to LC, Fiber Patch Cord, 1.6 mm Duplex, Riser	FEWLCLC42-JXM***	*** to be replaced with a numeric value depicting the cable length in meters
Commscope	25-Pair PowerSUM U/UTP 2061F Series Plenum Cables	2010B WH 25/24 R#####	Provide one (1) from the MDF to each IDF on the entire project. ##### to be replaced with numeric characters that depict the cable length
Panduit	LD non-metallic series low voltage, one-piece hinged design, single channel surface raceway includes adhesive backing and is made of impact resistant material with a smooth finish that will not scratch, peel, or corrode. The raceway includes an assortment of bend radius and standard fittings that complement the offering to help route, protect, and conceal low voltage data, voice, and video cabling	Pan-Way LD surface raceway system.	Coordinate with architect and owner on color.

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MANUFACTURER	DESCRIPTION	PRODUCT NUMBER	NOTES
Dynacom	Unwired, 66-Style Termination Block with clear, hinged cover	66M1-50	Provide one (1) for each 25-pair demarcation extension cable
Dynacom	66 wiring block, metal backboard, blue in color	183C*M	* to be replaced with a numeric value depicting the board size. Provide at each demarcation point for the mounting of the 66 wiring blocks. Board size shall consist two (2) mounting brackets per 25-pair cable installed.
Ditek	10GbE, Single Channel, RJ45/RJ45, PoE Surge Protector, STP Category 6/6A	DTK-MRJPOES	Provide one for each copper network cable associated with an exterior device, up to two (2) cables. Bond to TGBB per manufacturer's instructions
Ditek	Rack Mount, 10GbE, 12-Channel, RJ45/RJ45, PoE Surge Protector, STP Category 6/6A	DTK-RM12NETS	Provide one for every four (4) to ten (12) copper network cables associated with an exterior device and originating at the same MDF/IDF. Bond to TGBB per manufacturer's instructions
Ditek	Rack Mount, 10GbE, 24-Channel, RJ45/RJ45, PoE Surge Protector, STP Category 6/6A	DTK-RM24NETS	Provide one for every Thirteen (13) to Twenty-Four (24) copper network cables associated with an exterior device and originating at the same MDF/IDF. Bond to TGBB per manufacturer's instructions
EXTENDED DISTANCE POWERED FIBER FOR WIRELESS AP AND VIDEO SURVEILLANCE CAMERAS			
CommScope	Power Express Distribution shelf with alarm module	PFP-PX-S1	Power Express Class 2 shelf and starter kit, accommodates up to 4 modules of 8 SELV/Class 2 outputs, 1U
CommScope	Power Express Distribution module.	PFP-PX-8M	
CommScope	Power Express Blank Slot Panel	PFP-PX-SF	Provide one (1) for every empty slot.
CommScope	SPS Rectifier Power Distribution Shelf	PFP-SPS-1	
CommScope	1600W SPS Power Rectifier module	PFP-SPS-1600M	
CommScope	SPS Rectifier Controller Display	PFP-SPS-C1	Provide one per SPS Rectifier Power Distribution Shelf
CommScope	SPS Rectifier Blank Slot Panel	PFP-SPS-SF	Provide one (1) for every empty slot.
CommScope	CS340 Category 6 U/UTP filled Cable, outdoor direct burial, black jacket, 4 pair count, 1000 ft (305 m) length, reel	UN884019904/10 CS340 BLK C6 4/24 U/UTP RL 1KFT	
CommScope	OS2, Outdoor, 4-Strand Fiber	PFC-S04012	

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MANUFACTURER	DESCRIPTION	PRODUCT NUMBER	NOTES
Transition Networks	Gigabit SFP Module	TN-GLC-LH-SM.	Provide one (1) for each POE extender.
CommScope	PoE Extender, 2 Port Universal Mount, Outdoor, 60 Watt, 2-Port	PFU-P-C-0-060-02	
Hoffman	22" X "22" back panel	CP2424	
Hoffman	24"x24"x8" NEMA-4 junction box.	CSD24248	
Hoffman	Padlock Handle	CWHPTO	

END OF SECTION

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SECTION 274116.20

AUDIO AND VIDEO DISTRIBUTION SYSTEMS FOR SPECIAL VENUES

PART 1 – GENERAL

1.1 RELATED WORK

- A. The following sections shall associate with this specification as applicable.
 - 1. General Conditions
 - 2. Supplementary Conditions
 - 3. Division 1
 - 4. Division 26 in its entirety.
 - 5. Division 27 in its entirety.
 - 6. Division 28 in its entirety.

1.2 DESCRIPTION

- A. Summary of Work:
 - 1. Provide all equipment specified well as all miscellaneous parts and materials required for the proper, complete, and functional Video and/or Sound Distribution System at the following Venues:
 - a. Storm Shelter / GYM
 - 2. All applicable equipment shall bear the UL label.
 - 3. Governing Codes and Conflicts: If the requirements of these specifications or the Project Drawings exceed those of the governing codes and regulations, then the requirements of these specifications and the Drawings shall govern. However, nothing in the Drawings or Specifications shall be construed to permit work not conforming to all governing codes, regulations, and manufacturer installation requirements.
 - 4. Locate equipment to accommodate millwork, fixtures, marker boards and other room equipment at no additional cost to the owner.
 - 5. Plenum rated cable may be used as an option at the contractor's discretion. Wherever cabling is run exposed, conduit shall be used to cover and protect wiring.
 - 6. These documents are conceptual in nature. It shall be the responsibility of the approved installer to furnish a complete and functional system, including the items shown on the drawings, in the specifications, and items not designated in either. The installer's shop drawings and product data submittals shall represent a complete system and documents accepted do not relieve the installer from being required to provide any materials, equipment, or labor to furnish a complete and functional system as recognized by the Project's Technology Consultant and the Owner.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. The contractor providing and installing the integrated audiovisual systems and associated infrastructure shall be an authorized dealer of the specified projector manufacturer and be capable of providing the manufacturer's maximum available product warranty.

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2. All individuals installing the audio-video system must be employees of the authorized dealer and at least 75% of the installing staff shall have undergone a training class given by the manufacturer. Current certification indicating the successful completion of the training course shall be available upon request at the project and submitted in the contractor's product submittals.
 3. The proposing contractor and the installing contractor must be the same company. No subcontractor to the proposing audio-video contractor will be allowed for any portion of the audio-video scope of work.
 4. The System Installer shall meet all applicable regulations of the State and Department of Labor insofar as they apply to this type of system. The bidder shall be a firm normally employed in the audio-video industry and shall provide a reference list of ten (10) projects of equivalent size or larger and contact names confirming successful completion of projection system installations.
 5. The bidder shall have an authorized service center, within 75-miles of the project's location, for the brand of equipment that is submitted for bid. The Owner, Architect, and Consultant reserves the right to perform an onsite inspection as they deem necessary.
 6. The bidder must produce a letter from the manufacturer guaranteeing the delivery of all the equipment outlined in the specification herein.
 7. The bidder shall have a full-time local service personnel capable of servicing the projector system described herein.
- B. Pre-Construction Meeting:
1. The successful Contractor shall attend a mandatory pre-construction meeting with individuals deemed necessary by the Owner's representative prior to the start of the work.
 2. The contractor shall provide a mockup of the complete integrated audiovisual system solution for each of the typical spaces below before implanting the installation in multiple like rooms. Mockup shall include all products listed in part 2 of this specification. Coordinate with G.C., Architect, Consultant, and Owner for scheduling and location of mockup.
 3. All proposing contractors must have ability to demonstrate a/v system being proposed and provide owner with completely installed system to evaluate performance and operation.
- C. Acceptance: The Owner's representative reserves the right to reject all or a portion of the work performed, either on technical or aesthetic grounds.
- D. Warranty:
1. The selected system installer shall be factory authorized service center and shall provide an end-to-end performance warranty of not less than one (1) year. The proposer shall provide current certification documentation. The performance warranty shall be issued by the manufacturer and shall warrant that video projection system projectors have been tested to the district's approval. This end-to-end warranty shall cover the labor associated with removing/reinstalling any associated hardware or equipment as well as the replacement of all defective equipment or hardware.
 2. The bidder shall also submit with the materials mentioned in section 1.5 submittals of this specification a written explanation outlining the terms and conditions of product warranty of all parts and service of the integrated a/v solutions.

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1.4 REGULATORY REQUIREMENTS

- A. Standards: All work shall be performed in accordance with the latest revisions of the following standards and codes:
 - 1. Latest Local Codes and Amendments
 - 2. National Electrical Code, current version
- B. Other References:
 - 1. TIA/EIA-568-A Commercial Building Telecommunications Wiring Standard
 - 2. EIA/TIA-569 Commercial Building Standard for Telecommunication Pathways and Spaces.
 - 3. TIA/EIA-606 The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.
 - 4. TIA/EIA-607 Commercial Building Grounding and Bonding Requirements for Telecommunications.
 - 5. EIA/TIA 455-A Standard Test Procedure for Fiber Optic Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices and Other Fiber Optic Components.
 - 6. TIA/EIA TSB 67 Transmission Performance Specification for Field Testing of Unshielded Twisted-Pair Cabling Systems.
 - 7. TIA/EIA TSB 72 Centralized Optical Fiber Cabling Guidelines
 - 8. ISO/IEC 1180 Generic Cabling Standard
 - 9. EN 50173 Generic Cabling Standards for Customer Premises
 - 10. ANSI/EIA/TIA 526-14 Optical Power Loss Measurements of Installed Multimode Fiber Cable Plan.
- C. Governing Codes and Conflicts: If the requirements of these specifications or the Project Drawings exceed those of the governing codes and regulations, then the requirements of these specifications and the Drawings shall govern. However, nothing in the Drawings or Specifications shall be construed to permit work not conforming to all governing codes and regulations.

1.5 ABBREVIATIONS

- A. The following abbreviations are used in this document:
 - 1. AV-# Audiovisual input station / Presentation Station (Reference drawing legend)
 - CMP Ceiling Mounted Projector LCD or LED Flat panel screen/monitor

1.6 SUBMITTALS

- A. Project Initiation: Within fourteen (14) days of Notice to Proceed, the projection system installer shall furnish the following in a single consolidated submittal:
 - 1. Permits: The Contractor shall obtain all required permits and provide copies to the Owner/Architect/Engineer.
 - 2. Product Literature: Complete manufacturer's product literature for all, speakers, amplifiers, cable, cross-connect blocks, cable supports, cable labels, outlet devices, and other products to be used in the installation. In addition, whenever substitutions for recommended products are made, samples (when requested by the Owner/Designer) and the manufacturer's supporting documentation demonstrating compatibility with other related products shall be included.
 - 3. Construction Schedule: A time-scaled Construction Schedule, using PERT/CPM, indicating general project deadlines and specific dates relating to the installation of the cable distribution system.

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4. Testing: Proposed Contractor test result forms, and a list of instrumentation to be used for systems testing.
 5. The contractor shall provide a letter from the manufacturer stating that the dealer is an authorized service center.
 6. The resume and contact information of the full-time service personnel responsible for the installed projection system.
 7. Specification Compliance: A letter shall be provided stating, by section and subsection, that the installer complies with the ENTIRE specification section. If the installer intends to deviate from any portion of the specifications, a detailed explanation of reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter. No deviations shall be acceptable until they have been accepted by the project's technology consultant.
 8. Certifications: The contractor shall submit all of the following certifications and the certifications must contain dates which are valid from the date of proposal and not expire any sooner than 12 months after substantial completion of the project.
 - a. AMX authorized dealer certification
 - b. Installer training certification
 - 1) Provide specification with line by line acknowledgement of compliance.
- B. Shop Drawings: Submit the following items, for Owner review and approval, within twenty-eight (28) days of notice to proceed:
1. Proposed wiring and connectivity diagram of the proposed projection system including all faceplates and sound reinforcing equipment
 2. In addition to the wiring/connectivity diagram, the submitted drawings shall indicate the following, even if the following is expected to be provided by the project's electrical or general contractor:
 - a. Location of wall penetrations (all penetrations shall be sleeved and contain protective bushings at both ends)
 - b. Location of sleeved wall pass-thru
 - c. Size of sleeve at each location installed
 - d. Quantity of cable passing through each sleeve
 - e. Location of drops in each room (quantity or labeling of drops are not required in the submittal plans. Labeling shall be provided in the closeout plans and quantities shall be as per the contract documents, addendums, and issued changes. Each drop shall be labeled for the type of outlet that it is)
 - f. Conduit routing, size, quantity, and stub-up locations for all floor mounted outlets.
 3. Drawing Compliance: A letter shall be provided stating that the installer complies with the ENTIRE project drawing, including all general, keyed, and notes to contractor. If the installer intends to deviate from any portion of the specifications, a detailed explanation of reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter. NO DEVIATIONS SHALL BE ACCEPTABLE UNTIL THEY HAVE BEEN ACCEPTED BY THE PROJECT'S TECHNOLOGY CONSULTANT.
- C. Project Completion: As a condition for project acceptance, the Contractor shall submit the following for review and approval:
1. Samples: Complete manufacturer's product literature and samples (if requested) for all pre-approved substitutions to the recommended products made during the course of the Project.

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2. Inspection and Test Reports: During the course of the project, the Contractor shall maintain an adequate inspection system to ensure that the materials supplied, and the work performed conform to Contract requirements. The contractor shall provide written documentation that indicates that materials acceptance testing was conducted as specified. The Contractor shall also provide documentation, which indicates that all cable termination testing was completed and that all irregularities were corrected prior to job completion.
3. Operating and Maintenance Instructions: Operating and maintenance instructions for all devices within the system. These instructions shall reflect any changes made during the course of construction and shall be provided to the Owner for their use on disc or USB drive with the project name and description (2 copies).
4. Provide schematic line diagram of system components as deployed in each installation.

PART 2 – PRODUCTS

2.1 GENERAL

All products listed in this section shall be provided and installed by the contractor unless otherwise noted below. The following list is not intended to be a complete list of required equipment or cables as the project is to be Turnkey and may require equipment beyond the depth of this list. It is the contractor's responsibility to ensure that they are providing a complete and functional system with their proposal

- A. Installation: The cabling shall be installed per requirements of the manufacturer and the Project Documents utilizing materials meeting all applicable TIA/EIA standards. The Contractor is responsible for providing all incidental and/or miscellaneous hardware not explicitly specified below as required for a complete and operational system.
- B. Materials: Materials shall be as listed or shall be approved equivalent products of other manufacturers meeting the intent and quality level of the TIA/EIA specifications. All approved equivalent products will be published by addendum ten days prior to proposal for Architect / Engineer to review.
- C. Testing: All installed cabling shall be tested 100% good after installation by the Contractor.
- D. Ratings: All products shall be new and brought to the job site in the original manufacturer's packaging. Electrical components (including innerduct) shall bear the Underwriter's Laboratories label. All communications cable shall bear flammability testing ratings as follows:
 - CM Communications Cable
 - CMP Plenum Rated Communications Cable
 - CMR Riser-Rated Communications Cable
- E. Initial Cable Inspection: The Contractor shall inspect all cable prior to installation to verify that it is identified properly on the reel identification label, that it is of the proper gauge, containing the correct number of pairs, etc. Note any buckling of the jacket that would indicate possible problems. Damaged cable or any other components failing to meet specifications shall not be used in the installation.
- F. Cable Lubricants: Lubricants specifically designed for installing communications cable may be used to reduce pulling tension as necessary when pulling cable into conduit.
 1. Approved Products
 - a. Twisted-pair cable: Dyna-Blue
 - American Polywater

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- G. Fire Wall Sealant: Any penetration through firewalls (including those in sleeves) will be resealed with an Underwriter Laboratories (UL) approved sealant.
1. Approved Products
 - a. 3M or
 - b. Pre-approved equal

2.2 STORM SHELTER / GYMNASIUM – AUDIO DISTRIBUTION

- A. Contractor to provide and install a complete audio distribution system in compliance with the equipment specified in the table below and associated drawings. Installation shall turnkey, including programming, testing, and training.

QTY	MFR	PRODUCT NUMBER	DESCRIPTION
AUDIO DISTRIBUTION			
2	KDM	SP840A	Speaker Array
1	Crown	DCI 4 1250N	4 CH @ 1250 W/CH amplifier with BLU link (for court speakers, 2 speakers per amp channel, north pair, center pair, south pair, 1 spare CH)
1		Mixer	8-channel, 1RU rack mount
1	BSS	BLU-100	12 x 8 audio DSP
1	BSS	BLU-10BLK	3-gang, programmable audio control plate
1	Tascam	CD-400U	CD/Media Player with Bluetooth®/USB/SD/Aux and AM/FM Tuner
1	Octasound	RABX2	Aux/Bluetooth Mixer Interface (provide recessed enclosure with locking door)
WIRELESS MICROPHONE			
4	Shure	QLXD G50	Handheld and Lavalier Combo Wireless Microphone System
1	Shure	UA844+	Antenna Distribution System
2	Shure	UA874	Passive omnidirectional antenna (place antennas on opposites sides of the venue)

2.3 AUDIO AND VIDEO COMPONENTS AND EQUIPMENT - ALL VENUES

- A. Custom Plates
1. Liberty Panel Crafters, Proco, or RCI are approved manufacturers.
 2. Provide custom plates as indicated on the drawings.
- B. Equipment Rack: Provide and install equipment rack at locations designated on the contract drawings. Equipment rack shall consist of the following:
1. Enclosure:
 - a. Atlas Sound 300 Series wall mount rack with 6 spare keys. (1 per venue). Provide size to accommodate all equipment, plus an additional 25% for future growth.
 2. Additional Accessories:
 - a. Middle Atlantic D3 (3) space rack drawer (1 per venue)
 - b. Juice Goose JG 8LED Power Distribution Center with LED Lighting (1 per venue)
 - c. Juice Goose CQ 1520 Sequenced Power Control System (1 per venue); 20A with six rear outlets and three sequenced groups of outlets
 - d. Provide any additional hardware or lacing strips to make a complete installation
 - e. Provide blank panels necessary to enclose rack completely.

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- C. Miscellaneous Equipment
1. Provide the following equipment for each venue, unless noted otherwise.
 - a. (3) Shure PG81 Microphones, per venue
 - b. (3) 25' Microphone cable, per venue
 - c. (3) Black Tripods with Boom Arms
 - d. (1) Lectern Microphone stand, complete with shock-mount
 - e. (1) Atlas TL34-15E Boom Stand, per venue
 - f. (1) Desk Top Push-To-Talk Microphone, Shure 522, per venue
- D. Assistive Listening
1. Provide a remote antenna. Adjust DSP for "hard knee" compression on assisted listening output. Test and use equalization for maximum sound quality.
 - a. Listen LT-800-072-01 – Assisted Listening RF Transmitter
 - b. Listen LA-326 Universal Rack Mounting Kit
 - c. Listen LR-500-072-P1 Advanced Intelligent DSP RF Receiver
 - d. Listen LA-430 Intelligent Ear Phone/Neck Loop Lanyard
 - e. Listen LA-380-01 Intelligent 12-Unit Charging/Carrying Case
 - f. Provide quantities needed to fulfill the quantities stipulated in the Receivers for Assistive Listening Systems Table.

RECEIVERS FOR ASSISTIVE LISTENING SYSTEMS TABLE

Capacity of Seating in Assembly Area	Minimum Number of Required Receivers	Minimum Number of Required Receivers Required to be Hearing-aid Compatible
50 or less	2	2
51 to 200	2, plus 1 per 25 seats over 50 seats	2
201 to 500	2, plus 1 per 25 seats over 50 seats	1 per 4 receivers
501 to 1000	20, plus 1 per 33 seats over 500 seats	1 per 4 receivers
1001 to 2000	35, plus 1 per 50 seats over 1000 seats	1 per 4 receivers
2001 and over	55, plus 1 per 100 seats over 2000 seats	1 per 4 receivers

- E. Programming shall be coordinated with the Owner and Project's Consultant. Programming shall include, but not be limited to the following:
1. AV Control Panel Configuration
 2. Audio routing from any source location through the DSP
 3. Projector and screen control via the Audio / Video Control panel
 4. Device resolution and over/under-scanning settings
 5. Incorporation of any Owner furnished source equipment (maximum of 2)

2.4 CABLE ROUTING/PATHWAY

- A. Cable Support System: All audio-video cabling shall be installed and supported using an approved J-Hook cable support system at 4'-0" intervals unless installed in conduit. Do not exceed manufacture recommendation for the quantity of cables supported in an individual support.
- B. All cable bundles shall be grouped together using plenum rated Velcro for the entire run above and below the ceilings.

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PART 3 – EXECUTION

3.1 GENERAL

- A. Contractor is required to properly mount integrated A/V solutions and connect all ceiling video / audio cables to projector component inputs.
- B. Contractor is required to thoroughly test and verify operation of all A/V inputs and video modes prior to project completion.
- C. Contractor is required to focus and adjust projector to properly project image on viewing surface (screen or multimedia board depending on location).
- D. Contractor shall provide owner with written verification test process and results once all projectors have been installed, tested, and placed in final condition.
- E. Damage: The Contractor shall replace or rework cables showing evidence of improper handling including stretches, kinks, short radius bends, over tightened bindings, loosely twisted and over-twisted pairs at terminals and cable sheath removed too far (over 1-1/2 inches).
- F. The Contractor shall replace any damaged ceiling tiles that are broken during cable installation.
- G. Clean Up: All clean up activity related to work performed will be the responsibility of the Contractor and must be completed daily before leaving the facility.

3.2 DOCUMENTATION

- A. Contractor shall provide owner with detailed serial number listing and associated graphical room number designation equipment was installed. Contractor shall use actual graphical package room numbers not architectural plan numbers from construction set.

3.3 STATION WIRING INSTALLATION

- A. General: All cable must be handled with care during installation so as not to change performance specifications. Factory twists of each individual pair must be maintained up to the connection points at both ends of all category 6 cable. There shall never be more than one and one-quarter inch of unsheathed enhanced Category6 UTP cable at either the wiring USB Transmitter or Receiver.
- B. Exposed Cable: All cabling shall be installed inside walls or ceiling spaces whenever possible. Exposed station cable will only be run where indicated on the Drawings. Additional exposed cable runs will require Owner approval and will only be allowed when no other options exist.
- C. Placement: All cabling and associated hardware shall be placed so as to make efficient use of available space. All cabling and associated hardware shall be placed so as not to impair the Owner's efficient use of their full capacity.

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D. Cable Routes:

1. All cabling placed in ceiling areas must be in conduit, cable tray or an approved J-Hook cable support. Cable supports shall be permanently anchored to building structure or substrates. Provide attachment hardware and anchors designed for the structure to which attached and that are suitably sized to carry the weight of the cables to be supported. Do not route cable through webbing of structural steel. Cabling must be supported in dedicated supports intended to support cabling as described in this section. Contractor shall adhere to the manufacturer's suggested fill ratio for each size cable support installed.
2. Attaching cable to pipes or other mechanical items is not permitted. Communications cable shall be rerouted so as to provide a minimum of 18 inches spacing from light fixtures, sources of heat, power feeder conduits and EMI sources. Cabling shall not be attached to ceiling. Grid support wires. Cable runs shall be routed down the corridors; parallel or perpendicular to building structure. Multiple cables to be bundled together at and between each cable support installed.
3. Contractor shall be responsible for coordinating with other trades on the project so that the installed cable pathway does not interfere with the installation of other systems to insure that mechanical ducts, pipes, conduits, or any other above ceiling systems are not putting unnecessary stress on any portion of the install audio-video cabling.

3.4 STATION HARDWARE

- A. Flush mounted components: all component shall be inserted to a flush mounted faceplate unless designated otherwise.
- B. Placement: Where possible, the AV input outlets shall be located so that its centerline is 18 inches above floor level or 12 inches above permanent bench surfaces. Outlets shall not be mounted on temporary, movable, or removable surfaces, doors, or access hatches. The CMP outlet shall route directly to the rear of the projector and does not require any type of faceplates.

3.5 PROGRAMMING

- A. Programming shall be coordinated with the Owner and Project's Consultant. Programming shall include, but not be limited to the following:
 1. AV Control Panel Configuration
 2. Audio routing from any source location through the DSP
 3. Projector and screen control via the Audio / Video Control panel
 4. Device resolution and over/under-scanning settings
 5. Incorporation of any Owner furnished source equipment (maximum of 3)

3.6 FINAL TESTING REQUIREMENTS

- A. Notification: The Owner and Engineer shall be notified one week prior to any testing so that the testing may be witnessed.
- B. Inspection: Before requesting a final inspection, the Contractor shall perform a series of end-to-end installation performance tests. The Contractor shall submit for approval a proposal describing the test procedures, test result forms and timetable for all copper and fiber optic cabling.

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- C. Procedures: Trained personnel shall perform all testing. Acceptance of the test procedures discussed below is predicated on the Contractor's use of the recommended products and adherence to the inspection requirements and practices set forth. Acceptance of the completed installation will be evaluated in the context of each of these factors. Testing procedures shall consist of, but not be limited to the following:
1. Input locations to be tested utilizing multiple types of source equipment. Equipment to include:
 - a. Personal Computer (laptop)
 - b. Apple iMac
 - c. Apple Mac Mini
 - d. Google Chromebook
 - e. Additional devices may be required at the time of testing
 - f. contractor to provide devices on a single cart, to roll between inputs during testing.
 2. Routing of video, from any source, to each projector and display simultaneously and independently.
 3. Routing of audio, from any source, to each audio channel simultaneously and independently.
 4. Control of the entire system from each installed A/V Control Panel
 5. Additional test requirements may be required at the Owner and/or Consultant's request.

3.7 OWNER TRAINING AND DEMO

- A. A/V integrator shall provide demonstration of all integrated a/v solutions to owner's staff that have any stake with the operation and maintenance of the a/v solutions. Integrator shall produce sign in sheets for record of who was trained and when. Copies of sign in sheets shall be submitted with close out paperwork. Coordinate training dates with owner at project completion.
- B. Integrator shall provide factory training for owner's operations and maintenance personnel for each major component of the systems listed in the A/V solutions outlined in part 2 of these specifications. Training shall be a minimum of 4 hrs. per person. Re-training of staff shall be available, at no cost to the owner, to a maximum of 3 on-site training sessions up to 1 year from the date of project completion.
- C. All training is to be recorded via video recording and a copy of the recorded video shall be provided to the owner upon completion. All video recording equipment, for the recording of training, shall be provided by the integrator.

END OF SECTION

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SECTION 275000

BUILDING INTERCOMMUNICATIONS SYSTEM

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED WORK

- A. The following sections shall associate with this specification as applicable.
 - 1. General Conditions
 - 2. Supplementary Conditions
 - 3. Division 1
 - 4. Division 26 in its entirety.
 - 5. Division 27 in its entirety.
 - 6. Division 28 in its entirety.

1.2 GENERAL REQUIREMENTS

- A. The contractor shall furnish and install all required materials to expand the existing, intercom system as shown on the project drawings. It shall be the responsibility of the installing contractor to design the expanded/renovated areas of the system in accordance with the latest codes and standards.
- B. The contractor shall field verify the manufacturer, model, expansion capabilities, and location of the existing system.
- C. The system expansion shall be provided and installed by the manufacturer's authorized contractor. Certification shall be submitted verifying that the contractor is the manufacturer's authorized contractor. Included shall be certificates of attendance in manufacturer's installation / maintenance training by the contractors directly employed personnel. The communications contracting company shall have been in business for a minimum of 5 years, continuously furnishing the specified manufacturers' product lines and systems.
- D. The system expansion assemblies shall be completely factory built and tested by manufacturers of established reputation, who have and can refer to similar systems which are currently installed and functioning properly. The factory pre-assembled cabinets, consoles, and power supplies shall be UL approved and listed.
- E. The system's expansion shall be guaranteed for a period of one year from the date of acceptance or first beneficial use, whichever is first, against defects in materials, workmanship, design and improper adjustment. Any defects in the system's expansion shall be corrected at no expense to the Owner, provided the system does not show signs of abuse. During the guarantee period any work found not to be in conformance with the plans, specifications and addenda shall be brought into conformity with same at no additional cost to the owner.

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- F. The equipment described herein and furnished per these specifications shall be supplied by one communications contractor. The contractor shall hold the necessary License for this type of work. Equipment shall be manufactured by the same manufacturer of the existing system and all work shall be performed by a certified dealer of the existing manufacturer. Contractor is required to submit current certification from manufacturer with submittals.
- G. Approval request for installation of equipment not as specified herein must be received by the architect not less than ten days prior to bid opening. Proposals must be accompanied by complete technical data as well as a list of at least 10 references for successful Telephone / Intercom / Clock system installations. All potential bidders submitting proposals for substitute system approval must provide a working demonstration system, for the owner's inspection prior to final acceptance, to ensure that the submitted components are equal to the specified in all functional aspects. Demonstrations shall be provided at the owner's chosen location at no cost or inconvenience to the owner's personnel.
- H. Alternative proposals which are approved, for bidding purposes only, will be published by addenda. Proposals not complying with the prior approval requirements and conditions set forth will not be considered.
- I. The contractor shall make available, and maintain a radio dispatched mobile service department capable of furnishing equipment inspection and timely service at the Owner's location.
- J. The contractor shall be prepared to offer a service contract for the maintenance of the system beyond the warranty period.
- K. The contractor shall instruct personnel designated by the owner in the proper use, basic care, and maintenance of the equipment. Such training shall be provided as an integral component of the system.
- L. The contractor shall submit certificates of factory authorization and completion of the manufacturer's telephone installation and maintenance training.
- M. These documents are conceptual in nature. It shall be the responsibility of the approved installer to furnish a complete and functional system, including the items shown on the drawings, in the specifications, and items not designated in either. The installer's shop drawings and product data submittals shall represent a complete system and documents accepted do not relieve the installer from being required to provide any materials, equipment, or labor to furnish a complete and functional system as recognized by the Project's Technology Consultant and the Owner.

1.3 CONTRACTOR QUALIFICATIONS

- A. The installing contractor shall be the authorized representative of the intercom system to sell, install, and service the proposed manufacturer's equipment. The installing contractor shall have represented the intercom manufacturer's product for at least two years.

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- B. The installing contractor shall provide 24 hour, 365 days per year emergency service with factory trained, state licensed service technicians.
- C. The installing contractor must have a permanent office within a 120-mile radius of the project site and be an approved dealer/integrator, of the proposed system, in the nearest major metropolitan area.
- D. The installing contractor shall have been actively engaged in the business of selling, installing, and servicing systems in the surrounding area for at least ten (10) years.
- E. All individuals installing the intercom system must be employees of the certified installer and at least 25% of the installing staff shall have undergone a training class given by the manufacturer. Current certification indicating the successful completion of the training course shall be available upon request at the project and submitted in the contractor's product submittals.
- F. The entity providing pricing to furnish and install the system specified within this specification section and the physical installing entity of this system shall be one in the same. Absolutely no subcontracting on any portion of this system, by the system's proposing entity, will be allowed.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Within fourteen (14) days of Notice to Proceed, the system installer shall furnish the following in a single consolidated submittal:
 - a. Permits: The Contractor shall obtain all required permits and provide copies to the Owner/Architect/Engineer.
 - b. Product Literature: Complete manufacturer's product literature for all cable, termination components, cable supports, cable labels, field devices, and other products to be used in the installation. In addition, whenever substitutions for recommended products are made, samples (when requested by the Owner/Designer) and the manufacturer's supporting documentation demonstrating compatibility with other related products shall be included. The submittal shall have some type of distinguishing marker or pointer to indicated what specific product is to be provided
 - c. Construction Schedule: A time-scaled Construction Schedule, using PERT/CPM, indicating general project deadlines and specific dates relating to the installation of the cable distribution system.
 - d. Testing: Proposed Contractor system test result forms and a list of instrumentation to be used for systems testing.
 - e. Specification Compliance: A letter shall be provided stating, by section and subsection, that the system installer complies with the ENTIRE specification section. If the installer intends to deviate from any portion of the specifications, a detailed explanation of reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter. No deviations shall be acceptable until they have been accepted by the project's technology consultant.

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- f. Certifications: The contractor shall submit all of the following certifications and the certifications must contain dates which are valid from the date of proposal and not expire any sooner than 12 months after substantial completion of the project.
- 1) Manufacturer's Authorized Dealer/Installer Certification: This certification must be held by the proposing/installing contractor and state that the proposing/installing contractor is and authorized dealer/installer of the system specified within the project specifications. The certification must have been obtained by the office that is within a 120-mile radius of the project's location.
 - 2) Installer Certification: This certification must be held by at least 25% of the, on-site, staff and be made available at the site if requested by the owner, architect, and/or project's technology consultant.
 - 3) Licenses: This includes all licenses required by the state in which the work is being performed, the federal government, local authorities having jurisdiction, and any organization in that governs the specific system
- B. Shop Drawings:
1. Submit the following items, for Owner review and approval, within twenty-eight (28) days of notice to proceed:
 - a. Proposed circuit routing and circuit grouping plan prepared by a system registered designer. The designer's certification must be current. Identifiable, separate routing shall be shown for both the station cabling and any backbone trunk cabling.
 - b. In addition to the cable routing, the submitted drawings shall indicate the following, even if the following is expected to be provided by the project's electrical or general contractor:
 - 1) Location of all control equipment and remote power sources
 - 2) Locations of all field devices and outlets
 - 3) Location of wall penetrations (all penetrations shall be sleeved and contain protective bushings at both ends)
 - 4) Location of sleeved wall pass-thru
 - 5) Size of sleeve at each location installed
 - 6) Quantity of cable passing through each sleeve
 - 7) Location of drops in each room (quantity or labeling of drops are not required in the submittal plans. Labeling shall be provided in the closeout plans and quantities shall be as per the contract documents, addendums, and issued changes. Each drop shall be labeled for the type of outlet that it is)
 - 8) Conduit routing, size, quantity, and stub-up locations for all floor mounted outlets.
 - c. Drawing Compliance: A letter shall be provided stating that the system installer complies with the ENTIRE project drawing, including all general, keyed, and notes to contractor. If the installer intends to deviate from any portion of the specifications, a detailed explanation of reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter. No deviations shall be acceptable until they have been approved by the project's technology consultant.

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C. Close-out Procedures:

1. Four (4) copies of the following documents shall be delivered to the Architect/Engineer at the time of system acceptance. One (1) final copy of the same documents shall be delivered directly to the project's Technology Consultant upon final closeout of the project. The closeout submittals shall include:
 - a. Inspection and Test Reports: During the course of the Project, the Contractor shall maintain an adequate inspection system to ensure that the materials supplied, and the work performed, conform to contract requirements. The Contractor shall provide written documentation that indicates that materials acceptance testing was conducted as specified. The Contractor shall also provide documentation, which indicates that all cable termination testing was completed and that all irregularities were corrected prior to job completion.
 - b. Provide complete test reports for all cabling and devices that comprise system as outlined in this document.
 - c. Include the Name, address and telephone of the authorized factory representative with a 24-hour emergency service number.
 - d. The manual shall also include Manufacturer's data sheets and installation manuals/instructions for all equipment installed and a list of recommended spare parts.
 - e. Generic or typical owner's instruction and operation manual shall not be acceptable to fulfill this requirement.
 - f. An up-to-date record ("as-built") set of approved shop drawing prints that have been revised to show each and every change made to the structure cabling system from the original approved shop drawings. Drawings shall consist of a scaled plan of each building showing the placement of each individual item of the technical cabling system equipment as well as raceway size and routing, junction boxes, and conductor size, quantity, and color in each raceway.
 - g. As-built Drawings shall include cable pathways, device locations with correct labeling, control equipment locations, remote power supply locations, cross-connect locations, lightning protection locations, and MDF/IDF locations. The as-built drawings shall be prepared using AutoCad 2002 or later. Provide the Owner with electronic versions of the as-builts on CD media and (1) hard copy per binder.
 - h. All drawings must reflect point to point wiring, device address and programmed characteristics as verified in the presence of the engineer and/or the end user unless device addressing is electronically generated, and automatically graphically self-documented by the system.
 - i. A copy of the manufacturer's warranty on the installed system.
 - j. Any keys to cabinets and/or equipment and special maintenance tools required to repair, maintain, or service the system.
 - k. Operating and Maintenance Instructions for all devices within the system. These instructions shall reflect any changes made during the course of construction, and shall be provided to the Owner, for their use, in a three-ring binder labeled with the project name and description. (4 copies)

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- l. Upon completion of the work and at a time designated by the Architect or owner, provide formal training sessions for the Owner's operating personnel to include location, operation, and maintenance of all included systems and equipment. Minimum amount of training time shall be at least 4 hours.
- m. One (1) 30" x 42" laminated floor plan sheets illustrating technology drops and cable designation. Contractor shall provide one complete floor plan sheet for each telecommunications room (MDF or IDF)

1.5 FUNCTION - INTERCOM

- A. General: The contractor shall verify and document the functions of the existing system. All function of the existing system shall remain and be expanded to the newly added devices installed per the project drawings.
- B. Use materials and equipment that comply with referenced standards and manufacturer's standard design and construction, in accordance with published product information. Coordinate the features of all materials and equipment so they form an integrated system, with components and interconnections matched for optimum performance of specified functions.

1.6 Function - Master Clock: The master time controller is existing to remain.

PART 2 - PRODUCTS

2.1 EQUIPMENT

All head end equipment is existing to remain. The following system information if provided in the event that the information is not obtainable. Provide all necessary expansion equipment as required. Existing equipment is Rauland TCC2000 Telecenter U controller.

- A. External Paging Amplifier
 - 1. External paging amplifiers shall be provided as required to meet the load requirements to the system when activated in the all-page mode.
 - 2. Program/paging amplifiers shall have the following:
 - a. Power output of 250 watts RMS.
 - b. Maximum .5% harmonic distortion from 45-20KHz.
 - c. Frequency response of 20Hz to 20 KHz (+0, -1 dB).
 - d. -90- dB signal to noise ratio at 20Hz to 20 KHz.
 - e. 1-volt RMS input sensitivity at 1 KHz.
 - f. Bogen GS100 100W or approved equal
- B. Speakers, Ceiling, Pendant, and Beam Mounted
 - 1. Lay-In Ceiling Speakers:
 - a. General Purpose Speaker: 8" speaker with 5 oz. magnet complete with line matching transformer. Program rating shall be 5 watts continuous. The speaker shall be a Rauland, 1x2 lay-in at grid ceilings and at hard ceilings. 25/70V transformers shall have primary taps of 0.25, 0.5, 1, 2 and 5 watts. Tap speaker at 0.25 watt. White finish unless indicated otherwise.

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- b. Classroom, office, conference, telephone, teacher lounge, workroom speakers: 8-ohm speaker with 5 oz. magnet, complete with line matching transformer. Program rating shall be 4 watts continuous. The speaker shall be a 1x2 lay-in at grid ceilings and at hard ceilings, with integral volume control. 25/70V transformers shall have primary taps of 0.25, 0.5, 1, 2, 5 watts; tap speaker at 0.5 watt. Rauland BAFKIT1X2S
 - 2. Outdoor Speaker:
 - a. Horns shall be surface mounted, double re-entrant type, Atlas Sound VT-152 UCN or equivalent and integral compression driver rated for 15 watts of continuous power. Horns will be used in shop areas, maintenance bays and other areas where conditions warrant.
 - b. Provide and install protective cages for the loudspeaker horns in the gymnasiums or other areas that may warrant such protection.
 - 1. Outdoor speaker: Atlas VT-152UCN Compression Horn or equal
 - 2. Horn: Rauland 3603 Horn 30 watt 25V
- C. Remote Source Output Volume Control:
 - 1. Rack mounted in remote source rack. Provide line level volume control of output of each remote source device. Label each volume control for each output device.
- D. Wall Mounted Volume Control (Attenuators)
 - 1. Attenuator(s) shall be Atlas Sound AT Series Model AT10-PA auto transformer or approved equal. The power rating shall be 10W and total attenuation shall be 33dB. Attenuation per step for AT10-PA shall be 8 steps of 3dB and 6dB each for the last two positions. Attenuator shall be a step type control with a positive off position. There shall be no stop between the maximum and off positions. Switch shall have silver plated contacts to eliminate noise and contact loss. All terminations must be made via a removable terminal block. Unit(s) shall be supplied with stainless steel single gang face plates (with dial scale to indicate attenuator position).
- E. Secondary Clocks:
 - 1. General
 - a. Provide Rauland secondary clocks at locations shown on drawings.
 - b. Digital Clock: Microprocessor-controlled unit with red LED digital time display of hours and minutes.
 - 1) Digital Clock: Microprocessor-controlled unit with red LED digital time display of hours, minutes, and seconds.
 - 2) Display Height
 - a) 4.0" Flush Mount Digital Clock
 - b) 4.0" Surface Mount Digital Clock
 - 3) Display Format: Selectable between 12-hour (with "PM" indicator on LED display) and 24-hour formats.
 - c. Connections for Power and Correction:
 - 1) Wired synchronous connection to master clock for both operating power and correction.
 - d. Clock Circuit Power Booster
 - 1) Transformer power supply, mounted in steel cabinet with hinged door, and having fuse-protected input and output circuits.

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- e. Back Boxes
 - 1) Box and cover plate assembly shall be furnished by device manufacturer and be suitable for device to be mounted. Back boxes shall be equipped with knockouts and hanger straps or mounting adapters arranged for flush mounting device, unless otherwise indicated.
- f. Guards
 - 1) Formed-steel wire, shaped to fit around guarded device, with 1-inch (25-mm) maximum clearance.
 - 2) Mounting Provisions: Fixed tabs welded to guard and arranged for screw attachment to mounting surface.
 - 3) Finish for Indoor Devices: Clear epoxy lacquer over zinc plating or powder coat painted finish.

F. Administrative Control Console

- 1. The console shall provide selected, two-way voice communications and signaling between the console and room stations as well as between other control consoles in the systems. The console shall be equipped with a telephone handset with a retractable cord to allow private conversations. A built-in microphone and speaker shall provide for push-to-talk intercom conversations.
- 2. Multiple console locations may be required depending on the facility design. Coordinate location of the consoles with the district.
- 3. The console shall have the ability to program or change all of the operational characteristics of the Intercom/PA schedule
 - a. Rauland TCC20244 IP Administrative Console or approved equal

G. Media Player

- 1. IPOP or Bluetooth Connection

PART 3 – EXECUTION:

3.1 MATERIALS:

- A. Wire: Wire shall be #22 gauge at a minimum. Wire for communications system shall consist of 2 twisted pairs #22 solid copper under plenum jacket. No splices are permitted except in approved junction boxes. All terminations shall be made on telephone type punch blocks or at specified devices. Display, speaker, and specialty cables shall be as required for best operation under manufacturer recommendations.
- B. Jacks: All station device terminations (except speakers) shall be terminated on USOC standard modular jacks. Jacks for wall mounted telephones shall have lugs for securely attaching the instrument to the wall.
- C. Backboards: Provide 4 feet x 8 feet plywood backboards for mounting of system cross connect field. Mount as shown on the plans. Provide Modular Termination backboards with 110 type terminal blocks as required to terminate all cables. Provide Distribution and cross connect backboards equal to AT&T 110 Series for all cross connect wiring.

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3.2 INSTALLATION

- A. All work under this section shall be performed by persons having specific familiarity with telephone, data and sound system installation. Upon request the contractor shall submit resumes, references or other corroborating documentation, to the engineer to confirm the contractor's capabilities and experience.
- B. Grounding: Except where specifically indicated otherwise, all exposed non-current carrying metallic parts of the communications system shall be grounded. This may be accomplished via a driven ground rod, cold water pipe or building power ground. If the building power ground is used, a separate ground conductor shall be used from the equipment to the grounding grid. All grounding shall be done with #6 solid copper wire or larger. The contractor shall use every effort to ensure system stability and safety.
- C. Wiring: A comprehensive, documented communications wiring system is to be installed. Wiring is to be identified by room number, segregated, neatly laced, and terminated on telephone type punch blocks. Back boards and cross connect fields shall be neatly organized as to function. (ie: intercom, telephone stations, data network etc.) All termination points are to be labeled with function. Data cables shall be certified as usable and checked using the cable certification sheet. Data cables shall be labeled as per the data identification scheme.
- D. Speaker Wattage Taps: Tap all classrooms at ½ watt. Tap Corridor Speakers for 1 watt, Outside Horns 3.3 watts, Tap Speakers in High Ceilings (15FT +) at 4 watts. Rest rooms ½ watt.

3.3 TESTING AND TRAINING:

- A. Prior to connection of any terminal equipment all cables shall be tested as per REA spec. PC-4. Cables shall be tested for Opens, Splits, Crossed Pairs, Shorts to Ground and Shield Continuity. All defective cabling is to be replaced prior to device hook-up.
- B. Upon completion of the installation the contractor shall test each room station speaker, handset or call switch for proper operation. All telephones, programming and functions are to be tested for proper operation. All emergency and program functions are to be tested. Any malfunction shall be corrected prior to final acceptance.
- C. Operational guidelines shall be given in written form in sufficient numbers so that all key personnel have operational instructions of programming, station use and special features. Copies of these instructions shall be provided for permanent record in the operations and maintenance manuals specified in part 1.04 above.

END OF SECTION

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SECTION 280100

OPERATION AND MAINTENANCE (O&M) MANUALS
OF ELECTRONIC SAFETY AND SECURITY SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Compile Electronic Safety and Security (ESS) product data and related information appropriate for Owner's operation and maintenance of products furnished under Contract. Prepare ESS operating and maintenance data as specified in this Section and as referenced in other sections of specifications.
- B. Instruct Owner's personnel in operation and maintenance of equipment and systems.
- C. Submit three (3) electronic copies, on separate devices (CD, USB Flash Drive, or some type of solid-state storage device), of complete O&M manuals in final form. The submitted manual shall be the system manufacturer's operations manual, supplemented with operations and maintenance instructions custom tailored for the system installed. Electronic documentation shall be provided in a non-proprietary PDF format, without password restrictions.
- D. Hard copies shall be provided upon request of the Owner, Architect, and/or Consultant.
- E. Recorded video of all training sessions shall be included in each copy, of each system's final submitted O&M.
- F. The final submitted manual shall include a sign-in sheet and owner/consultant signed acceptance of all training sessions.

1.2 ELECTRICAL OPERATING AND MAINTENANCE MANUAL SUBMITTAL SCHEDULE

- A. Thirty (30) days after receipt of reviewed submittals bearing the Project Technology Consultant's stamp of acceptance (including re-submittals), submit for review, an electronic copy of the first draft of the System's O&M Manual. This copy shall contain as applicable to the specific system, a minimum of the following:
 - 1. Table of Contents for each element
 - 2. Contractor information
 - 3. All shop drawings, coordination drawings and product data, bearing the Project technology Consultant's stamp of acceptance.
 - 4. All parts and maintenance manuals for items of equipment
 - 5. Warranties (without starting dates)
 - 6. Certifications that have been completed; submit forms and outlines of certifications that have not been completed
 - 7. Operating and maintenance procedures.
 - 8. Form of Owner's Training Program Syllabus (including times and dates)
 - 9. Control operations / equipment wiring diagrams
 - 10. Coordination Drawings
 - 11. Schedule of Low Voltage Wire and Cable
 - 12. Schedule of ESS Equipment
 - 13. Schedule of ESS Field Devices

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14. Access Control Door Schedules
 15. Video Surveillance Camera Schedules
 16. Other required operating and maintenance information that are complete.
 17. Cable pathway layout drawings and station map, including through wall and floor penetration locations and sleeve sizes.
- B. Copy will be returned to the Contractor within 15 days with comments for corrections.
- C. Submit the electronic completed manuals (hard copies upon request) in final form to the Project's Technology Consultant.
1. Prior to substantial completion for Owner's use after the Owner accepts facility maintenance.
 2. Include all specified data, test reports, drawings, dated warranties, certificates, training videos. along with other materials and information.
- D. The Project's Technology Consultant shall review the manuals for completeness within 15 days.
- E. The Contractor shall be notified of any missing or omitted materials. The Manuals shall be reworked by the Contractor, as required, in the office of the Project's Technology Consultant. The manuals will not be retransmitted.
- F. Electronic and/or hard copies of the accepted manuals shall be delivered to the Owner prior to substantial completion.

PART 2 - PRODUCTS

2.1 BINDERS

- A. Upon the request for hard copies of the O&M manuals, the binders shall consist of the following configuration:
1. Commercial quality black, 3-ring binders with clear, durable, cleanable plastic covers.
 2. Minimum ring size: 1"; Maximum ring size: 3".
 3. When multiple binders are used, correlate the data into related groupings.
 4. Label contents on spine and face of binder with full size insert. Label under plastic cover.

PART 3 - EXECUTION

3.1 SYSTEM OPERATION AND MAINTENANCE MANUAL

- A. Form for Manuals Submitted in Hard Copy Format:
1. Prepare data in form of an instructional manual for use by Owner's personnel.
 2. Format:
 - a. Size: 8-1/2" x 11"
 - b. Text: Manufacturer's printed data or neatly typewritten.
 3. Drawings:
 - a. Provide reinforced punched binder tab and bind in text.
 - b. Fold larger drawings to size of text pages.
 4. Provide flyleaf indexed tabs for each separate product or each piece of operating equipment.

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5. Cover: Identify each volume with typed or printed title "Operating and Maintenance Instructions". List:
 - a. Title of Project
 - b. Identity of separate structures as applicable
 - c. Identity of general subject matter covered in the manual.
 6. Binder as specified
- B. Content of Manual:
1. Neatly typewritten Table of Contents for each volume arranged in systematic order as outlined in the specifications.
 - a. Contractor, name of responsible principal, address and telephone number
 - b. A list of each product required to be included, indexed to content of the volume.
 - c. List with each product, name, address and telephone number of:
 - 1) Subcontractor or installer
 - 2) Maintenance contractor as appropriate
 - 3) Identify area of responsibility of each.
 - 4) Local source of supply for parts and replacement
 - d. Identify each product-by-product name and other identifying symbols as set forth in Contract Documents.
 2. Product Data:
 - a. Include those sheets pertinent to the specific product.
 - b. Annotate each sheet to:
 - 1) Identify specific product or part installed.
 - 2) Identify data applicable to installation.
 - 3) Delete references to inapplicable information.
 3. Drawings:
 - a. Supplement product data with drawings as necessary to illustrate:
 - 1) Relations of component parts of equipment and systems
 - 2) Control and flow diagrams
 - b. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
 - c. Do not use Project Record Documents as maintenance drawings.
 4. Written text as required to supplement product data for the particular installation:
 - a. Organize in consistent format under separate headings for different procedures.
 - b. Provide logical sequence of instructions for each procedure.
 5. Copy of each warranty, bond and service contract issued
 - a. Provide information sheet for Owner's personnel, giving:
 - 1) Proper procedures in event of failure
 - 2) Instances that might affect validity of warranties or bonds
 6. Shop drawings, coordination drawings and product data as specified.
- C. Sections for Equipment and Systems
1. Content for each unit of equipment and system as appropriate:
 - a. Description of unit and component parts:
 - 1) Function, normal operating characteristics, and limiting conditions.
 - 2) Performance curves, engineering data and tests.
 - 3) Complete nomenclature and commercial number of replaceable parts.

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- b. Operating procedures:
 - 1) Start up, break-in, routine / normal operating instructions
 - 2) Regulation, control, stopping, shut down and emergency instructions
 - 3) Special operating instructions
 - c. Maintenance procedures:
 - 1) Routine operations
 - 2) Guide to trouble-shooting
 - 3) Disassembly, repair and reassembly
 - 4) Alignment, adjusting and checking
 - 5) Routine service based on operating hours
 - d. Manufacturer's printed operating and maintenance instructions.
 - e. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
 - 1) Items recommended to be stocked as spare parts.
 - f. Schedule of low voltage wire and cable
 - g. Schedule of ESS equipment
 - h. Schedule of ESS field devices
 - i. Each Contractor's coordination drawings.
 - 1) As installed color coded wiring and cabling diagrams.
 - j. List of original manufacturer's spare parts and recommended quantities to be maintained in storage.
 - k. Other data as required under pertinent sections of the specifications.
- 2. Prepare and include additional data when the need for such data becomes apparent during instruction of Owner's personnel.
 - 3. Additional requirements for operating and maintenance data as outlined in respective sections of specifications
 - 4. Provide complete information for products specified in Division 27.
 - 5. Provide certificates of compliance as specified in each related section.
 - 6. Provide start up reports as specified in each related section.
 - 7. Provide signed receipts for spare parts and material.
 - 8. Provide training report and certificates.

END OF SECTION

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SECTION 280100

OPERATION AND MAINTENANCE (O&M) MANUALS
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- D. Hard copies shall be provided upon request of the Owner, Architect, and/or Consultant.
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PART 3 - EXECUTION

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 - b. Text: Manufacturer's printed data or neatly typewritten.
 3. Drawings:
 - a. Provide reinforced punched binder tab and bind in text.
 - b. Fold larger drawings to size of text pages.
 4. Provide flyleaf indexed tabs for each separate product or each piece of operating equipment.

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5. Cover: Identify each volume with typed or printed title "Operating and Maintenance Instructions". List:
 - a. Title of Project
 - b. Identity of separate structures as applicable
 - c. Identity of general subject matter covered in the manual.
 6. Binder as specified
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 - a. Contractor, name of responsible principal, address and telephone number
 - b. A list of each product required to be included, indexed to content of the volume.
 - c. List with each product, name, address and telephone number of:
 - 1) Subcontractor or installer
 - 2) Maintenance contractor as appropriate
 - 3) Identify area of responsibility of each.
 - 4) Local source of supply for parts and replacement
 - d. Identify each product-by-product name and other identifying symbols as set forth in Contract Documents.
 2. Product Data:
 - a. Include those sheets pertinent to the specific product.
 - b. Annotate each sheet to:
 - 1) Identify specific product or part installed.
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 - 3) Delete references to inapplicable information.
 3. Drawings:
 - a. Supplement product data with drawings as necessary to illustrate:
 - 1) Relations of component parts of equipment and systems
 - 2) Control and flow diagrams
 - b. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
 - c. Do not use Project Record Documents as maintenance drawings.
 4. Written text as required to supplement product data for the particular installation:
 - a. Organize in consistent format under separate headings for different procedures.
 - b. Provide logical sequence of instructions for each procedure.
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 - 2) Performance curves, engineering data and tests.
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- b. Operating procedures:
 - 1) Start up, break-in, routine / normal operating instructions
 - 2) Regulation, control, stopping, shut down and emergency instructions
 - 3) Special operating instructions
 - c. Maintenance procedures:
 - 1) Routine operations
 - 2) Guide to trouble-shooting
 - 3) Disassembly, repair and reassembly
 - 4) Alignment, adjusting and checking
 - 5) Routine service based on operating hours
 - d. Manufacturer's printed operating and maintenance instructions.
 - e. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
 - 1) Items recommended to be stocked as spare parts.
 - f. Schedule of low voltage wire and cable
 - g. Schedule of ESS equipment
 - h. Schedule of ESS field devices
 - i. Each Contractor's coordination drawings.
 - 1) As installed color coded wiring and cabling diagrams.
 - j. List of original manufacturer's spare parts and recommended quantities to be maintained in storage.
 - k. Other data as required under pertinent sections of the specifications.
- 2. Prepare and include additional data when the need for such data becomes apparent during instruction of Owner's personnel.
 - 3. Additional requirements for operating and maintenance data as outlined in respective sections of specifications
 - 4. Provide complete information for products specified in Division 27.
 - 5. Provide certificates of compliance as specified in each related section.
 - 6. Provide start up reports as specified in each related section.
 - 7. Provide signed receipts for spare parts and material.
 - 8. Provide training report and certificates.

END OF SECTION

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SECTION 280500

ELECTRONIC SAFETY AND SECURITY
BASIC MATERIALS, METHODS, AND GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Except as modified in this Section, General Conditions, Supplementary Conditions, applicable provisions of Division 01 General Requirements, and other provisions and requirements of the Contract Documents apply to work of Division 28 Electronic Safety and Security.
- B. Applicable provisions of this section apply to all sections of Division 28, Electronic Safety and Security.
- C. The general provisions of the Contract and the requirements of the following Sections apply to the Work specified in this Section. See following sections for related general and specific requirements following sections shall associate with this specification as applicable.
 - 1. Division 26 in its entirety.
 - 2. Division 27 in its entirety.
 - 3. Division 28 in its entirety.
- D. The entire drawing and specification package apply to the work specified in the Electronic Safety and Security specifications and shall be complied with in every respect. The Contract Documents are comprised of the drawings and specifications. The Contractor shall examine these Contract Documents, and coordinate required work indicated in each.

1.2 CODES AND STANDARDS

- A. All equipment and work performed shall comply with all of the current and applicable Codes, Rules, Ordinances, Regulations and Standards (including those not specifically listed in this Specification) as interpreted and enforced by the authorities having jurisdiction including:
 - 1. Americans with Disabilities Act (ADA)
 - 2. Authorities Having Jurisdiction (AHJ) - Local
 - 3. American National Standards Institute (ANSI)
 - 4. American Society of Testing and Materials (ASTM) *Communications Cables - B694, B736, D4565, D4566, D4730, D4731, D4732*
 - 5. Building Industry Consulting Services International (BICSI)
 - 6. Code of Federal Regulations - Title 47
 - 7. Electronics Industries Association (EIA) *Standard Test Procedures for Fiber Optic Fibers, Cables, Transducers, Connecting and Terminating Devices - EIA-455 Series*
 - 8. Federal Communications Commission (FCC) - Communications Act and FCC Rules
 - 9. Federal Information Processing Standards (FIPS) *Federal Building Standard for Telecommunications Pathways and Spaces - FIPS PUB 175, FIPS PUB 176*

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10. The Insulated Cable Engineers Association (ICEA) *Communications Cable Stands - P-47-434, S-56-434, S-80-576, S84-608, S-85-625, S-86-634, S-87-640, S-89-648, S-90-661, S-98-688, S-99-689, S-100-685*
 11. International Electro-technical Commission (IEC)
 12. Institute of Electrical and Electronic Engineers (IEEE) *Local Area Networks/Metropolitan Networks Standards Collection - LAN/MAN 802 Series*
 13. International Organization for Standardization (ISO) (ISO/IEC) *Premise Wiring Core and LAN/MAN Core Equivalents-11801, 8802, 14763-1*
 14. International Telecommunication Union (ITU-T) *Telecommunications Standardization*
 15. National Electrical Code (NEC) *National Electrical Code - NFPA 70*
 16. National Electrical Contractor's Association (NECA) *Standards of Installation*
 17. National Electrical Manufacturers Association (NEMA) *Performance Standard for Twisted Pair Premise Voice and Data Communications Cable-WC 63.1, WC 63.2, WC 66*
 18. National Electrical Safety Code (NESC)
 19. National Fire Protection Association (NFPA) - *National Fire Alarm Code NFPA 72, Life Safety Code NFPA 101*
 20. Society of Cable Telecommunications Engineers (SCTE)
 21. Local Accessibility Standards
 22. Telecommunications Industries Association (TIA) *(ANSI/TIA/EIA) Wiring and Cabling Standards - 526, 568, 569, 570, 571, 598, 606, 607, 758, TSB 31-B, 63, 67, 72, 75 and 95*
 23. Uniform Building Code (UBC)
 24. Underwriters Laboratories, Inc. (U.L.) - *497A, 910, 1077, 1863, 1283, 1459, 1604, 1651, 1681, 1690, 1778, 1977*
- B. Resolve any code violations discovered in contract documents with the Engineer prior to award of the contract. After Contract award, any correction or additions necessary for compliance with applicable codes shall be made at no additional cost to the Owner.
- C. This Contractor shall be responsible for being aware of and complying with asbestos NESHAP regulations, as well as all other applicable codes, laws and regulations.
- D. Obtain all permits required.

1.3 SUMMARY

- A. The work covered by the specifications includes furnishing materials, labor, transportation, tools, permits, fees, utilities, and incidentals necessary for the complete installation of work required in the Contract Drawings.
- B. It is the intent of the Contract Documents to provide a new and/or an extension of the existing installation, as shown in the associated specifications and drawings, complete in every respect.
- C. Provide complete and working ESS Systems including equipment, conduit, wiring, material, labor and training as described in this Specification and the Drawings. The ESS Systems Drawings and Specifications are the sole property of the Architect and are not to be duplicated, scanned, loaned or in any way made available to persons not designated as authorized by the Architect. All ESS Systems plans and specifications are to be returned to the Architect following completion of bid.

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1.4 CONTRACTOR'S QUALIFICATIONS

- A. An approved contractor for the work under this division shall be:
 - 1. A specialist in this field and have the personnel, experience, training, and skill, and the organization to provide a practical working system.
 - 2. Able to furnish evidence of having contracted for and installed not less than ten (10) systems of comparable size and type that have served their Owners satisfactorily for not less than 3 years.
 - 3. Perform work by persons qualified to produce workmanship of specified quality. Persons performing work shall be required to be licensed. Onsite supervision shall have minimum of the following:
 - a. Licenses, as applicable to the system being installed
 - b. Manufacturer's Certifications
 - 1) Firm Certification
 - 2) Installer Certification
 - 3) Programmer's Certification
 - 4) System Designer Certification.

1.5 DRAWINGS AND SPECIFICATIONS

- A. The drawings and these specifications are complementary to each other, and what is required by one shall be as binding as if required by both.
- B. If variations or departures from the drawings are deemed necessary by the Contractor, details of such departures and the reasons therefore shall be submitted to the Consultant for review. No departures shall be made without prior written acceptance of the Consultant.
- C. Should the drawings or specifications disagree in themselves or with their counterpart, the better quality or greater quantity of work or materials shall be estimated upon, and unless otherwise directed by the Consultant in writing, shall be performed or furnished. In the case that the specifications should not fully agree with the Schedules, the latter shall govern. Figures indicated on drawings govern scale measurements and large-scale details govern small scale drawings.
- D. The approximate locations of system equipment and components are indicated on the Drawings. These Drawings are not intended to give complete and accurate details in regard to location of equipment, field devices, etc. Exact locations are to be determined by actual measurements at the building and will in all cases be subject to the Review of the Owner or Consultant, who reserves the right to make any reasonable changes in the locations indicated without additional cost to the Owner.
- E. Items specifically mentioned in the Specifications but not shown on the Drawings and/or items shown on Drawings but not specifically mentioned in the Specifications shall be installed by the Contractor under the appropriate section of work as if they were both specified and shown.
- F. Any discrepancies between the Contract Documents and actual job site conditions shall be reported to the Owner or Consultant, so that they will be resolved prior to the bidding, where this cannot be done at least 7 working days prior to bid; the greater or costlier of the discrepancy shall be bid. All labor and materials required to perform the work described shall be included as part of this Contract.

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- G. It is the intention of this Section of the Specifications, and associated drawings, to outline minimum requirements to furnish the Owner with a turnkey and fully operating system in cooperation with other trades.
- H. The contract documents are schematic in nature in that they are only to establish scope and a minimum level of quality. They are not to be used as actual working construction drawings. The actual working construction drawings shall be the shop drawings accepted by project's consultant.
- I. The Contractor shall be responsible for coordination and proper relation of his work to the building structure and to the work of all trades. The Contractor shall visit the premises and thoroughly familiarize himself with the existing site conditions, details of the work and the working conditions, and verify dimensions in the field. The Contractor shall advise the project's consultant of any discrepancy prior to bidding. The submission of bids shall be deemed evidence of the Contractor's site visit; coordination of existing conditions and include consideration for existing conditions.
- J. These documents are conceptual in nature. It shall be the responsibility of the approved installer to furnish a complete and functional system, including the items shown on the drawings, in the specifications, and items not designated in either. The installer's shop drawings and product data submittals shall represent a complete system and documents accepted by the project's consultant shall not relieve the installer from being required to provide any materials, equipment, or labor to furnish a complete and functional system as recognized by the Project's Technology Consultant and the Owner.

1.6 BUILDING CONSTRUCTION AND LAYOUT OF WORK

- A. General: It shall be the responsibility of the Contractor to consult the Engineering Drawings and Details so as to thoroughly familiarize himself with the type and quality of construction to be provided on this project.
- B. The drawings are diagrammatic in nature and do not show every connection in detail or every line or conduit in its exact location. These details are subject to the requirements of all codes, ordinances, and standards; as well as all structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in closed ceiling space and/or furred chases unless specifically noted or indicated to be exposed. Work shall be installed to avoid crippling of structural members. All work shall be run parallel or perpendicular to the lines of the building unless otherwise noted.
- C. The approximate location of equipment items is indicated on the drawings. Exact locations are to be determined by coordination of dimensions from approved equipment submittals and site-verified field measurements and will in all cases be subject to the approval of the Consultant. The Consultant reserves the right to make any reasonable changes in the indicated locations prior to installation for no additional cost.
- D. In areas of existing special ceiling construction, the removal and restoration must be carefully planned such that the existing condition of the ceilings is maintained. It may be necessary for the Contractor to procure a Subcontractor familiar with this work to achieve this requirement.

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- E. Consider space limitations imposed by contiguous work in selection and location of equipment and material. Do not provide equipment or material that is not suitable in this respect.

1.7 RELATION WITH OTHER TRADES

- A. Carefully study all matters and conditions concerning the project. Submit notification of conflict in ample time to prevent unwarranted changes in any work. Review other Divisions of these specifications to determine their requirements. Extend electrical services and final connections to all items requiring same.
- B. Because of the complicated relationship of this work to the total project, conscientiously study the relation and cooperate as necessary to accomplish the full intent of the documents.
- C. Where cabling pass through walls or floors, metal sleeves shall be provided and shall be sealed to prevent spread of fire and smoke. In walls, they shall extend 3" beyond the finished surface. In pipe chases, they shall extend 8" inches above floor slab and be cemented in a watertight manner. Size of these sleeves shall be at least as required to maintain a maximum 40% conduit fill ratio. 1/2 inch greater than outside diameter of the conduit.
- D. Locate and size openings required for installation of work specified in this Division in sufficient time to prevent delay in the work.
- E. Refer to other Divisions of the specifications for the scope of required connections to equipment furnished under other Division. Determine from the General Contractor / Construction Manager for the various trades, the Owner, and by direction from the Architect / Engineer, the exact location of all items. The construction trades involved shall furnish all roughing-in drawings and wiring diagrams required for proper installation of the electrical work.
 - 1. Make final connections to all ESS equipment indicated on the drawings, except as noted.
- F. Request all Shop Drawings required in ample time to permit proper installation of all electrical provisions.
- G. Extend services as indicated to the various items of equipment furnished by others. Rough-in for the various items and make final connections ready for operation upon placing of the equipment.

1.8 CONCEALED AND EXPOSED WORK

- A. When the word "concealed" is defined as hidden from sight as in chases, furred spaces or above ceilings. "Exposed" is defined as open to view, in plain sight.

1.9 GUARANTEE

- A. Guarantee work for a minimum of two years or as noted longer elsewhere from the date of substantial completion of the project. During that period make good any faults or imperfections that may arise due to defects or omissions in material, equipment or workmanship. At the Owner's option, replacement of failed parts or equipment shall be provided.

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1.10 MATERIAL AND EQUIPMENT

- A. Furnish new and unused materials and equipment meeting the requirements of the paragraph specifying acceptable manufacturers. Where two or more units of the same type or class of equipment are required, provide units of a single manufacturer.

1.11 NOISE AND VIBRATION

- A. Select equipment to operate with minimum noise and vibration. If noise or vibration is produced or transmitted to or through the building structure by equipment, piping, ducts or other parts of work, and judged objectionable by the Owner, Architect, or Engineer, rectify such conditions at no additional cost to the Owner. If the item of equipment is judged to produce objectionable noise or vibration, demonstrate at no additional cost that equipment performs within designated limits on a vibration chart.

1.12 ACCEPTABLE MANUFACTURERS

- A. Manufacturers names and catalog number specified under sections of Division 28 are used to establish standards of design, performance, quality and serviceability and not to limit competition. Equipment of similar design, equal to that specified, manufactured by a named manufacturer shall be acceptable on approval. A request for prior approval of equipment not listed must be submitted ten (10) days before proposal due date. Submit complete design and performance data to the Architect. The Architect and Owner issue approvals of acceptable manufacturers as addenda to the Construction Proposal Documents.
- B. Where acceptable manufacturers are listed, only products of those manufacturers may be provided. Additionally, the product must meet all the detailed requirements of the specifications.
- C. If no manufacturer's name is mentioned, the Contractor shall provide equipment and material which meet the specifications.

1.13 UTILITIES, LOCATIONS AND ELEVATIONS

- A. Locations and elevations of the various utilities included within the scope of this work:
 - 1. Obtained from utility maps and other substantially reliable sources.
 - 2. Are offered separate from the Contract Documents as a general guide only without guarantees to accuracy.
- B. Examine the site and verify the location and elevation of all utilities and of their relation to the work. Existing utilities indicated on the site plans are for reference only and shall be field verified by the Contractor with the respective public or private utility.

1.14 CONTRACT DRAWINGS

- A. Contract drawings are diagrammatic only and do not give fully dimensioned locations of various elements of work. Determine exact locations from field measurements.
- B. It is the responsibility of the Contractor to compare the scale of all electrical drawings with the scale of the architectural drawings and make adjustments to all electrical drawings which have the incorrect drawing scale so that his material takeoffs are not in error due to an incorrectly labeled drawing scale and his proposal is complete.

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1.15 ABBREVIATIONS AND DEFINITIONS

Abbreviations:

A/V	Audio/Visual
AWG	American Wire Gauge
BCR	Building Communications Room
CMP	Communications Media Plenum
CMR	Communications Media Riser
dB	Decibel
EMI	Electromagnetic Interference
ER	Equipment Room
ESS	Electronic Safety and Security
FACP	Fire Alarm Control Panel
FCR	Floor Communications Room
Hz	Hertz
IDF	Intermediate Distribution Frame
Km	Kilometer
LCD	Liquid Crystal Display
LED	Light Emitting Diode
M	Micron
MDF	Main Distribution Frame
MHz	Megahertz
NEXT	Near-End Cross Talk
nm	Nano-meter
OFN	Optical Fiber Non-conductive
OFNP	Optical Fiber Non-conductive Plenum
OFNR	Optical Fiber Non-conductive Riser
OTDR	Optical Time Domain Reflectometer
TC	Telecommunications Closet (<i>Now referred to as TR</i>)
TR	Telecommunications Room (<i>A.K.A. TC - Telecommunication Closet</i>)
UTP	Unshielded Twisted Pair Wire

Definitions:

Low Voltage Wire - Wire or cable used for one or more systems that operate on 24 volts or less. Low Voltage Wire is used to install and interconnect one or more of the ESS Systems. Low Voltage Wire includes patch cords, jumpers and all portions of cable or wire used to make the ESS Systems operational or for system communications.

Electronic Safety and Security Systems - One or more of the following and associated equipment: Fire Detection/Alarm Systems, Intrusion Detection/Alarm Systems, Access Control Systems, Video Surveillance Systems,

1.16 QUALITY ASSURANCE

A. Equipment Standards:

1. System and all components shall be brand new stock from manufacturer.
2. All electronics shall be 100% solid state.
3. System and all components shall bear a UL Label.

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B. Contractor Qualifications:

At the time of Proposal, the Contractor shall:

1. Have manufactured, supplied or installed at least three (3) other systems of similar size, complexity, and general operation as the systems described in these specifications. The Contractor shall furnish in writing to Architect proof of compliance with this paragraph at the time of proposal.
2. Hold all legally required Texas State Contractor's licenses necessary to accomplish the installation and activation of the described system at the facilities indicated. The Contractor shall submit copies of licenses to the Architect prior to the start of work
3. Hold all legally required state registrations to meet local requirements for submittal drawings.
4. Have a local office within fifty (50) miles of the project site staffed with factory trained technicians who have experience on systems of similar complexity and function as the systems described in these specifications. These technicians shall be fully capable of system engineering support, installation supervising, system start-up, and providing the Owner with training and service on both hardware and software for the systems specified.
5. Certify complete and total compliance with the provisions of these specifications by letter or submittal of the proposal response forms, signed by an officer of the corporation, or a principal if other ownership currently exists. In addition, the letter or forms shall include a complete listing of exceptions, if any.

1.17 SUBMITTALS

A. Provide SUBMITTALS according to Division 1 and the following.

B. Requirements:

1. Submit paragraph-by-paragraph specification review indicating compliance or deviation with explanation.
2. Submit proof that all system components and cables are U.L. Listed.
3. An equipment list with names of manufacturers, model numbers, and technical information on all equipment proposed. Clearly mark exact model number proposed to be installed.
4. Product technical information sheets for each principal components in the proposed system, including cable, wire, terminal marking, and wire marking material.
5. Certification from the manufacturer stating that the system Contractor is an authorized distributor or installer of the proposed system when such certifications exist.
6. A statement listing every technical and operational parameter wherein the submitted equipment varies from that which was originally specified. If the submitter fails to list a particular variance and his submittal is accepted, but is subsequently deemed to be unsatisfactory because of the unlisted variance, the submitter shall replace or modify such equipment at once and without cost to the Owner.

1.18 EXAMINATION OF SITE

- A. The Contractor shall have visited the site and familiarized himself with all existing conditions prior to submitting his proposal and shall be prepared to carry out the work within the existing limitations. Failure or neglect to do so shall not relieve the Contractor of his responsibilities not entitle him to additional compensation for work overlooked and not included in his proposal.

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- B. The Contractor shall confirm the availability of the proper power source for each piece of specified equipment, through site visits and Drawings as necessary. Where proper power does not exist, the Contractor shall provide the required power, circuits, outlets, conduits, and wire as specified under Division 26.

1.19 DATA ACCURACY

- A. Absolute accuracy of information regarding existing conditions cannot be guaranteed. The Drawings and Specifications are for the assistance and guidance of the Contractor and exact locations, distances, elevations, etc., shall be governed by actual field conditions. Where variations from the contract documents are required, such variations shall be approved by the Architect / Owner.

1.20 SECURITY

- A. The Contractor is responsible for complying with all of the Owner's and facility security's requirements to prevent theft or damage to equipment, tools and materials. If any deviation from facility security requirements is necessary, approval for such deviation shall be coordinated with the Owner.
- B. The Contractor shall not disclose any confidential information of the Owner. The Contractor acknowledges that such action is highly injurious and can do damage to the Owner. The Contractor will agree to and comply with the standard policies and provisions of the Owner regarding outside Contractors and Consultants.

1.21 UTILITIES

- A. It shall be the responsibility of the Contractor to provide all temporary connection and cables, lighting, light stands and power. The facilities shall be used in accordance with all applicable regulations regarding operations, safety and fire hazards of the governmental Authorities Having Jurisdiction, provided they are not used in a wasteful manner.

1.22 PERMITS

- A. All permits required for the specified performance and completion of the work shall be secured by the Contractor. These permits shall be presented and reviewed at the initial project progress meeting.

1.23 NOTIFICATION

- A. The Contractor shall not shut off any existing systems. The Contractor shall give the Owner at least ten (10) calendar day's notice of any requirements to shut off or interference with existing alarm, regulating, computer or other service systems. The Owner will arrange and execute any shutdown. All work such as splicing, connections, etc., necessary to establish or re-establish any system shall be completed by the Contractor in close coordination with the Owner.

1.24 INTERFERENCES WITH THE OWNER

- A. Transportation and storage of materials at the facility, work involving the facility, and all other matters affecting the habitual use by the Owner of its buildings, shall be conducted so as to cause the least possible interference, and at times and in a manner acceptable to the Owner. The Contractor shall make every effort to delivery equipment per the schedule required by the project.

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1.25 PROJECT RECORD DOCUMENTS

- A. Maintain at the job site a separate set of white prints (blue line or black line) of the contract drawings for the sole purpose of recording the "as-built" changes and diagrams of those portions of work in which actual construction is significantly at variance with the contract drawings. Mark the drawings with a colored pencil. Prepare, as the work progresses and upon completion of work, reproducible drawings clearly indicating locations of various major and minor feeders, equipment, and other pertinent items, as installed. Record underground and underslab cables installed, dimensioning exact location and elevation of such installations.
- B. At conclusion of project, obtain without cost to the Owner, electronic AutoCAD 2014+ / Revit CAD files of the original drawings and transfer as-built changes to these. Provide the following as-built documents including all contract drawings regardless of whether corrections were necessary and include in the transmittal: "2 sets of CDs and prints for Owner's use, one set of CDs, prints, and mylars for Architect / Engineers Records". Delivery of these as-built electronic, reproducible and prints is a condition of final acceptance.
 - 1. 3 sets of electronic AutoCAD (2014+ dwg) / Revit CAD drawing files, on CD-ROM media, of each contract as-built drawing.
 - 2. One reproducible Dayrex mylar film positive of each contract as-built drawing.
 - 3. Three sets of blue or black-line prints of each contract as-built drawing.
- C. As-Built Drawings should indicate the following information as a minimum:
 - 1. Indicate all addendum changes to documents.
 - 2. Remove Engineer's Seal, name, address, and logo from drawings.
 - 3. Mark documents AS-BUILT DRAWINGS.
 - 4. Clearly indicate: DOCUMENT PRODUCED BY:
 - 5. Indicate all changes to construction during construction. Indicate actual routing of all conduit and cables, etc that were deviated from construction drawings.
 - 6. Indicate exact location of all underground ESS raceways, and elevations.
 - 7. Correct schedules to reflect (actual) equipment furnished and manufacturer.
 - 8. During the execution of work, maintain a complete set of Drawings and specifications upon which all locations of equipment, devices, and all deviations and changes from the construction documents in the work shall be recorded.
 - 9. Exact location of all ESS equipment in building. Label panel schedules to indicate actual location.
 - 10. Exact location of all ESS equipment in and outside of the building.
 - 11. Location, size and routing of all ESS cables, conduits, equipment, etc. shall be accurately and neatly shown to dimension.
 - 12. Exact location of all roof mounted equipment, wall, roof and floor penetrations.
 - 13. Cloud all changes.

1.26 OPERATING TESTS

- A. After all ESS systems have been completed and put into operation, subject each system to an operating test under design conditions to ensure proper sequencing and operation throughout the range of operation. Tests shall be made in the presence of the Architect / Engineer and Owner. Provide minimum 24-hour advance notice of scheduling of all tests. Make adjustments as required to ensure proper functioning of all systems. Special tests on individual systems are specified under individual sections. Submit 3 copies of all certifications and test reports adequately in advance of completion of the work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

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1.27 WARRANTY

- A. All equipment shall be covered for the full manufacturers warranty period and systems shall be warranted by the Contractor for a period of two years commencing with the filing date of substantial completion. The Warranty shall cover all costs for warranty service, including parts, labor, prompt field service, pick-up, transportation, delivery, reinstallation, and retesting. A contract for service shall cover the period starting with the first expected activation of each system and shall continue without interruption to cover the period to the end of the two-year warranty as defined above. The end of the warranty period shall be handled such that a smooth transition to a maintenance agreement with the Owner shall be achieved with no lapse in coverage.
- B. Submit 3 copies of all warranties and guarantees for systems, equipment, devices and materials. These shall be included in the Operating and Maintenance Manuals.

1.28 BUILDING CONSTRUCTION

- A. It shall be the responsibility of the sub-contractor to consult the Architectural and Engineering drawings, details and specifications and thoroughly familiarize himself as to the construction and all job-related requirements. All construction trades shall cooperate with the General Contractor / Construction Manager job site superintendent and lay out work so that all piping, cables, pathways, raceways, and other items are placed in the walls, furred spaces, chases, etc., so that there shall be no delay in the job.

1.29 TEMPORARY FACILITIES

- A. General: Refer to Division 01 for general requirements on temporary facilities.
- B. Temporary Wiring: Temporary power and lighting for construction purposes shall be provided under Division 26. Installation of temporary power shall be in accordance with NEC Article 305.
- C. Temporary facilities, wire, lights and devices are the property of this Contractor and shall be removed at the completion of the Contract.

1.30 EXTRA MATERIALS

- A. Keys: Provide three (3) sets of all keys for system cabinets.

PART 2 - PRODUCTS

2.1 WORK INCLUDED

- A. All materials listed in PART 2 - PRODUCTS of this Division Sections and on the Drawings shall be provided by the Contractor unless specifically excluded or modified in other portions of this Specification or Addendums.

2.2 GENERAL MATERIALS AND EQUIPMENT REQUIREMENTS

- A. Materials, in general, shall conform to the National Electrical Code requirements and shall be listed, inspected, and approved by the Underwriters Laboratories and shall bear the UL label where labeling service is available. The label or listing of the Underwriters Laboratories, Inc. will be accepted as evidence that the materials or equipment conform

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to the applicable standards of that agency. In lieu of this listing, the Contractor may submit a statement from a nationally recognized, adequately equipped testing agency, indicating that the items have been tested in accordance with required procedures, and that the materials and equipment comply with all Contract requirements.

2.3 STANDARD PRODUCTS

- A. Materials and equipment shall be the standard catalog products of manufacturers regularly engaged in the manufacture of products conforming to these specifications and shall essentially duplicate materials and equipment that have been in satisfactory use at least two (2) years prior to bid opening. Where custom or special items are required, these shall be fully described using drawings, material lists, etc., which fully describe in detail the item proposed for use on this project.

2.4 MANUFACTURE'S INSTRUCTIONS

- A. The Contractor is responsible for furnishing the proper Electronic Safety and Security equipment and/or material and for seeing it is installed as intended by the manufacturer. The Contractor shall, wherever necessary, request advice and supervisory assistance from equipment manufacturers as required for the proper installation, operation, or start-up. The Contractor shall notify the Consultant, in writing, of any conflict between the Contract Documents and the manufacturer's recommendations and shall obtain, from the Consultant, instructions/direction before proceeding with the work. The Contractor shall pay for all costs resulting from deficiencies created by installation not in accordance with the manufacturer's recommendations or the instructions of the Consultant.

2.5 RUST PREVENTION

- A. Metallic materials shall be protected against corrosion. Exposed metallic parts of equipment exposed to the elements shall be given a rust inhibiting treatment and standard finish by the manufacturer. Components such as boxes, bodies, fittings, guards, and miscellaneous parts shall be protected in accordance with the ASTM A123 or A153, except where other equivalent protective treatment is specifically approved in writing.

2.6 STORAGE AT SITE

- A. The Contractor shall not receive material or equipment at the job site until ready for installation or until there is suitable space provided to properly protect equipment from rust, weather, humidity, dust, or physical damage.
- B. All electronic equipment, containing sealed lead acid batteries or gel cells, shall be stored in climate-controlled area until installed or reinstalled. Do not store in non-climate controlled connex storage units.
- C. Storage is to be provided and secured by the contractor. In the event that the Owner should agree to furnish storage space, security of the space and its contents shall remain the responsibility of the contractor.

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2.7 CONDITION OF MATERIALS

- A. All materials required for the installation of the Electronic Safety and Security systems shall be new and unused. Any material or equipment damaged in transit from the factory, during delivery to premises, while in storage on premises, while being installed, or while being tested, until time of final acceptance, shall be replaced by this Contractor without extra cost to Owner.

2.8 NAMEPLATES

- A. Factory assembled components and equipment shall be provided with be factory stamped labeling. Labeling will have information required to specifically identify the component and/or equipment in the future such as the manufacturer's name, catalog number, serial number, etc. All data on the labels shall be legible at the time of final inspection.

2.9 ACCESS DOORS

- A. Wherever access is required in walls or ceilings to concealed junction boxes, pull boxes, equipment, etc., installed under this Division, furnish a hinged access door and frame with flush latch handle to another Division for installation. Doors shall be as follows:
 - 1. Plaster Surfaces: Milcor Style K.
 - 2. Ceramic Tile Surfaces: Milcor Style M.
 - 3. Drywall Surfaces: Milcor Style DW.
 - 4. Install panels only in locations approved by the Architect.

2.10 SPACE LIMITATIONS

- A. Equipment shall be chosen which shall properly fit into the physical space provided and shown on the drawings, allowing ample room for access, servicing, removal and replacement of parts, etc. Adequate space shall be allowed for clearances in accordance with applicable codes and standards. Physical dimensions and arrangement of equipment shall be subject to the approval of the Consultant.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. This project has a critical path, which must be closely followed in order to meet the completion date. The Contractor shall review the proposed schedule at the Award of Contract meeting and be prepared to staff his work force according to the schedule constraints presented at that time.
- B. Aesthetics are an important consideration in this installation. All components shall be installed so as to have aesthetically pleasing results as determined by the Owner and Architect. Actual locations of all visible components shall be coordinated in advance with the Owner and Architect.
- C. Install, make fully operational and test the system as indicated on the Drawings and in the Specifications. Where information is not available the worst-case condition must be assumed to ensure a complete, functional system.

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- D. Any interfacing with other systems shall be the Contractor's responsibility under this contract, and the details, both logical and physical, of such interfaces shall be reflected in the Submittals and As-Built drawings.
- E. If appropriate, interfaces with the Owner's Data Network or Telecommunications System shall be coordinated with the Owner and Architect.
- F. All necessary back boards, back-boxes, pull-boxes, connectors, supports, conduit, cable and wire shall be furnished and installed to provide a complete and reliable system. Exact location of all backboards, boxes, conduit and wiring runs shall be presented to the Owner / Architect for approval in advance of any installation. Provide as required and as specified in Division 26.
- G. Where required provide 120-VAC, 60 Hz power from nearest electrical panel through a junction box, to the system devices. Provide as required and as specified in Division 26.
- H. Where required, install conduit, cable and wire parallel and square with building lines, including raised floor areas. Conduit fills shall not exceed 40%.
- I. All equipment shall be mounted with sufficient clearance to minimize EMI as well as meet all applicable codes and facilitate observation and testing. Securely hand and/or fasten with appropriate fittings to ensure positive grounding, free of ground loops, throughout the entire system. Units shall be installed parallel and square to building lines.
- J. Quiet and vibration-free operation of all equipment is a requirement of this installation. Properly adjust, repair, balance or replace any equipment producing objectionable (in the judgment of the Owner or Architect) noise or vibration in any of the occupied areas of any building and provide additional brackets and bracing if necessary. Any such additions or changes shall be at no additional cost to the Owner.
- K. Installation shall comply with the CODES AND STANDARDS portion of this Section. Where more than one code or regulation is applicable, the more stringent shall apply.
- L. Where new equipment is replacing old equipment, the Contractor is responsible for removing and disposing of the old equipment and doing whatever repair work is necessary as specified by the Owner / Architect.
- M. Install firestopping, as specified in Division 26 for all penetrations in slabs and firewalls to meet code at the completion of work and prior to final testing demonstration to the Owner.
- N. The installation shall be performed in a professional manner.
- O. On a daily basis, clean up and deposit in appropriate containers all debris from work performed under the appropriate specification sections. Stack and organize all parts, tools and equipment when not being used.
- P. Preparation, handling and installation shall be in accordance with the Manufacturer's written instructions and technical data appropriate to the product specified.
- Q. All work shall conform to the National Electrical Contractor's Association "Standard of Installation" for general installation practice.

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- R. At the conclusion of the installation, all work areas, including all enclosures and boxes, shall be vacuumed and cleaned to remove all debris and grease.

3.2 COORDINATION WITH OWNER / ARCHITECT

- A. Close coordination with the Owner / Architect is vital to achieve a complete, aesthetically pleasing job. The Contractor shall ensure that the Owner / Architect is kept fully apprized of job progress.

3.3 CUTTING, PAINTING, AND PATCHING

- A. Structural members shall not be drilled, bored or notched in such a manner that shall impair their structural value. Cutting of holes in structural members, if required, shall be done with core drills and only with the specific approval of the Owner / Architect for each instance.
- B. All walls that require cutting or repair during the installation process shall be returned to their original condition, including the matching of colors and finishes to the satisfaction of the Owner / Architect, and at no additional cost to the Owner.

3.4 WIRE AND CABLE

- A. All low voltage cable shall be low smoke plenum rated, limited energy, with 300-volt insulation.
- B. All wires in exposed areas shall run through conduit as specified in Division 26.
- C. Provide conduits, cable trays, raceways, wireways, boxes and outlets as specified in Division 26.
- D. After installation, and before termination, all wiring shall be checked and tested to insure there are no grounds, opens, or shorts on any conductors. In addition, all wires between buildings or underground and all coax cables shall have insulation tested with a megohmmeter (megger) and a reading of greater than 20 megohms shall be required to successfully complete the test.
- E. Run wires continuously from termination to termination without splices.
- F. Wire and cable shall be supported in each equipment and terminal cabinet and in each terminal and pull box in vertical risers and horizontal runs with wire duct and strap-type supports. At any point where wire duct is required for good wire management, whether shown on elevations or not, install appropriate duct. Where terminal boards are used, wire ducts shall be supplied on both sides and at no time shall wires cross over terminal boards. Arrange cables neatly to allow inspection, removal and replacement. Lace cables as required. Spot tie wire bundles with plastic cable ties and securely affix to panels. If screw type terminals are specified, terminal strip connections shall be locking, tongue style, pressure crimp, and solderless spade lug.
- G. Visually inspect wire and cable for faulty insulation prior to installation. Protect cable ends at all times with acceptable end caps except during actual termination. At no time shall any coaxial cable be subjected to a bend less than a 6-inch radius. Protect wire and cable from kinks. Install 1 pull rope for all 2" or larger sized conduits.

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- H. Provide plastic bushings and strain relief material at all conduit exit points and where necessary, to avoid abrasion of wire and excess tension on wire and cable.
- I. Cables above accessible ceilings shall not rest on ceiling tiles. Use Velcro tie wraps, J-hooks or D-rings to hold cables. Provide independent support for all cables. Support is to be from building structure (do not support from pipes or conduits). ESS cables shall not tie off on HVAC supports, all-thread, ceiling grid hanger wire or electrical / mechanical piping system.
- J. Ground and bond equipment and circuits in accordance with NEC and Division 26.

3.5 IDENTIFICATION AND TAGGING

- A. All cables, wires, wiring forms, terminal blocks and terminals shall be identified by labels, tags to other permanent markings in accordance with TIA/EIA-606. The markings shall clearly indicate the function, source, or destination of all cabling, wiring and terminals. All cables and wires shall be identified, utilizing heat-shrink, machine printed, polyolefin wire markers (Brady Type B-32 *or equal*). Handwritten tags are not acceptable.
- B. Should a situation arise where the wire tagging format as shown on the drawings cannot be used, a substitute format shall be submitted which complies with the intent to provide documentation that will permit end-to-end tracing of all ESS Systems wiring.
- C. All panels shall be provided with permanently attached engraved lamacoid labels with identifying names and functions. All terminal points shall be appropriately labeled. Labels shall be consistent in form, color, and typeface throughout the system and all must contain the name of the system or subsystem as part of the label textual information. Design, color, font and layout shall be coordinated with, and approved by, the Owner.
- D. Identification of Equipment:
 - 1. All major equipment shall have a manufacturer's label identifying the manufacturer's address, equipment model and serial numbers, equipment size, and other pertinent data. Take care not to obliterate this nameplate. The legend on all nameplates or tags shall correspond to the identification shown on the Operating Instructions.
 - 2. A black-white-black 3-layer laminated plastic engraved identifying nameplate shall be permanently secured to each wireway, terminal cabinet, and ESS cabinet or rack.
 - a. Identifying nameplates shall have 1/2-inch high, engraved letters.
 - 3. Permanent, waterproof, black markers shall be used to identify each ESS grid junction box, clearly indicating the type of system available at that junction box.
 - 4. Pull Boxes: Field work each with a nameplate showing identity, and identifying equipment connected to it. Nameplates shall also indicate where pull box is fed from.
- E. Prohibited Markings: Markings intended to identify the manufacturer, vendor, or other source from whom the material has been obtained are prohibited for installation in public, tenant, or common areas within the project. Also prohibited are materials or devices that bear evidence that markings or insignias have been removed. Certification, testing (example, Underwriters Laboratories), and approval labels are exceptions to this requirement.

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- F. Warning Signs: Provide warning signs where there is hazardous exposure associated with access to or operation of ESS facilities. Provide text of sufficient size to convey adequate information at each location; mount permanently in an appropriate and effective location. Comply with industry standards for color and design.
- G. Wire and Cable Labeling: Provide wire markers on each conductor in all boxes, pull boxes, gutters, wireways. Identify with drop/circuit number.
- H. Underground Warning Tape: Thomas and Betts or approved equal. Six-inch wide plastic tape, colored red or orange with suitable warning legend describing buried ESS lines. All underground conduits shall be so identified. Tape shall be buried at a depth of 6-inches below grade and directly above conduits or ductbanks. Provide magnetic marking tape below all underground conduits.

3.6 CUTTING AND PATCHING

- A. General: Comply with the requirements of Division 01 for the cutting and patching of other work to accommodate the installation of electrical work. Except as authorized by the Architect / Engineer, cutting and patching of electrical work to accommodate the installation of other work is not permitted.

3.7 INSTRUCTION OF OWNER'S PERSONNEL

- A. Before proceeding with the instruction of Owner Personnel, prepare a typed outline, listing the subjects that will be covered in this instruction, and submit the outline for review by the Owner. At the conclusion of the instruction period obtain the signature of each person being instructed on each copy of the reviewed outline to signify that he has a proper understanding of the operation and maintenance of the systems and resubmit the signed outlines.
- B. Prior to substantial completion, conduct an on-site training program to instruct Owner's operating personnel in the operation and maintenance of the ESS systems.
 - 1. Provide the training during regular working day.
 - 2. The Instructors shall be experienced in their phase of operation and maintenance of the electrical systems and with the project.
- C. Time to be allocated for instructions.
 - 1. Minimum of 12 hours dedicated instructor time
 - 2. 4 hours on each of 3 days
 - 3. Additional instruction time for specific systems as specified in other Sections.
- D. Before on-site training, submit the program syllabus; proposed time and dates; for review and approval, minimum 48 hours prior to proposed training time and date.
 - 1. One copy to the Owner
 - 2. One copy to the Architect / Engineer
- D. The Owner shall provide a list of personnel to receive instructions and shall coordinate their attendance at the agreed upon times.
- E. Use operation and maintenance manuals as the basis of instruction. Review manual with personnel in detail. Explain all aspects of operation and maintenance.

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- F. Demonstrate start-up, operation, control, adjustment, troubleshooting, servicing, maintenance, and shut down of each item of equipment.
- G. Demonstrate equipment functions (both individually and as part of the total integrated system).
- H. Prepare and insert additional data in the operating and maintenance manuals when the need for additional data becomes apparent during instructions.
- I. Submit a report within one week after completion of training. List time and date of each demonstration, hours devoted to the demonstration, and a list of people present, with their respective signatures.
- J. At the conclusion of the on-site training program, have the person designated by the Owner sign a certificate to certify that he/she has a proper understanding of the system, that the demonstrations and instructions have been satisfactorily completed, and the scope and content of the operating and maintenance manuals used for the training program are satisfactory.
- K. Provide a copy of the report and the certificate in an appropriately tabbed section of each Operating and Maintenance Manual.

3.8 OPENINGS

- A. Framed, cast or masonry openings for boxes, equipment or conduits are specified under other divisions. Drawings and layout work for exact size and location of all openings are included under this division.

3.9 OBSTRUCTIONS

- A. The drawings indicate certain information pertaining to surface and subsurface obstructions, which has been taken from available drawings. Such information is not guaranteed, however, as to accuracy of location or complete information.
 - 1. Before any cutting or trenching operations are begun, verify with Owner's representative, utility companies, municipalities, and other interested parties that all available information has been provided.
 - 2. Should obstruction be encountered, whether shown or not, alter routing of new work, reroute existing lines, remove obstruction where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of the new work and leave existing services and structures in a satisfactory and serviceable condition.
- B. Assume total responsibility for and repair any damage to existing utilities or construction, whether or not such existing facilities are shown.

3.10 VANDAL RESISTANT DEVICES

- A. Where vandal resistant screws or bolts are employed on the project, deliver to the Owner 2 suitable tools for use with each type of fastener used.
- B. Proof of delivery of these items to the Owner shall be included in the Operating and Maintenance Manuals.

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3.11 PROTECTION

- A. Protect work, equipment, fixtures, and materials. At work completion, work must be clean and in original manufacturer's condition.
- B. Do not deliver equipment to this project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather shall be rejected, and the contractor is obligated to furnish new equipment of a like kind at no additional cost to the Owner.

3.12 EQUIPMENT BACKBOARDS

- A. Backboards: ¾ inch, fire retardant, exterior grade plywood, painted gray, both sides.
 - 1. Provide minimum of two 4-ft. by 8-ft. sheets of plywood for each location shown.
 - 2. Provide minimum of two 4-ft. by 4-ft. sheets of plywood for each ESS location.

3.13 SITE MANAGEMENT RESPONSIBILITY

- A. The Contractor shall provide an on-site Project Manager as defined in CONTRACTOR'S QUALIFICATIONS portion of this Section.

3.14 DEMOLITION AND RELOCATION

- A. The Contractor shall modify, remove, and relocate all materials and items so indicated on the drawings or required by the installation of new facilities. All removals and/or dismantling shall be conducted in a manner as to produce maximum salvage. Salvage materials shall remain as directed by the Owner. Materials and items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to the approval of the Owner. The Contractor may substitute new materials and items of like design and quality in lieu of materials and items to be relocated, if approved by the Owner.
- B. All items scheduled for relocation and/or reuse shall be inspected by the Contractor and the Owner or his authorized representative. A written report of the condition of each item shall be made and provided to the Consultant. Where items scheduled for relocation and/or reuse are considered unsuitable for reuse, the Contractor shall so notify the Consultant and await reinstallation instructions before proceeding with removal. Items damaged in reinstallation shall be repaired or replaced by the Contractor as directed by the Owner at no additional cost to the Owner or the Consultant.
- C. All items which are to be relocated shall be carefully removed in reverse to original assembly or placement and protected until relocated. The Contractor shall clean, repair, and provide all new materials, fittings, and appurtenances required to complete the relocation and to restore the items to good operative order. All relocations shall be performed by workmen skilled in the work and in accordance with standard practice of the trades involved.
- D. Service lines and wiring to items to be removed, salvaged, or relocated shall be removed to points as indicated on the drawings, specified, or acceptable to the Owner. Service lines and wiring not scheduled for reuse shall be removed to the points at which reuse is to be continued or service is to remain. Such services shall be sealed, capped, or otherwise tied off or connections into the existing facilities in such a manner as to result in

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minimum interruption of services to adjacent occupied areas. Services to existing areas or facilities which must remain in operation during the construction period shall not be interrupted without prior specific written approval of the Consultant.

3.15 EXISTING SYSTEM TESTING

- A. Contractor shall have each low voltage system tested prior to the commencement of construction. Systems shall include all systems that fall under the Division 28 umbrellas, as identified in the Division 2 of the Construction Specifications Institute (CSI) current Master Format. Test shall include the functionality of all field devices and equipment. Any failures or items found to be functioning not to specification, shall be reported prior to construction. Any items found to be improperly or non-functioning upon the completion of the project, shall be replaced and/or repaired, by the contractor, at no additional cost to the project or the owner.
- B. Contractor shall document the location and any ID tag, MAC address, IP address, or bar code of any existing device that is to be removed from its current location. Devices that are to remain, shall be reinstalled in the exact location that they reside in prior to construction, unless noted otherwise.
- C. Any individual/firm that will be removing, relocating, reinstalling, or tampering with any devices; shall be licensed by the state and certified by the manufacturer of the system.
- D. Contractor shall remove any devices where construction occurs to prevent possible damage to the device. Removal of any devices which support user connection or other systems, shall be coordinated with the owner prior to removal and/or taking offline.

3.16 START-UP RESPONSIBILITY

- A. The Contractor shall initiate System operation. The Contractor shall provide competent Start-Up personnel on each consecutive working day until all ESS Systems are functional and ready to start the acceptance test phase. If the Contractor, in the Owner / Architect's judgment, is not demonstrating progress in solving any technical problems, the Contractor shall supply Manufacturer's factory technical representation and diagnostic equipment at no cost to the Owner, until resolution of those defined problems. Where appropriate, the Contractor shall bring the Systems on-line in their basic state (i.e., alarm reporting, facility code access control, etc.) It is the responsibility of the Owner to provide the specific database information that will be utilized for initial system programming.
- B. Properly ground each piece of electronic equipment prior to applying power. Properly ground all shielded wire shields to the appropriate earth ground at the hub end only, not at the remote or device end.
- C. Use a start-up sequence that incrementally brings each portion of the system on-line in a logical order that incorporates checking individual elements before proceeding to subsequent elements until the entire system is operational. The basic steps should include:
 - 1. Establish ground planes at the equipment rooms and hub end of the systems as specified in Division 26.
 - 2. Disconnect power, connect the first device, reconnect power, and verify operational correctness. Repeat until the entire system is verified and operational.

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3.17 PREPARATION FOR ACCEPTANCE (SUBSTANTIAL COMPLETION)

- A. All systems, equipment, and devices shall be in full and proper adjustment and operation, and properly labeled and identified.
- B. All materials shall be neat, clean and unmarred, and parts securely attached.
- C. All extra material as specified shall be delivered and stored at the premises as directed.
- D. Test reports of each system and each system's components and As-Built Project Drawings shall be complete and available for inspection and delivery as directed by the Owner.

3.18 SYSTEM ACCEPTANCE REQUIREMENTS

- A. Before final acceptance or work, the Contractor shall perform and/or deliver each of the following in the order stated.
- B. The Contractor shall deliver three (3) composite "System Operations and Maintenance" manuals in three-ring binders, sized to hold the material below, plus 50% excess. Each manual shall contain in appropriately tabbed sections:
 - 1. A statement of Guarantee including date of termination and the name and phone number of the persons to be called in the event of equipment failure.
 - 2. A set of Operating procedures for the overall System that includes all required Owner activities, and that allows for the Owner operation of all attributes and facilities of the System.
 - 3. A section for each specific type of equipment containing the vendor manuals, instruction sheets, and any related literature that came in the original shipping container for that piece of equipment. Include all warranty cards.
- C. Testing:
 - 1. The Contractor shall perform all tests required by Division 28 and those submitted as part of this Section.
 - 2. The Contractor shall activate all devices for proper system operation, including supervisory and trouble circuit tests. Similarly, audible alarms will not be activated except on a one-time, coordinated basis, to check the actual sounding devices.
 - 3. A test report for each piece of equipment shall be prepared by the Contractor and submitted to the Owner. This report shall include a complete listing of every device, the date it was tested, by whom and the results. The final test reports shall indicate that every device tested successfully. Failure to completely test and document the tests will result in a delay of final testing and acceptance.
- D. As-Built Drawings:
 - 1. After completion of all the tests listed above, and prior to the final acceptance test, The Contractor shall submit the complete As-Built drawings as identified in PART 1 – PROJECT RECORD DRAWINGS.
 - 2. The final As-Built Drawings shall consist on one set of reproducible prints, two (2) sets of Point-to-Point Detail Drawings, Equipment Schedules, and the complete detailed technical data that was shipped by the manufacturer with all installed equipment.

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- E. Final Acceptance Test: The Final Acceptance Test shall demonstrate the installed and activated System's performance and compliance with System Specifications. However, before this testing can begin the following must have received and reviewed by the Owner.
1. System Operations and Maintenance Manuals
 2. System Test Reports
 3. As-Built Drawings

3.19 NOTICE OF COMPLETION

- A. When the Final System Acceptance Requirements described above including the Final Acceptance Test described above have been satisfactorily completed. The Owner / Architect shall issue a Letter of Completion to the Contractor indicating the date of such completion. The Notice of Completion shall be recorded by the Contractor upon receipt of the Owner / Architect completion letter. This date of record shall be the start of the warranty period.

END OF SECTION

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SECTION 280500

ELECTRONIC SAFETY AND SECURITY
BASIC MATERIALS, METHODS, AND GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Except as modified in this Section, General Conditions, Supplementary Conditions, applicable provisions of Division 01 General Requirements, and other provisions and requirements of the Contract Documents apply to work of Division 28 Electronic Safety and Security.
- B. Applicable provisions of this section apply to all sections of Division 28, Electronic Safety and Security.
- C. The general provisions of the Contract and the requirements of the following Sections apply to the Work specified in this Section. See following sections for related general and specific requirements following sections shall associate with this specification as applicable.
 - 1. Division 26 in its entirety.
 - 2. Division 27 in its entirety.
 - 3. Division 28 in its entirety.
- D. The entire drawing and specification package apply to the work specified in the Electronic Safety and Security specifications and shall be complied with in every respect. The Contract Documents are comprised of the drawings and specifications. The Contractor shall examine these Contract Documents, and coordinate required work indicated in each.

1.2 CODES AND STANDARDS

- A. All equipment and work performed shall comply with all of the current and applicable Codes, Rules, Ordinances, Regulations and Standards (including those not specifically listed in this Specification) as interpreted and enforced by the authorities having jurisdiction including:
 - 1. Americans with Disabilities Act (ADA)
 - 2. Authorities Having Jurisdiction (AHJ) - Local
 - 3. American National Standards Institute (ANSI)
 - 4. American Society of Testing and Materials (ASTM) *Communications Cables - B694, B736, D4565, D4566, D4730, D4731, D4732*
 - 5. Building Industry Consulting Services International (BICSI)
 - 6. Code of Federal Regulations - Title 47
 - 7. Electronics Industries Association (EIA) *Standard Test Procedures for Fiber Optic Fibers, Cables, Transducers, Connecting and Terminating Devices - EIA-455 Series*
 - 8. Federal Communications Commission (FCC) - Communications Act and FCC Rules
 - 9. Federal Information Processing Standards (FIPS) *Federal Building Standard for Telecommunications Pathways and Spaces - FIPS PUB 175, FIPS PUB 176*

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10. The Insulated Cable Engineers Association (ICEA) *Communications Cable Stands - P-47-434, S-56-434, S-80-576, S84-608, S-85-625, S-86-634, S-87-640, S-89-648, S-90-661, S-98-688, S-99-689, S-100-685*
 11. International Electro-technical Commission (IEC)
 12. Institute of Electrical and Electronic Engineers (IEEE) *Local Area Networks/Metropolitan Networks Standards Collection - LAN/MAN 802 Series*
 13. International Organization for Standardization (ISO) (ISO/IEC) *Premise Wiring Core and LAN/MAN Core Equivalents-11801, 8802, 14763-1*
 14. International Telecommunication Union (ITU-T) *Telecommunications Standardization*
 15. National Electrical Code (NEC) *National Electrical Code - NFPA 70*
 16. National Electrical Contractor's Association (NECA) *Standards of Installation*
 17. National Electrical Manufacturers Association (NEMA) *Performance Standard for Twisted Pair Premise Voice and Data Communications Cable-WC 63.1, WC 63.2, WC 66*
 18. National Electrical Safety Code (NESC)
 19. National Fire Protection Association (NFPA) - *National Fire Alarm Code NFPA 72, Life Safety Code NFPA 101*
 20. Society of Cable Telecommunications Engineers (SCTE)
 21. Local Accessibility Standards
 22. Telecommunications Industries Association (TIA) *(ANSI/TIA/EIA) Wiring and Cabling Standards - 526, 568, 569, 570, 571, 598, 606, 607, 758, TSB 31-B, 63, 67, 72, 75 and 95*
 23. Uniform Building Code (UBC)
 24. Underwriters Laboratories, Inc. (U.L.) - *497A, 910, 1077, 1863, 1283, 1459, 1604, 1651, 1681, 1690, 1778, 1977*
- B. Resolve any code violations discovered in contract documents with the Engineer prior to award of the contract. After Contract award, any correction or additions necessary for compliance with applicable codes shall be made at no additional cost to the Owner.
- C. This Contractor shall be responsible for being aware of and complying with asbestos NESHAP regulations, as well as all other applicable codes, laws and regulations.
- D. Obtain all permits required.

1.3 SUMMARY

- A. The work covered by the specifications includes furnishing materials, labor, transportation, tools, permits, fees, utilities, and incidentals necessary for the complete installation of work required in the Contract Drawings.
- B. It is the intent of the Contract Documents to provide a new and/or an extension of the existing installation, as shown in the associated specifications and drawings, complete in every respect.
- C. Provide complete and working ESS Systems including equipment, conduit, wiring, material, labor and training as described in this Specification and the Drawings. The ESS Systems Drawings and Specifications are the sole property of the Architect and are not to be duplicated, scanned, loaned or in any way made available to persons not designated as authorized by the Architect. All ESS Systems plans and specifications are to be returned to the Architect following completion of bid.

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1.4 CONTRACTOR'S QUALIFICATIONS

- A. An approved contractor for the work under this division shall be:
 - 1. A specialist in this field and have the personnel, experience, training, and skill, and the organization to provide a practical working system.
 - 2. Able to furnish evidence of having contracted for and installed not less than ten (10) systems of comparable size and type that have served their Owners satisfactorily for not less than 3 years.
 - 3. Perform work by persons qualified to produce workmanship of specified quality. Persons performing work shall be required to be licensed. Onsite supervision shall have minimum of the following:
 - a. Licenses, as applicable to the system being installed
 - b. Manufacturer's Certifications
 - 1) Firm Certification
 - 2) Installer Certification
 - 3) Programmer's Certification
 - 4) System Designer Certification.

1.5 DRAWINGS AND SPECIFICATIONS

- A. The drawings and these specifications are complementary to each other, and what is required by one shall be as binding as if required by both.
- B. If variations or departures from the drawings are deemed necessary by the Contractor, details of such departures and the reasons therefore shall be submitted to the Consultant for review. No departures shall be made without prior written acceptance of the Consultant.
- C. Should the drawings or specifications disagree in themselves or with their counterpart, the better quality or greater quantity of work or materials shall be estimated upon, and unless otherwise directed by the Consultant in writing, shall be performed or furnished. In the case that the specifications should not fully agree with the Schedules, the latter shall govern. Figures indicated on drawings govern scale measurements and large-scale details govern small scale drawings.
- D. The approximate locations of system equipment and components are indicated on the Drawings. These Drawings are not intended to give complete and accurate details in regard to location of equipment, field devices, etc. Exact locations are to be determined by actual measurements at the building and will in all cases be subject to the Review of the Owner or Consultant, who reserves the right to make any reasonable changes in the locations indicated without additional cost to the Owner.
- E. Items specifically mentioned in the Specifications but not shown on the Drawings and/or items shown on Drawings but not specifically mentioned in the Specifications shall be installed by the Contractor under the appropriate section of work as if they were both specified and shown.
- F. Any discrepancies between the Contract Documents and actual job site conditions shall be reported to the Owner or Consultant, so that they will be resolved prior to the bidding, where this cannot be done at least 7 working days prior to bid; the greater or costlier of the discrepancy shall be bid. All labor and materials required to perform the work described shall be included as part of this Contract.

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- G. It is the intention of this Section of the Specifications, and associated drawings, to outline minimum requirements to furnish the Owner with a turnkey and fully operating system in cooperation with other trades.
- H. The contract documents are schematic in nature in that they are only to establish scope and a minimum level of quality. They are not to be used as actual working construction drawings. The actual working construction drawings shall be the shop drawings accepted by project's consultant.
- I. The Contractor shall be responsible for coordination and proper relation of his work to the building structure and to the work of all trades. The Contractor shall visit the premises and thoroughly familiarize himself with the existing site conditions, details of the work and the working conditions, and verify dimensions in the field. The Contractor shall advise the project's consultant of any discrepancy prior to bidding. The submission of bids shall be deemed evidence of the Contractor's site visit; coordination of existing conditions and include consideration for existing conditions.
- J. These documents are conceptual in nature. It shall be the responsibility of the approved installer to furnish a complete and functional system, including the items shown on the drawings, in the specifications, and items not designated in either. The installer's shop drawings and product data submittals shall represent a complete system and documents accepted by the project's consultant shall not relieve the installer from being required to provide any materials, equipment, or labor to furnish a complete and functional system as recognized by the Project's Technology Consultant and the Owner.

1.6 BUILDING CONSTRUCTION AND LAYOUT OF WORK

- A. General: It shall be the responsibility of the Contractor to consult the Engineering Drawings and Details so as to thoroughly familiarize himself with the type and quality of construction to be provided on this project.
- B. The drawings are diagrammatic in nature and do not show every connection in detail or every line or conduit in its exact location. These details are subject to the requirements of all codes, ordinances, and standards; as well as all structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in closed ceiling space and/or furred chases unless specifically noted or indicated to be exposed. Work shall be installed to avoid crippling of structural members. All work shall be run parallel or perpendicular to the lines of the building unless otherwise noted.
- C. The approximate location of equipment items is indicated on the drawings. Exact locations are to be determined by coordination of dimensions from approved equipment submittals and site-verified field measurements and will in all cases be subject to the approval of the Consultant. The Consultant reserves the right to make any reasonable changes in the indicated locations prior to installation for no additional cost.
- D. In areas of existing special ceiling construction, the removal and restoration must be carefully planned such that the existing condition of the ceilings is maintained. It may be necessary for the Contractor to procure a Subcontractor familiar with this work to achieve this requirement.

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- E. Consider space limitations imposed by contiguous work in selection and location of equipment and material. Do not provide equipment or material that is not suitable in this respect.

1.7 RELATION WITH OTHER TRADES

- A. Carefully study all matters and conditions concerning the project. Submit notification of conflict in ample time to prevent unwarranted changes in any work. Review other Divisions of these specifications to determine their requirements. Extend electrical services and final connections to all items requiring same.
- B. Because of the complicated relationship of this work to the total project, conscientiously study the relation and cooperate as necessary to accomplish the full intent of the documents.
- C. Where cabling pass through walls or floors, metal sleeves shall be provided and shall be sealed to prevent spread of fire and smoke. In walls, they shall extend 3" beyond the finished surface. In pipe chases, they shall extend 8" inches above floor slab and be cemented in a watertight manner. Size of these sleeves shall be at least as required to maintain a maximum 40% conduit fill ratio. 1/2 inch greater than outside diameter of the conduit.
- D. Locate and size openings required for installation of work specified in this Division in sufficient time to prevent delay in the work.
- E. Refer to other Divisions of the specifications for the scope of required connections to equipment furnished under other Division. Determine from the General Contractor / Construction Manager for the various trades, the Owner, and by direction from the Architect / Engineer, the exact location of all items. The construction trades involved shall furnish all roughing-in drawings and wiring diagrams required for proper installation of the electrical work.
 - 1. Make final connections to all ESS equipment indicated on the drawings, except as noted.
- F. Request all Shop Drawings required in ample time to permit proper installation of all electrical provisions.
- G. Extend services as indicated to the various items of equipment furnished by others. Rough-in for the various items and make final connections ready for operation upon placing of the equipment.

1.8 CONCEALED AND EXPOSED WORK

- A. When the word "concealed" is defined as hidden from sight as in chases, furred spaces or above ceilings. "Exposed" is defined as open to view, in plain sight.

1.9 GUARANTEE

- A. Guarantee work for a minimum of two years or as noted longer elsewhere from the date of substantial completion of the project. During that period make good any faults or imperfections that may arise due to defects or omissions in material, equipment or workmanship. At the Owner's option, replacement of failed parts or equipment shall be provided.

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1.10 MATERIAL AND EQUIPMENT

- A. Furnish new and unused materials and equipment meeting the requirements of the paragraph specifying acceptable manufacturers. Where two or more units of the same type or class of equipment are required, provide units of a single manufacturer.

1.11 NOISE AND VIBRATION

- A. Select equipment to operate with minimum noise and vibration. If noise or vibration is produced or transmitted to or through the building structure by equipment, piping, ducts or other parts of work, and judged objectionable by the Owner, Architect, or Engineer, rectify such conditions at no additional cost to the Owner. If the item of equipment is judged to produce objectionable noise or vibration, demonstrate at no additional cost that equipment performs within designated limits on a vibration chart.

1.12 ACCEPTABLE MANUFACTURERS

- A. Manufacturers names and catalog number specified under sections of Division 28 are used to establish standards of design, performance, quality and serviceability and not to limit competition. Equipment of similar design, equal to that specified, manufactured by a named manufacturer shall be acceptable on approval. A request for prior approval of equipment not listed must be submitted ten (10) days before proposal due date. Submit complete design and performance data to the Architect. The Architect and Owner issue approvals of acceptable manufacturers as addenda to the Construction Proposal Documents.
- B. Where acceptable manufacturers are listed, only products of those manufacturers may be provided. Additionally, the product must meet all the detailed requirements of the specifications.
- C. If no manufacturer's name is mentioned, the Contractor shall provide equipment and material which meet the specifications.

1.13 UTILITIES, LOCATIONS AND ELEVATIONS

- A. Locations and elevations of the various utilities included within the scope of this work:
 - 1. Obtained from utility maps and other substantially reliable sources.
 - 2. Are offered separate from the Contract Documents as a general guide only without guarantees to accuracy.
- B. Examine the site and verify the location and elevation of all utilities and of their relation to the work. Existing utilities indicated on the site plans are for reference only and shall be field verified by the Contractor with the respective public or private utility.

1.14 CONTRACT DRAWINGS

- A. Contract drawings are diagrammatic only and do not give fully dimensioned locations of various elements of work. Determine exact locations from field measurements.
- B. It is the responsibility of the Contractor to compare the scale of all electrical drawings with the scale of the architectural drawings and make adjustments to all electrical drawings which have the incorrect drawing scale so that his material takeoffs are not in error due to an incorrectly labeled drawing scale and his proposal is complete.

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1.15 ABBREVIATIONS AND DEFINITIONS

Abbreviations:

A/V	Audio/Visual
AWG	American Wire Gauge
BCR	Building Communications Room
CMP	Communications Media Plenum
CMR	Communications Media Riser
dB	Decibel
EMI	Electromagnetic Interference
ER	Equipment Room
ESS	Electronic Safety and Security
FACP	Fire Alarm Control Panel
FCR	Floor Communications Room
Hz	Hertz
IDF	Intermediate Distribution Frame
Km	Kilometer
LCD	Liquid Crystal Display
LED	Light Emitting Diode
M	Micron
MDF	Main Distribution Frame
MHz	Megahertz
NEXT	Near-End Cross Talk
nm	Nano-meter
OFN	Optical Fiber Non-conductive
OFNP	Optical Fiber Non-conductive Plenum
OFNR	Optical Fiber Non-conductive Riser
OTDR	Optical Time Domain Reflectometer
TC	Telecommunications Closet (<i>Now referred to as TR</i>)
TR	Telecommunications Room (<i>A.K.A. TC - Telecommunication Closet</i>)
UTP	Unshielded Twisted Pair Wire

Definitions:

Low Voltage Wire - Wire or cable used for one or more systems that operate on 24 volts or less. Low Voltage Wire is used to install and interconnect one or more of the ESS Systems. Low Voltage Wire includes patch cords, jumpers and all portions of cable or wire used to make the ESS Systems operational or for system communications.

Electronic Safety and Security Systems - One or more of the following and associated equipment: Fire Detection/Alarm Systems, Intrusion Detection/Alarm Systems, Access Control Systems, Video Surveillance Systems,

1.16 QUALITY ASSURANCE

A. Equipment Standards:

1. System and all components shall be brand new stock from manufacturer.
2. All electronics shall be 100% solid state.
3. System and all components shall bear a UL Label.

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B. Contractor Qualifications:

At the time of Proposal, the Contractor shall:

1. Have manufactured, supplied or installed at least three (3) other systems of similar size, complexity, and general operation as the systems described in these specifications. The Contractor shall furnish in writing to Architect proof of compliance with this paragraph at the time of proposal.
2. Hold all legally required Texas State Contractor's licenses necessary to accomplish the installation and activation of the described system at the facilities indicated. The Contractor shall submit copies of licenses to the Architect prior to the start of work
3. Hold all legally required state registrations to meet local requirements for submittal drawings.
4. Have a local office within fifty (50) miles of the project site staffed with factory trained technicians who have experience on systems of similar complexity and function as the systems described in these specifications. These technicians shall be fully capable of system engineering support, installation supervising, system start-up, and providing the Owner with training and service on both hardware and software for the systems specified.
5. Certify complete and total compliance with the provisions of these specifications by letter or submittal of the proposal response forms, signed by an officer of the corporation, or a principal if other ownership currently exists. In addition, the letter or forms shall include a complete listing of exceptions, if any.

1.17 SUBMITTALS

A. Provide SUBMITTALS according to Division 1 and the following.

B. Requirements:

1. Submit paragraph-by-paragraph specification review indicating compliance or deviation with explanation.
2. Submit proof that all system components and cables are U.L. Listed.
3. An equipment list with names of manufacturers, model numbers, and technical information on all equipment proposed. Clearly mark exact model number proposed to be installed.
4. Product technical information sheets for each principal components in the proposed system, including cable, wire, terminal marking, and wire marking material.
5. Certification from the manufacturer stating that the system Contractor is an authorized distributor or installer of the proposed system when such certifications exist.
6. A statement listing every technical and operational parameter wherein the submitted equipment varies from that which was originally specified. If the submitter fails to list a particular variance and his submittal is accepted, but is subsequently deemed to be unsatisfactory because of the unlisted variance, the submitter shall replace or modify such equipment at once and without cost to the Owner.

1.18 EXAMINATION OF SITE

A. The Contractor shall have visited the site and familiarized himself with all existing conditions prior to submitting his proposal and shall be prepared to carry out the work within the existing limitations. Failure or neglect to do so shall not relieve the Contractor of his responsibilities not entitle him to additional compensation for work overlooked and not included in his proposal.

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- B. The Contractor shall confirm the availability of the proper power source for each piece of specified equipment, through site visits and Drawings as necessary. Where proper power does not exist, the Contractor shall provide the required power, circuits, outlets, conduits, and wire as specified under Division 26.

1.19 DATA ACCURACY

- A. Absolute accuracy of information regarding existing conditions cannot be guaranteed. The Drawings and Specifications are for the assistance and guidance of the Contractor and exact locations, distances, elevations, etc., shall be governed by actual field conditions. Where variations from the contract documents are required, such variations shall be approved by the Architect / Owner.

1.20 SECURITY

- A. The Contractor is responsible for complying with all of the Owner's and facility security's requirements to prevent theft or damage to equipment, tools and materials. If any deviation from facility security requirements is necessary, approval for such deviation shall be coordinated with the Owner.
- B. The Contractor shall not disclose any confidential information of the Owner. The Contractor acknowledges that such action is highly injurious and can do damage to the Owner. The Contractor will agree to and comply with the standard policies and provisions of the Owner regarding outside Contractors and Consultants.

1.21 UTILITIES

- A. It shall be the responsibility of the Contractor to provide all temporary connection and cables, lighting, light stands and power. The facilities shall be used in accordance with all applicable regulations regarding operations, safety and fire hazards of the governmental Authorities Having Jurisdiction, provided they are not used in a wasteful manner.

1.22 PERMITS

- A. All permits required for the specified performance and completion of the work shall be secured by the Contractor. These permits shall be presented and reviewed at the initial project progress meeting.

1.23 NOTIFICATION

- A. The Contractor shall not shut off any existing systems. The Contractor shall give the Owner at least ten (10) calendar day's notice of any requirements to shut off or interference with existing alarm, regulating, computer or other service systems. The Owner will arrange and execute any shutdown. All work such as splicing, connections, etc., necessary to establish or re-establish any system shall be completed by the Contractor in close coordination with the Owner.

1.24 INTERFERENCES WITH THE OWNER

- A. Transportation and storage of materials at the facility, work involving the facility, and all other matters affecting the habitual use by the Owner of its buildings, shall be conducted so as to cause the least possible interference, and at times and in a manner acceptable to the Owner. The Contractor shall make every effort to delivery equipment per the schedule required by the project.

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1.25 PROJECT RECORD DOCUMENTS

- A. Maintain at the job site a separate set of white prints (blue line or black line) of the contract drawings for the sole purpose of recording the "as-built" changes and diagrams of those portions of work in which actual construction is significantly at variance with the contract drawings. Mark the drawings with a colored pencil. Prepare, as the work progresses and upon completion of work, reproducible drawings clearly indicating locations of various major and minor feeders, equipment, and other pertinent items, as installed. Record underground and underslab cables installed, dimensioning exact location and elevation of such installations.
- B. At conclusion of project, obtain without cost to the Owner, electronic AutoCAD 2014+ / Revit CAD files of the original drawings and transfer as-built changes to these. Provide the following as-built documents including all contract drawings regardless of whether corrections were necessary and include in the transmittal: "2 sets of CDs and prints for Owner's use, one set of CDs, prints, and mylars for Architect / Engineers Records". Delivery of these as-built electronic, reproducible and prints is a condition of final acceptance.
 - 1. 3 sets of electronic AutoCAD (2014+ dwg) / Revit CAD drawing files, on CD-ROM media, of each contract as-built drawing.
 - 2. One reproducible Dayrex mylar film positive of each contract as-built drawing.
 - 3. Three sets of blue or black-line prints of each contract as-built drawing.
- C. As-Built Drawings should indicate the following information as a minimum:
 - 1. Indicate all addendum changes to documents.
 - 2. Remove Engineer's Seal, name, address, and logo from drawings.
 - 3. Mark documents AS-BUILT DRAWINGS.
 - 4. Clearly indicate: DOCUMENT PRODUCED BY:
 - 5. Indicate all changes to construction during construction. Indicate actual routing of all conduit and cables, etc that were deviated from construction drawings.
 - 6. Indicate exact location of all underground ESS raceways, and elevations.
 - 7. Correct schedules to reflect (actual) equipment furnished and manufacturer.
 - 8. During the execution of work, maintain a complete set of Drawings and specifications upon which all locations of equipment, devices, and all deviations and changes from the construction documents in the work shall be recorded.
 - 9. Exact location of all ESS equipment in building. Label panel schedules to indicate actual location.
 - 10. Exact location of all ESS equipment in and outside of the building.
 - 11. Location, size and routing of all ESS cables, conduits, equipment, etc. shall be accurately and neatly shown to dimension.
 - 12. Exact location of all roof mounted equipment, wall, roof and floor penetrations.
 - 13. Cloud all changes.

1.26 OPERATING TESTS

- A. After all ESS systems have been completed and put into operation, subject each system to an operating test under design conditions to ensure proper sequencing and operation throughout the range of operation. Tests shall be made in the presence of the Architect / Engineer and Owner. Provide minimum 24-hour advance notice of scheduling of all tests. Make adjustments as required to ensure proper functioning of all systems. Special tests on individual systems are specified under individual sections. Submit 3 copies of all certifications and test reports adequately in advance of completion of the work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

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1.27 WARRANTY

- A. All equipment shall be covered for the full manufacturers warranty period and systems shall be warranted by the Contractor for a period of two years commencing with the filing date of substantial completion. The Warranty shall cover all costs for warranty service, including parts, labor, prompt field service, pick-up, transportation, delivery, reinstallation, and retesting. A contract for service shall cover the period starting with the first expected activation of each system and shall continue without interruption to cover the period to the end of the two-year warranty as defined above. The end of the warranty period shall be handled such that a smooth transition to a maintenance agreement with the Owner shall be achieved with no lapse in coverage.
- B. Submit 3 copies of all warranties and guarantees for systems, equipment, devices and materials. These shall be included in the Operating and Maintenance Manuals.

1.28 BUILDING CONSTRUCTION

- A. It shall be the responsibility of the sub-contractor to consult the Architectural and Engineering drawings, details and specifications and thoroughly familiarize himself as to the construction and all job-related requirements. All construction trades shall cooperate with the General Contractor / Construction Manager job site superintendent and lay out work so that all piping, cables, pathways, raceways, and other items are placed in the walls, furred spaces, chases, etc., so that there shall be no delay in the job.

1.29 TEMPORARY FACILITIES

- A. General: Refer to Division 01 for general requirements on temporary facilities.
- B. Temporary Wiring: Temporary power and lighting for construction purposes shall be provided under Division 26. Installation of temporary power shall be in accordance with NEC Article 305.
- C. Temporary facilities, wire, lights and devices are the property of this Contractor and shall be removed at the completion of the Contract.

1.30 EXTRA MATERIALS

- A. Keys: Provide three (3) sets of all keys for system cabinets.

PART 2 - PRODUCTS

2.1 WORK INCLUDED

- A. All materials listed in PART 2 - PRODUCTS of this Division Sections and on the Drawings shall be provided by the Contractor unless specifically excluded or modified in other portions of this Specification or Addendums.

2.2 GENERAL MATERIALS AND EQUIPMENT REQUIREMENTS

- A. Materials, in general, shall conform to the National Electrical Code requirements and shall be listed, inspected, and approved by the Underwriters Laboratories and shall bear the UL label where labeling service is available. The label or listing of the Underwriters Laboratories, Inc. will be accepted as evidence that the materials or equipment conform to the applicable standards of that agency. In lieu of this listing, the Contractor may

HKS 26399.005

ELECTRONIC SAFETY AND SECURITY SYSTEMS BASIC MATERIALS,
METHODS AND GENERAL PROVISIONS
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submit a statement from a nationally recognized, adequately equipped testing agency, indicating that the items have been tested in accordance with required procedures, and that the materials and equipment comply with all Contract requirements.

2.3 STANDARD PRODUCTS

- A. Materials and equipment shall be the standard catalog products of manufacturers regularly engaged in the manufacture of products conforming to these specifications and shall essentially duplicate materials and equipment that have been in satisfactory use at least two (2) years prior to bid opening. Where custom or special items are required, these shall be fully described using drawings, material lists, etc., which fully describe in detail the item proposed for use on this project.

2.4 MANUFACTURE'S INSTRUCTIONS

- A. The Contractor is responsible for furnishing the proper Electronic Safety and Security equipment and/or material and for seeing it is installed as intended by the manufacturer. The Contractor shall, wherever necessary, request advice and supervisory assistance from equipment manufacturers as required for the proper installation, operation, or start-up. The Contractor shall notify the Consultant, in writing, of any conflict between the Contract Documents and the manufacturer's recommendations and shall obtain, from the Consultant, instructions/direction before proceeding with the work. The Contractor shall pay for all costs resulting from deficiencies created by installation not in accordance with the manufacturer's recommendations or the instructions of the Consultant.

2.5 RUST PREVENTION

- A. Metallic materials shall be protected against corrosion. Exposed metallic parts of equipment exposed to the elements shall be given a rust inhibiting treatment and standard finish by the manufacturer. Components such as boxes, bodies, fittings, guards, and miscellaneous parts shall be protected in accordance with the ASTM A123 or A153, except where other equivalent protective treatment is specifically approved in writing.

2.6 STORAGE AT SITE

- A. The Contractor shall not receive material or equipment at the job site until ready for installation or until there is suitable space provided to properly protect equipment from rust, weather, humidity, dust, or physical damage.
- B. All electronic equipment, containing sealed lead acid batteries or gel cells, shall be stored in climate-controlled area until installed or reinstalled. Do not store in non-climate controlled connex storage units.
- C. Storage is to be provided and secured by the contractor. In the event that the Owner should agree to furnish storage space, security of the space and its contents shall remain the responsibility of the contractor.

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2.7 CONDITION OF MATERIALS

- A. All materials required for the installation of the Electronic Safety and Security systems shall be new and unused. Any material or equipment damaged in transit from the factory, during delivery to premises, while in storage on premises, while being installed, or while being tested, until time of final acceptance, shall be replaced by this Contractor without extra cost to Owner.

2.8 NAMEPLATES

- A. Factory assembled components and equipment shall be provided with be factory stamped labeling. Labeling will have information required to specifically identify the component and/or equipment in the future such as the manufacturer's name, catalog number, serial number, etc. All data on the labels shall be legible at the time of final inspection.

2.9 ACCESS DOORS

- A. Wherever access is required in walls or ceilings to concealed junction boxes, pull boxes, equipment, etc., installed under this Division, furnish a hinged access door and frame with flush latch handle to another Division for installation. Doors shall be as follows:
 - 1. Plaster Surfaces: Milcor Style K.
 - 2. Ceramic Tile Surfaces: Milcor Style M.
 - 3. Drywall Surfaces: Milcor Style DW.
 - 4. Install panels only in locations approved by the Architect.

2.10 SPACE LIMITATIONS

- A. Equipment shall be chosen which shall properly fit into the physical space provided and shown on the drawings, allowing ample room for access, servicing, removal and replacement of parts, etc. Adequate space shall be allowed for clearances in accordance with applicable codes and standards. Physical dimensions and arrangement of equipment shall be subject to the approval of the Consultant.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. This project has a critical path, which must be closely followed in order to meet the completion date. The Contractor shall review the proposed schedule at the Award of Contract meeting and be prepared to staff his work force according to the schedule constraints presented at that time.
- B. Aesthetics are an important consideration in this installation. All components shall be installed so as to have aesthetically pleasing results as determined by the Owner and Architect. Actual locations of all visible components shall be coordinated in advance with the Owner and Architect.
- C. Install, make fully operational and test the system as indicated on the Drawings and in the Specifications. Where information is not available the worst-case condition must be assumed to ensure a complete, functional system.

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- D. Any interfacing with other systems shall be the Contractor's responsibility under this contract, and the details, both logical and physical, of such interfaces shall be reflected in the Submittals and As-Built drawings.
- E. If appropriate, interfaces with the Owner's Data Network or Telecommunications System shall be coordinated with the Owner and Architect.
- F. All necessary back boards, back-boxes, pull-boxes, connectors, supports, conduit, cable and wire shall be furnished and installed to provide a complete and reliable system. Exact location of all backboards, boxes, conduit and wiring runs shall be presented to the Owner / Architect for approval in advance of any installation. Provide as required and as specified in Division 26.
- G. Where required provide 120-VAC, 60 Hz power from nearest electrical panel through a junction box, to the system devices. Provide as required and as specified in Division 26.
- H. Where required, install conduit, cable and wire parallel and square with building lines, including raised floor areas. Conduit fills shall not exceed 40%.
- I. All equipment shall be mounted with sufficient clearance to minimize EMI as well as meet all applicable codes and facilitate observation and testing. Securely hand and/or fasten with appropriate fittings to ensure positive grounding, free of ground loops, throughout the entire system. Units shall be installed parallel and square to building lines.
- J. Quiet and vibration-free operation of all equipment is a requirement of this installation. Properly adjust, repair, balance or replace any equipment producing objectionable (in the judgment of the Owner or Architect) noise or vibration in any of the occupied areas of any building and provide additional brackets and bracing if necessary. Any such additions or changes shall be at no additional cost to the Owner.
- K. Installation shall comply with the CODES AND STANDARDS portion of this Section. Where more than one code or regulation is applicable, the more stringent shall apply.
- L. Where new equipment is replacing old equipment, the Contractor is responsible for removing and disposing of the old equipment and doing whatever repair work is necessary as specified by the Owner / Architect.
- M. Install firestopping, as specified in Division 26 for all penetrations in slabs and firewalls to meet code at the completion of work and prior to final testing demonstration to the Owner.
- N. The installation shall be performed in a professional manner.
- O. On a daily basis, clean up and deposit in appropriate containers all debris from work performed under the appropriate specification sections. Stack and organize all parts, tools and equipment when not being used.
- P. Preparation, handling and installation shall be in accordance with the Manufacturer's written instructions and technical data appropriate to the product specified.
- Q. All work shall conform to the National Electrical Contractor's Association "Standard of Installation" for general installation practice.

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- R. At the conclusion of the installation, all work areas, including all enclosures and boxes, shall be vacuumed and cleaned to remove all debris and grease.

3.2 COORDINATION WITH OWNER / ARCHITECT

- A. Close coordination with the Owner / Architect is vital to achieve a complete, aesthetically pleasing job. The Contractor shall ensure that the Owner / Architect is kept fully apprized of job progress.

3.3 CUTTING, PAINTING, AND PATCHING

- A. Structural members shall not be drilled, bored or notched in such a manner that shall impair their structural value. Cutting of holes in structural members, if required, shall be done with core drills and only with the specific approval of the Owner / Architect for each instance.
- B. All walls that require cutting or repair during the installation process shall be returned to their original condition, including the matching of colors and finishes to the satisfaction of the Owner / Architect, and at no additional cost to the Owner.

3.4 WIRE AND CABLE

- A. All low voltage cable shall be low smoke plenum rated, limited energy, with 300-volt insulation.
- B. All wires in exposed areas shall run through conduit as specified in Division 26.
- C. Provide conduits, cable trays, raceways, wireways, boxes and outlets as specified in Division 26.
- D. After installation, and before termination, all wiring shall be checked and tested to insure there are no grounds, opens, or shorts on any conductors. In addition, all wires between buildings or underground and all coax cables shall have insulation tested with a megohmmeter (megger) and a reading of greater than 20 megohms shall be required to successfully complete the test.
- E. Run wires continuously from termination to termination without splices.
- F. Wire and cable shall be supported in each equipment and terminal cabinet and in each terminal and pull box in vertical risers and horizontal runs with wire duct and strap-type supports. At any point where wire duct is required for good wire management, whether shown on elevations or not, install appropriate duct. Where terminal boards are used, wire ducts shall be supplied on both sides and at no time shall wires cross over terminal boards. Arrange cables neatly to allow inspection, removal and replacement. Lace cables as required. Spot tie wire bundles with plastic cable ties and securely affix to panels. If screw type terminals are specified, terminal strip connections shall be locking, tongue style, pressure crimp, and solderless spade lug.
- G. Visually inspect wire and cable for faulty insulation prior to installation. Protect cable ends at all times with acceptable end caps except during actual termination. At no time shall any coaxial cable be subjected to a bend less than a 6-inch radius. Protect wire and cable from kinks. Install 1 pull rope for all 2" or larger sized conduits.

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- H. Provide plastic bushings and strain relief material at all conduit exit points and where necessary, to avoid abrasion of wire and excess tension on wire and cable.
- I. Cables above accessible ceilings shall not rest on ceiling tiles. Use Velcro tie wraps, J-hooks or D-rings to hold cables. Provide independent support for all cables. Support is to be from building structure (do not support from pipes or conduits). ESS cables shall not tie off on HVAC supports, all-thread, ceiling grid hanger wire or electrical / mechanical piping system.
- J. Ground and bond equipment and circuits in accordance with NEC and Division 26.

3.5 IDENTIFICATION AND TAGGING

- A. All cables, wires, wiring forms, terminal blocks and terminals shall be identified by labels, tags to other permanent markings in accordance with TIA/EIA-606. The markings shall clearly indicate the function, source, or destination of all cabling, wiring and terminals. All cables and wires shall be identified, utilizing heat-shrink, machine printed, polyolefin wire markers (Brady Type B-32 *or equal*). Handwritten tags are not acceptable.
- B. Should a situation arise where the wire tagging format as shown on the drawings cannot be used, a substitute format shall be submitted which complies with the intent to provide documentation that will permit end-to-end tracing of all ESS Systems wiring.
- C. All panels shall be provided with permanently attached engraved lamacoid labels with identifying names and functions. All terminal points shall be appropriately labeled. Labels shall be consistent in form, color, and typeface throughout the system and all must contain the name of the system or subsystem as part of the label textual information. Design, color, font and layout shall be coordinated with, and approved by, the Owner.
- D. Identification of Equipment:
 - 1. All major equipment shall have a manufacturer's label identifying the manufacturer's address, equipment model and serial numbers, equipment size, and other pertinent data. Take care not to obliterate this nameplate. The legend on all nameplates or tags shall correspond to the identification shown on the Operating Instructions.
 - 2. A black-white-black 3-layer laminated plastic engraved identifying nameplate shall be permanently secured to each wireway, terminal cabinet, and ESS cabinet or rack.
 - a. Identifying nameplates shall have 1/2-inch high, engraved letters.
 - 3. Permanent, waterproof, black markers shall be used to identify each ESS grid junction box, clearly indicating the type of system available at that junction box.
 - 4. Pull Boxes: Field work each with a nameplate showing identity, and identifying equipment connected to it. Nameplates shall also indicate where pull box is fed from.
- E. Prohibited Markings: Markings intended to identify the manufacturer, vendor, or other source from whom the material has been obtained are prohibited for installation in public, tenant, or common areas within the project. Also prohibited are materials or devices that bear evidence that markings or insignias have been removed. Certification, testing (example, Underwriters Laboratories), and approval labels are exceptions to this requirement.

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- F. Warning Signs: Provide warning signs where there is hazardous exposure associated with access to or operation of ESS facilities. Provide text of sufficient size to convey adequate information at each location; mount permanently in an appropriate and effective location. Comply with industry standards for color and design.
- G. Wire and Cable Labeling: Provide wire markers on each conductor in all boxes, pull boxes, gutters, wireways. Identify with drop/circuit number.
- H. Underground Warning Tape: Thomas and Betts or approved equal. Six-inch wide plastic tape, colored red or orange with suitable warning legend describing buried ESS lines. All underground conduits shall be so identified. Tape shall be buried at a depth of 6-inches below grade and directly above conduits or ductbanks. Provide magnetic marking tape below all underground conduits.

3.6 CUTTING AND PATCHING

- A. General: Comply with the requirements of Division 01 for the cutting and patching of other work to accommodate the installation of electrical work. Except as authorized by the Architect / Engineer, cutting and patching of electrical work to accommodate the installation of other work is not permitted.

3.7 INSTRUCTION OF OWNER'S PERSONNEL

- A. Before proceeding with the instruction of Owner Personnel, prepare a typed outline, listing the subjects that will be covered in this instruction, and submit the outline for review by the Owner. At the conclusion of the instruction period obtain the signature of each person being instructed on each copy of the reviewed outline to signify that he has a proper understanding of the operation and maintenance of the systems and resubmit the signed outlines.
- B. Prior to substantial completion, conduct an on-site training program to instruct Owner's operating personnel in the operation and maintenance of the ESS systems.
 - 1. Provide the training during regular working day.
 - 2. The Instructors shall be experienced in their phase of operation and maintenance of the electrical systems and with the project.
- C. Time to be allocated for instructions.
 - 1. Minimum of 12 hours dedicated instructor time
 - 2. 4 hours on each of 3 days
 - 3. Additional instruction time for specific systems as specified in other Sections.
- D. Before on-site training, submit the program syllabus; proposed time and dates; for review and approval, minimum 48 hours prior to proposed training time and date.
 - 1. One copy to the Owner
 - 2. One copy to the Architect / Engineer
- D. The Owner shall provide a list of personnel to receive instructions and shall coordinate their attendance at the agreed upon times.
- E. Use operation and maintenance manuals as the basis of instruction. Review manual with personnel in detail. Explain all aspects of operation and maintenance.

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- F. Demonstrate start-up, operation, control, adjustment, troubleshooting, servicing, maintenance, and shut down of each item of equipment.
- G. Demonstrate equipment functions (both individually and as part of the total integrated system).
- H. Prepare and insert additional data in the operating and maintenance manuals when the need for additional data becomes apparent during instructions.
- I. Submit a report within one week after completion of training. List time and date of each demonstration, hours devoted to the demonstration, and a list of people present, with their respective signatures.
- J. At the conclusion of the on-site training program, have the person designated by the Owner sign a certificate to certify that he/she has a proper understanding of the system, that the demonstrations and instructions have been satisfactorily completed, and the scope and content of the operating and maintenance manuals used for the training program are satisfactory.
- K. Provide a copy of the report and the certificate in an appropriately tabbed section of each Operating and Maintenance Manual.

3.8 OPENINGS

- A. Framed, cast or masonry openings for boxes, equipment or conduits are specified under other divisions. Drawings and layout work for exact size and location of all openings are included under this division.

3.9 OBSTRUCTIONS

- A. The drawings indicate certain information pertaining to surface and subsurface obstructions, which has been taken from available drawings. Such information is not guaranteed, however, as to accuracy of location or complete information.
 - 1. Before any cutting or trenching operations are begun, verify with Owner's representative, utility companies, municipalities, and other interested parties that all available information has been provided.
 - 2. Should obstruction be encountered, whether shown or not, alter routing of new work, reroute existing lines, remove obstruction where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of the new work and leave existing services and structures in a satisfactory and serviceable condition.
- B. Assume total responsibility for and repair any damage to existing utilities or construction, whether or not such existing facilities are shown.

3.10 VANDAL RESISTANT DEVICES

- A. Where vandal resistant screws or bolts are employed on the project, deliver to the Owner 2 suitable tools for use with each type of fastener used.
- B. Proof of delivery of these items to the Owner shall be included in the Operating and Maintenance Manuals.

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3.11 PROTECTION

- A. Protect work, equipment, fixtures, and materials. At work completion, work must be clean and in original manufacturer's condition.
- B. Do not deliver equipment to this project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather shall be rejected, and the contractor is obligated to furnish new equipment of a like kind at no additional cost to the Owner.

3.12 EQUIPMENT BACKBOARDS

- A. Backboards: ¾ inch, fire retardant, exterior grade plywood, painted gray, both sides.
 - 1. Provide minimum of two 4-ft. by 8-ft. sheets of plywood for each location shown.
 - 2. Provide minimum of two 4-ft. by 4-ft. sheets of plywood for each ESS location.

3.13 SITE MANAGEMENT RESPONSIBILITY

- A. The Contractor shall provide an on-site Project Manager as defined in CONTRACTOR'S QUALIFICATIONS portion of this Section.

3.14 DEMOLITION AND RELOCATION

- A. The Contractor shall modify, remove, and relocate all materials and items so indicated on the drawings or required by the installation of new facilities. All removals and/or dismantling shall be conducted in a manner as to produce maximum salvage. Salvage materials shall remain as directed by the Owner. Materials and items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to the approval of the Owner. The Contractor may substitute new materials and items of like design and quality in lieu of materials and items to be relocated, if approved by the Owner.
- B. All items scheduled for relocation and/or reuse shall be inspected by the Contractor and the Owner or his authorized representative. A written report of the condition of each item shall be made and provided to the Consultant. Where items scheduled for relocation and/or reuse are considered unsuitable for reuse, the Contractor shall so notify the Consultant and await reinstallation instructions before proceeding with removal. Items damaged in reinstallation shall be repaired or replaced by the Contractor as directed by the Owner at no additional cost to the Owner or the Consultant.
- C. All items which are to be relocated shall be carefully removed in reverse to original assembly or placement and protected until relocated. The Contractor shall clean, repair, and provide all new materials, fittings, and appurtenances required to complete the relocation and to restore the items to good operative order. All relocations shall be performed by workmen skilled in the work and in accordance with standard practice of the trades involved.
- D. Service lines and wiring to items to be removed, salvaged, or relocated shall be removed to points as indicated on the drawings, specified, or acceptable to the Owner. Service lines and wiring not scheduled for reuse shall be removed to the points at which reuse is to be continued or service is to remain. Such services shall be sealed, capped, or otherwise tied off or connections into the existing facilities in such a manner as to result in

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minimum interruption of services to adjacent occupied areas. Services to existing areas or facilities which must remain in operation during the construction period shall not be interrupted without prior specific written approval of the Consultant.

3.15 EXISTING SYSTEM TESTING

- A. Contractor shall have each low voltage system tested prior to the commencement of construction. Systems shall include all systems that fall under the Division 28 umbrellas, as identified in the Division 2 of the Construction Specifications Institute (CSI) current Master Format. Test shall include the functionality of all field devices and equipment. Any failures or items found to be functioning not to specification, shall be reported prior to construction. Any items found to be improperly or non-functioning upon the completion of the project, shall be replaced and/or repaired, by the contractor, at no additional cost to the project or the owner.
- B. Contractor shall document the location and any ID tag, MAC address, IP address, or bar code of any existing device that is to be removed from its current location. Devices that are to remain, shall be reinstalled in the exact location that they reside in prior to construction, unless noted otherwise.
- C. Any individual/firm that will be removing, relocating, reinstalling, or tampering with any devices; shall be licensed by the state and certified by the manufacturer of the system.
- D. Contractor shall remove any devices where construction occurs to prevent possible damage to the device. Removal of any devices which support user connection or other systems, shall be coordinated with the owner prior to removal and/or taking offline.

3.16 START-UP RESPONSIBILITY

- A. The Contractor shall initiate System operation. The Contractor shall provide competent Start-Up personnel on each consecutive working day until all ESS Systems are functional and ready to start the acceptance test phase. If the Contractor, in the Owner / Architect's judgment, is not demonstrating progress in solving any technical problems, the Contractor shall supply Manufacturer's factory technical representation and diagnostic equipment at no cost to the Owner, until resolution of those defined problems. Where appropriate, the Contractor shall bring the Systems on-line in their basic state (i.e., alarm reporting, facility code access control, etc.) It is the responsibility of the Owner to provide the specific database information that will be utilized for initial system programming.
- B. Properly ground each piece of electronic equipment prior to applying power. Properly ground all shielded wire shields to the appropriate earth ground at the hub end only, not at the remote or device end.
- C. Use a start-up sequence that incrementally brings each portion of the system on-line in a logical order that incorporates checking individual elements before proceeding to subsequent elements until the entire system is operational. The basic steps should include:
 - 1. Establish ground planes at the equipment rooms and hub end of the systems as specified in Division 26.
 - 2. Disconnect power, connect the first device, reconnect power, and verify operational correctness. Repeat until the entire system is verified and operational.

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3.17 PREPARATION FOR ACCEPTANCE (SUBSTANTIAL COMPLETION)

- A. All systems, equipment, and devices shall be in full and proper adjustment and operation, and properly labeled and identified.
- B. All materials shall be neat, clean and unmarred, and parts securely attached.
- C. All extra material as specified shall be delivered and stored at the premises as directed.
- D. Test reports of each system and each system's components and As-Built Project Drawings shall be complete and available for inspection and delivery as directed by the Owner.

3.18 SYSTEM ACCEPTANCE REQUIREMENTS

- A. Before final acceptance or work, the Contractor shall perform and/or deliver each of the following in the order stated.
- B. The Contractor shall deliver three (3) composite "System Operations and Maintenance" manuals in three-ring binders, sized to hold the material below, plus 50% excess. Each manual shall contain in appropriately tabbed sections:
 - 1. A statement of Guarantee including date of termination and the name and phone number of the persons to be called in the event of equipment failure.
 - 2. A set of Operating procedures for the overall System that includes all required Owner activities, and that allows for the Owner operation of all attributes and facilities of the System.
 - 3. A section for each specific type of equipment containing the vendor manuals, instruction sheets, and any related literature that came in the original shipping container for that piece of equipment. Include all warranty cards.
- C. Testing:
 - 1. The Contractor shall perform all tests required by Division 28 and those submitted as part of this Section.
 - 2. The Contractor shall activate all devices for proper system operation, including supervisory and trouble circuit tests. Similarly, audible alarms will not be activated except on a one-time, coordinated basis, to check the actual sounding devices.
 - 3. A test report for each piece of equipment shall be prepared by the Contractor and submitted to the Owner. This report shall include a complete listing of every device, the date it was tested, by whom and the results. The final test reports shall indicate that every device tested successfully. Failure to completely test and document the tests will result in a delay of final testing and acceptance.
- D. As-Built Drawings:
 - 1. After completion of all the tests listed above, and prior to the final acceptance test, The Contractor shall submit the complete As-Built drawings as identified in PART 1 – PROJECT RECORD DRAWINGS.
 - 2. The final As-Built Drawings shall consist on one set of reproducible prints, two (2) sets of Point-to-Point Detail Drawings, Equipment Schedules, and the complete detailed technical data that was shipped by the manufacturer with all installed equipment.

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- E. Final Acceptance Test: The Final Acceptance Test shall demonstrate the installed and activated System's performance and compliance with System Specifications. However, before this testing can begin the following must have received and reviewed by the Owner.
1. System Operations and Maintenance Manuals
 2. System Test Reports
 3. As-Built Drawings

3.19 NOTICE OF COMPLETION

- A. When the Final System Acceptance Requirements described above including the Final Acceptance Test described above have been satisfactorily completed. The Owner / Architect shall issue a Letter of Completion to the Contractor indicating the date of such completion. The Notice of Completion shall be recorded by the Contractor upon receipt of the Owner / Architect completion letter. This date of record shall be the start of the warranty period.

END OF SECTION

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SECTION 280507

SHOP DRAWINGS, COORDINATION DRAWINGS & PRODUCT DATA

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Prepare submittals as required by Division 1 and as outlined below.
- B. Submit product data shop drawings only for the following and for items specifically requested elsewhere in the Contract Drawings and Specifications. Architect / Engineer reserves the right to refuse shop drawings not requested for review and to imply that materials shall be provided as specified without exception.
- C. The term submittal, as used herein, refers to all:
 - 1. Shop Drawings
 - 2. Coordination Drawings
 - 3. Product data
- D. Submittals shall be prepared and produced for:
 - 1. Distribution as specified
 - 2. Inclusion in the Operating and Maintenance Manual, as specified, in the related section

1.2 SHOP DRAWINGS

- A. Present drawings in a clear and thorough manner. Identify details by reference to sheet and detail, schedule, or room numbers shown on Contract Drawings.
- B. Show all dimensions of each item of equipment on a single composite Shop Drawing. Do not submit a series of drawings of components.
- C. Identify field dimensions; show relation to adjacent or critical features or work or products.

1.3 COORDINATION DRAWINGS

- A. Present in a clear and thorough manner. Title each drawing with project name. Identify each element of drawings by reference to sheet number and detail, or room number of contract documents. Minimum drawing scale: 1/4"=1'-0".
- B. Prepare coordination drawings to coordinate installations for efficient use of available space, for proper sequence of installation and to resolve conflicts. Coordinate with work specified in other sections and other divisions of the specifications.
- C. For each room containing ESS equipment and each rack with ESS equipment, submit plan and elevation drawings. Show:
 - 1. Actual ESS equipment and components to be furnished.
 - 2. NEC working space and NEC access to NEC working space.
 - 3. Relationship to other equipment and components and openings, doors and obstructions
 - 4. Rack location and dimensions

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- D. Identify field dimensions. Show relation to adjacent or critical features of work or products.
- E. Verify location of ESS station devices and other work specified in this Division.
 - 1. Coordinate with drawing details, site conditions and millwork shop drawings prior to installation.
 - 2. Where required for clarification, submit shop drawings prior to rough-in and fabrication.
- F. Submit shop drawings in plan, elevation and sections, showing outlets and other devices in casework, cabinetwork and built-in furniture.

1.4 PRODUCT DATA

- A. All product options specified shall be indicated on the product data submittal. All options listed on the standard product printed data not clearly identified as not part of the product data submitted shall become part of the Contract and shall be provided.
- B. Mark each copy of standard printed data to identify pertinent products, referenced to specification section and article number.
- C. Show reference standards, performance characteristics and capacities; wiring and piping diagrams and controls; component parts; finishes; dimensions and required clearances.
- D. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete information not applicable.
- E. Mark up a copy of the specifications for the product to indicate a) acknowledgement of the specification requirement (Comply), or b) acknowledgement that the particular specification requirement does not apply to this specific project (Not Applicable) or, c) acknowledgement that the specification requirement cannot be made or that a variance is being submitted for review to the Architect / Engineer/Owner (Does Not Comply, Explanation:)

1.5 MANUFACTURERS INSTRUCTIONS

- A. Submit Manufacturer's instructions for storage, preparation, assembly, installation, start-up and adjusting.

1.6 CONTRACTOR RESPONSIBILITIES

- A. Review submittals prior to transmittal.
- B. Determine and verify:
 - 1. Field measurements
 - 2. Field construction criteria
 - 3. Manufacturer's catalog numbers
 - 4. Conformance with requirements of Contract Documents
- C. Coordinate submittals with requirements of the work and of the Contract Documents.
- D. Notify the Architect / Engineer in writing at time of submission of any deviations in the submittals from requirements of the Contract Documents.

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- E. Do not fabricate products, or begin work for which submittals are specified, until such submittals have been produced and bear contractor's stamp. Do not fabricate products or begin work scheduled to have submittals reviewed until return of reviewed submittals with Architect / Engineer's acceptance.
- F. Contractor's responsibility for errors and omissions in submittals is not relieved whether Architect / Engineer reviews submittals or not.
- G. Contractor's responsibility for deviations in submittals from requirements of Contract Documents is not relieved whether Architect / Engineer reviews submittals or not, unless Architect / Engineer gives written acceptance of the specific deviations on reviewed documents.
- H. Submittals shall show sufficient data to indicate complete compliance with Contract Documents:
 - 1. Proper sizes and capacities
 - 2. That the item will fit in the available space in a manner that will allow proper service
 - 3. Construction methods, materials and finishes
- I. Schedule submissions at least 15 days before date reviewed submittals will be needed.

1.7 SUBMISSION REQUIREMENTS

- A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the Project or in the work of any other Contractor.
- B. Number of submittals required:
 - 1. Shop Drawings and Coordination Drawings: Submit four opaque reproductions.
 - 2. Product Data: Submit the number of copies the contractor requires, plus those to be retained by the Architect / Engineer.
- C. Accompany submittals with transmittal letter, in duplicate, containing:
 - 1. Date
 - 2. Project title and number
 - 3. Contractor's name, address and telephone number
 - 4. The number of each Shop Drawing, Project Datum and Sample submitted
 - 5. Other pertinent data
- D. Submittals shall include:
 - 1. The date of submission
 - 2. The project title and number
 - 3. Contract Identification
 - 4. The names of:
 - a. Contractor
 - b. Subcontractor
 - c. Supplier
 - d. Manufacturer
 - 5. Identification of the product
 - 6. Field dimensions, clearly identified as such
 - 7. Relation to adjacent or critical features of the work or materials
 - 8. Applicable standards, such as ASTM or federal specifications numbers
 - 9. Identification of deviations from contract documents
 - 10. Suitable blank space for General Contractor and Architect / Engineer stamps
 - 11. Contractor's signed and dated Stamp of Approval

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- E. Coordinate submittals into logical groupings to facilitate interrelation of the several items.
 - 1. Finishes which involve Architect / Engineer selection of colors, textures or patterns
 - 2. Associated items requiring correlation for efficient function or for installation

1.8 SUBMITTAL SPECIFICATION INFORMATION

- A. Every submittal document shall bear the following information as used in the project manual:
 - 1. The related specification section number
 - 2. The exact specification section title
- B. Submittals delivered to the Architect / Engineer without the specified information will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.9 RESUBMISSION REQUIREMENTS

- A. Make resubmittals under procedures specified for initial submittals.
 - 1. Indicate that the document or sample is a resubmittal
 - 2. Identify changes made since previous submittals
- B. Indicate any changes which have been made other than those requested by the Architect / Engineer.

1.10 CONTRACTOR'S STAMP OF APPROVAL

- A. Contractor shall stamp and sign each document certifying to the review of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the work and of Contract Documents.
- B. Contractor's stamp of approval on any submittal shall constitute a representation to Owner and Architect / Engineer that Contractor has either determined and verified all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data or assumes full responsibility for doing so, and that Contractor has reviewed or coordinated each submittal with the requirements of the work and the Contract Documents.
- C. Do not deliver any submittals to the Architect / Engineer that do not bear the Contractor's stamp of approval and signature.
- D. Submittals delivered to the Architect / Engineer without Contractor's stamp of approval and signature will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.11 ARCHITECT / ENGINEER REVIEW OF IDENTIFIED SUBMITTALS

- A. The Architect / Engineer will:
 - 1. Review identified submittals with reasonable promptness and in accordance with schedule. Specific equipment submittals that may be required to be expedited shall be submitted separately without other submittal items not requiring the same prompt attention.
 - 2. Affix stamp and initials or signature, and indicate requirements for resubmittal or approval of submittal
 - 3. Return submittals to Contractor for distribution or for resubmission

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- B. Review of submittals will not extend to design data reflected in submittals that is peculiarly within the special expertise of the Contractor or any party dealing directly with the Contractor.
- C. Architect / Engineer's review is only for conformance with the design concept of the project and for compliance with the information given in the contract.
 - 1. The review shall not extend to means, methods, sequences, techniques or procedures of construction or to safety precautions or programs incident thereto.
 - 2. The review shall not extend to review of quantities, dimensions, weights or gauges, fabrication processes or coordination with the work of other trades.
- D. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

1.12 SUBSTITUTIONS

- A. Do not make requests for substitution employing the procedures of this Section.
- B. The procedure for making a formal request for substitution is specified in Division 01.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 SHOP DRAWINGS AND PRODUCT DATA

- A. Submittals shall not be combined or bound together with any other material submittal.
- B. Submit individually bound shop drawings and product data for the following when specified or provided:
 - 1. Low Voltage Wire
 - 2. Electronic Access Control and Intrusion Detection
 - 3. Electronic Surveillance
 - 4. Fire Detection and Alarm

3.2 COORDINATION DRAWINGS

- A. Submit coordination drawings as specified.

END OF SECTION

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SECTION 280510

CONTRACT QUALITY CONTROL

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Contract quality control including workmanship, manufacturer's instructions, mock-ups and demonstrations.

1.2 QUALITY CONTROL PROGRAM

- A. Maintain quality control over supervision, subcontractors, suppliers, manufacturers, products, services, site conditions and workmanship to produce work in accordance with contract documents.

1.3 WORKMANSHIP

- A. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.
- B. Perform work by persons qualified to produce workmanship of specified quality.
- C. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking. Under no conditions shall material or equipment be suspended from structural bridging.
- D. Provide finishes to match approved samples; all exposed finishes shall be approved by the Architect / Engineer. Submit color samples as required.

1.4 MANUFACTURER'S INSTRUCTIONS

- A. Comply with instructions in full detail, including each step in sequence.
- B. Should instruction conflict with Contract Documents, request clarification from Architect / Engineer before proceeding.

1.5 MANUFACTURER'S CERTIFICATES

- A. When required in individual Specification Sections, submit manufacturer's certificate in duplicate, certifying that products meet or exceed specified requirements.

1.6 MANUFACTURER'S FIELD SERVICES

- A. When required in individual Specification Sections, manufacturer shall provide a manufacturer's qualified personnel to observe:
 - 1. Field conditions.
 - 2. Condition of installation.
 - 3. Quality of workmanship.
 - 4. Start-up of equipment.
 - 5. Testing and adjusting of equipment.
- B. Manufacturer's qualified personnel shall make written report of observations and recommendations to Architect / Engineer.

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1.7 MOCK UPS

- A. Assemble and erect the specified equipment and products complete, with specified anchorage and support devices, seals and finishes.
- B. Do not proceed with any work involving a mock-up, until the related mock up has been approved in writing.
- C. Acceptable mock-ups in place shall be retained in the completed work where possible.
- D. Perform tests and submit results as specified.

1.8 SCHEDULING OF MOCK-UPS

- A. Schedule demonstration and observation of mock-ups, in phases, with Architect / Engineer.
 - 1. Rough-in
 - 2. Finish with all appurtenances in place
 - 3. Demonstrations

PART 2 - PRODUCTS

2.1 REFERENCE APPLICABLE SPECIFICATION SECTIONS

PART 3 - EXECUTION

3.1 ADJUSTMENTS AND MODIFICATIONS

- A. Contractor shall provide all adjustments and modifications as requested by the manufacturer's qualified personnel at no additional cost to Owner.

3.2 MOCK-UPS

- A. Mock up a typical classroom, science lab of each type, and computer lab with all wiring devices, cover plates, rough-in boxes, conduits, etc. provide all conductors from all wiring devices to above ceiling space to demonstrate conduit routing and conductor fill.

END OF SECTION

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SECTION 280550

FIRESTOPS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide firestop as required, and as specified. Refer to Architectural drawings for all fire and smoke rated partitions, walls, floors, etc.
- B. Types: Firestop required for the project includes smokestop.

1.2 QUALITY ASSURANCE

- A. UL Label: Firestops shall be UL labeled.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Nelson.
- B. 3M (Minnesota Mining Manufacturing).
- C. Hilti
- D. Specified Technologies, Inc.

2.2 MATERIAL AND COMPONENTS

- A. General: Except as otherwise indicated, provide firestop manufacturer's standard materials and components as indicated by published product information, designed and constructed as recommended by the manufacturer, and as required for installation.

2.3 FIRESTOP

- A. Conduits: Provide a soft, permanently flexible sealant for 1-1/2 to 2 hour rated fireproofing for steel conduits (up to 4" diameter).
- B. Low Voltage Cables, Fiber Optic Cable and Innerduct: Provide Specified Technologies, Inc. EZ-Path single, double, or triple pathways as required.

PART 3 - EXECUTION

3.1 INSTALLATION OF FIRESTOPS

- A. General: Install firestops in accordance with the manufacturer's installation instructions and industry practices to ensure that the firestops comply with requirements. Comply with UL and NFPA standards for the installation of firestops.

END OF SECTION

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SECTION 281000

ACCESS CONTROL SYSTEM (ACS)

PART 1 - GENERAL

1.1 RELATED WORK

- A. The following, in their entirety and as applicable, shall apply to this section. Including any associated drawings.
 - 1. Conditions of the Contract
 - 2. Division 1
 - 3. Division 26
 - 4. Division 27
 - 5. Division 28

1.2 WORK INCLUDED

- A. The Contractor shall furnish and install a complete microprocessor-based access control system as specified herein. The system shall include, but not be limited to, all control equipment, power supplies, power circuits, signal initiating and signaling devices, conduit, wire, fittings, and all other accessories required to provide a complete and operable system. Expand existing ACS system.
- B. Security system devices indicated are for reference and coordination purposes only. The installing contractor shall design and provide a complete system, meeting the requirement of specification. The Contractor shall provide all security system devices required for complete system perimeter coverage acceptable to all governing authorities, Architect and Owner.
- C. The system shall include security for all access into building, including but not limited to the following:
 - 1. Control Panels
 - 2. Power Supplies
 - 3. Interconnection of panels
 - 4. Installation of new devices
 - 5. Card reader
 - 6. Magnetic locking hardware
 - 7. Request to exit devices
 - 8. Door position sensors
 - 9. Door Hardware (as specified herein and/or in Division 08, door hardware)
 - 10. All additional material, hardware, and labor required for a fully functional, turnkey system
- D. The contractor shall connect each controller to the ACS Management System.
- E. All system programming will be performed by the system installer. The system installer will be required to meet with the Owner, engineer, and system manager to discuss wiring and termination of the system control panels and field devices prior to installation.
- F. Licensing: The contractor shall NOT utilize any of the owner's existing licensing for this scope of work. All licensing shall be provided by the contractor, no exceptions. Including, but not limited to the following:
 - 1. Portal Licensing
 - 2. Controller Licensing

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- 3. Wireless Licensing
- 4. Video Management Software Integration Licensing
- G. Contractor to refer to specification 08 71 00 Door Hardware. Provide and install all hardware specified to be provided by the "Access Control Contractor", "Security Installer", "Division 28", or any variation thereof.
- H. The documents issued for this project are conceptual in nature, including but not limited to specifications and drawings. It shall be the responsibility of the approved installer to furnish a complete and functional system, including the items shown on the drawings, in the specifications, and items not designated in either. The installer's shop drawings and product data submittals shall represent a complete system, and documents accepted do not relieve the installer from being required to provide any materials, equipment, or labor to furnish a complete and functional system as recognized by the Project's Technology Consultant and the Owner.

1.3 REFERENCES

- A. Code of Federal Regulations (CFR).
- B. Institute of Electrical and Electronics Engineers (IEEE):
 - 1. 802.3 Ethernet Standards.
 - 2. IEEE 1100 Recommended Practice for Powering and Grounding Electronic Equipment.
- C. International Electrotechnical Commission (IEC).
- D. International Organization for Standardization (ISO):
 - 1. ISO / IEC 10918 - Information technology -- Digital compression and coding of continuous-tone still images: Requirements and guidelines; JPEG.
 - 2. ISO / IEC 14496-10 - Information Technology - Coding Of Audio-Visual Objects - Part 10: Advanced Video Coding; MPEG-4 Part 10 (ITU H.264).
 - 3. ISO / IEC 23008-2 - High Efficiency Coding and Media Delivery In Heterogeneous Environments - Part 2: High Efficiency Video Coding; MPEG-H Part2 (ITU H.265, HEVC).
- E. Federal Communications Commission (FCC):
 - 1. FCC Part 15 – Radio Frequency Device
- F. Underwriters Laboratories (UL):
 - 1. UL294 – Access Control Systems Units
- G. Electronic Industries Alliance (EIA)
 - 1. RS485 - Electrical Characteristics of Generators and Receivers for use in Balanced Digital Multi-Point Systems
- H. Federal Information Processing Standards (FIPS)
 - 1. Advanced Encryption Standard (AES) (FIPS197)
 - 2. FIPS201-2: Open Options DNA Fusion FIPS in conjunction with an E2-SSP-D2-FIPS, NSC-100-FIPS, RSC-2-FIPS and other listed components will provide an access control solution that is fully FIPS 201-2 compliant.
 - 3. Personal Identity Verification (PIV) of Federal Employees and Contractors
- I. Homeland Security Presidential Directive 12 (HSPD12)

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- J. National Fire Protection Association Standards:
 - 1. NFPA 70 - National Electrical Code
 - 2. NFPA 72 - National Fire Alarm Code
 - 3. NFPA 101 - Life Safety Code
- K. RoHS compliant
- L. SIA AC-01-1996.10 - Access Control - Wiegand
- M. Local & State Building Codes
- N. Requirements of Local Authorities having Jurisdiction
- O. Requirements of American Disabilities Act (Public law 101-336).
- P. Texas Accessibility Standards (T.A.S.)
- Q. Texas Insurance Code.

1.4 QUALITY ASSURANCE

- A. Contractor Qualifications:
 - 1. The installing contractor shall be the authorized representative of the Access Control Manufacturer to sell, install, and service the proposed manufacturer's equipment. The installing contractor shall have represented the security alarm manufacturer's product for at least two years.
 - 2. The installing contractor shall be licensed as required, by the State in which the project is located in, as a security services contractor to design, sell, install, and service security alarm systems.
 - 3. The installing contractor shall provide 24-hour, 365 days per year emergency service with factory trained service technicians.
 - 4. The installing firm shall have personnel on their staff that has been actively engaged in the business of designing, selling, installing, and servicing security alarm systems for at least ten (10) years.
 - 5. All Contractors must submit to the owner prior to starting any work the factory training certificates for all personnel that will be working on the access control system. No person is allowed to work on the system without proper manufacturer's certification.
 - 6. The proposing contractor for this system and the installing contractor of this system shall be of the same organization. Absolutely no subcontracting of any portion of this system by the proposing contractor will be allowed.
 - 7. The proposing/installing contractor of this system must be an authorized dealer / integrator for the project's specified Video Surveillance and the Intrusion Detection systems as well as the system specified in this section.
 - 8. For proper, smooth, and complete integration of the IP security camera, access control, and intrusion detection systems; the proposing/installing contractor of the video surveillance and intrusion detection systems must be the same contractors.
 - 9. Contractor must be a current integrator of solution in the closest major metropolitan area marketplace, have a permanent office located within 75-miles of the project, and be able to include information on current support staff to be able to service this client.

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1.5 SUBMITTALS AND CLOSE-OUT

- A. Product Data: Within fourteen (14) days of Notice to Proceed, the system installer shall furnish the following in a single consolidated submittal:
1. Permits: The Contractor shall obtain all required permits and provide copies to the Owner / Architect / Engineer.
 2. Product Literature: Complete manufacturer's product literature for all system equipment, power supplies, cable, termination components, cable supports, cable labels, field devices, and other products to be used in the installation. In addition, whenever substitutions for recommended products are made, samples (when requested by the Owner/Designer) and the manufacturer's supporting documentation, demonstrating compatibility with other related products shall be included. The submittal shall have some type of distinguishing marker or pointer to indicated what specific product is to be submitted.
 3. Construction Schedule: A time-scaled Construction Schedule indicating general project deadlines and specific dates relating to the installation of the cable distribution system.
 4. Specification Compliance: A letter shall be provided stating, by section and subsection, that the system installer complies with the ENTIRE specification section. If the installer intends to deviate from any portion of the specifications, a detailed explanation of reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter. No deviations shall be acceptable until they have been accepted by the project's technology consultant.
 5. Certifications: The contractor shall submit all of the following certifications and the certifications must contain dates which are valid from the date of proposal and not expire any sooner than 12 months after substantial completion of the project.
 - a. Manufacturer's Authorized Dealer/Installer Certification: This certification must be held by the proposing/installing contractor and state that the proposing/installing contractor is and authorized dealer/installer of the system specified within the project specifications. The certification must have been obtained by the office that is within a 75-mile radius of the project's location.
 - b. Installer Certification: This certification must be held by at least 25% of the, on-site, staff and be made available at the site if requested by the owner, architect, and/or project's technology consultant.
 - c. Licenses: This includes all licenses required by the state in which the work is being performed, the federal government, local authorities having jurisdiction, and any organization in that governs the specific system.
- B. Shop Drawings: Submit the following items, for Owner review and approval, within twenty-eight (28) days of notice to proceed:
1. Proposed circuit routing and circuit grouping plan prepared by a system registered designer. The designer's certification must be current. Identifiable, separate routing shall be shown for both the station cabling and any backbone trunk cabling.
 2. In addition to the cable routing, the submitted drawings shall indicate the following, even if the following is expected to be provided by the project's electrical or general contractor:
 - a. Location of all control equipment and remote power sources
 - b. Locations of all field devices and outlets
 - c. Location of wall penetrations (all penetrations shall be sleeved and contain protective bushings at both ends)
 - e. Location of sleeved wall and/or floor pass-thru
 - f. Size of sleeve at each location installed
 - g. Quantity of cable passing through each sleeve

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- h. Conduit routing, size, quantity, and stub-up locations for any floor mounted outlets or outlets installed in casework.
 - 3. Drawing Compliance: A letter shall be provided stating that the system installer complies with the entire project drawing, including all general, keyed, and notes to contractor. If the installer intends to deviate from any portion of the specifications, a detailed explanation of reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter. No deviations shall be acceptable until they have been approved by the project's technology consultant.
- C. Close-out Procedures: For review and acceptance, furnish an electronic copy of the following documents to the Architect / Engineer. Upon acceptance of the submitted close-out documents, provide four (4) copies on an electronic storage media (CD or USD Flash Drive) Labeled with the project name, date of submission, and the name of the submitting firm. Final copies shall be delivered directly to the project's Technology Consultant. The closeout submittals shall include the following and be packaged in a storable container with the physical storage media and any physical items listed:
 - 1. Inspection and Test Reports: During the course of the Project, the Contractor shall maintain an adequate inspection system to ensure that the materials supplied, and the work performed, conform to contract requirements. The Contractor shall provide written documentation that indicates that materials acceptance testing was conducted as specified. The Contractor shall also provide documentation, which indicates that all cable termination testing was completed and that all irregularities were corrected prior to job completion.
 - 2. Provide complete test reports for all cabling and devices that comprise system as outlined in this document.
 - 3. Include the Name, address and telephone of the authorized factory representative with a 24-hour emergency service number.
 - 4. The manual shall also include Manufacturer's data sheets and installation manuals/instructions for all equipment installed and a list of recommended spare parts.
 - 5. Generic or typical owner's instruction and operation manual shall not be acceptable to fulfill this requirement.
 - 6. An up-to-date record ("as-built") set of approved shop drawing prints that have been revised to show each and every change made to the system from the original approved shop drawings.
 - 7. As-built Drawings shall include cable pathways; device locations with correct labeling, control equipment locations, remote power supply locations, cross connect locations, and lightning protection locations. The as-built drawings shall be prepared using AutoCAD 2014 or later.
 - 8. All drawings must reflect point to point wiring, device address and programmed characteristics as verified in the presence of the engineer and/or the end user unless device addressing is electronically generated, and automatically graphically self-documented by the system.
 - 9. A copy of the manufacturer's warranty on the installed system.
 - 10. Any keys to cabinets and/or equipment and special maintenance tools required to repair, maintain, or service the system.
 - 11. Operating and Maintenance Instructions for all devices within the system. These instructions shall reflect any changes made during the course of construction, and shall be provided to the Owner, for their use, in a three-ring binder labeled with the project name and description. (4 copies)

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12. Upon completion of the work and at a time designated by the Architect or owner, provide formal training sessions for the Owner's operating personnel to include location, operation, and maintenance of all included systems and equipment. Provide a video copy of the training session as well as all sign in and training sign off sheets
13. One (1) 30" x 42" laminated floor plan sheets illustrating device locations, system wiring configuration, and cable designation. Contractor shall provide one complete floor plan sheet at each panel location.

1.6 DEFINITIONS

A. Abbreviations:

1. ACS Access Control System
2. VMS Video Management System
3. NVR Network Video Recorder
4. IDS Intrusion Detection System
5. GUI Graphical User Interface
6. IP Internet Protocol
7. CR Card Reader
8. DS Door Station
9. MS Master Station
10. PIR Passive Infrared Sensor
11. LD Lockdown
13. LO Lockout
14. MDF Main Distribution Frame
15. IDF Intermediate Distribution Frame

B. Definitions:

1. Access Card: A coded employee card, usually the size of a credit card, recognizable to the access control system and read by a reader to allow access. It can be used for photo identification of the cardholder and for other data collection purposes. Card technologies include magnetic strips, wiegand-effect, proximity (active/passive), barium ferrite, smart/intelligent cards, and NFC enabled applications on mobile devices.
2. Access Control System: An interconnected set of controllers, managing the entrance and exit of people through secured areas.
3. Access Level: The door or combination of doors and/or barriers an individual is authorized to pass through and the times they are permitted.
4. Anti-Pass back (Anti-Tailgating): This feature protects against more than one person using the same card or number. It defines each system card reader and card ID number as IN, OUT or other. Once a card is granted access to an IN reader, it must be presented to an OUT reader before another IN reader access is granted. Cards will continue to have access to all authorized OTHER readers.
6. Alarm: A signal that indicates a problem.
7. Alarm input: A device that is monitored by the access control panel. An alarm signal will be generated if the device is activated.
8. Badge: Badge is a template or a design for creating a card. DNA Fusion includes a full-featured badge layout utility for designing, creating and printing badges. Badge design includes magnetic stripe encoding, bar coding, signatures and so on.
9. Bar Code: A method of encoding information using lines and blank spaces of varying size and thickness to represent alphanumeric characters.

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10. Biometrics: A general term for the verification of individuals using unique biological characteristics (i.e. fingerprints, hand geometry, voice analysis, the retinal pattern in the eye).
11. Card and Card Holder: A card is an identity proof of a person and a card holder is a person who holds the card. Multiple cards can be assigned to a single card holder to provide different access.
12. Controller: A microprocessor-based circuit board that manages access to a secured area. The controller receives information that it uses to determine through which doors and at what times cardholders are granted access to secure areas. Based on that information, the controller can lock/unlock doors, sound alarms, and communicate status to a host computer.
13. Card Reader: A device that retrieves information stored on an access card and transmits that information to a controller.
14. Digital Video Recorder: A security system device that records the video from the surveillance cameras (IP and Analog) on a hard disk.
15. Door: A generic term for a securable entry way. In many access control applications, a "door" may be a gate, turnstile, elevator door, or similar device.
17. Duress: Forcing a person to provide access to a secure area against that person's wishes.
18. Input: An electronic sensor on a controller that detects a change of state in a device outside the controller.
19. Integrated lockset: An integrated, intelligent locking solution that typically runs on batteries, but can be externally powered, that contains most of the door components, i.e. reader, door contact, and request to exit in a single, mountable unit.
20. Keypad: An alphanumeric grid which allows a user to enter an identification code. A flat device which has buttons that may be pressed in a sequence to send data to a controller, and which differs from a typewriter-like computer keyboard.
21. Output Relay: A device that changes its state upon receiving a signal from a controller. Typically, the state change prompts an action outside of the controller such as activating or deactivating a device. The auxiliary relays found in access control panels or NODES that control external devices.
22. Shunt Time: The length of time a door open alarm is suppressed (shunted) after a valid card access or free egress request. This time should be just enough to allow a card user to open a door or gate, pass through, and then close it.
23. Time Schedules: Schedules that allow cards to function or not function depending on the time of day. This is used to limit access to the facility. The schedule may include not only time but which days of the week a card is valid.
24. Video Management System: An enterprise-class video management and storage solution

1.7 PRE-INSTALLATION MEETINGS

- A. Convene minimum two weeks prior to starting work of this section.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store products in manufacturer's unopened packaging bearing the brand name and manufacturer's identification until ready for installation.
- B. Handling: Handle materials to avoid damage.

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1.9 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.10 SEQUENCING

- A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.11 WARRANTY

- A. The ACS furnished by the System Integrator including wiring, software, hardware and third-party products shall be fully warranted for parts, materials and labor for a minimum of 1 year from date of the final acceptance.
- B. Manufacturer shall provide a limited 3-year warranty for the product to be free of defects in material and workmanship.

PART 2 - PRODUCTS

- 2.1 Reference Attachment 'A' of this specification for supplemental scope and product material list as it relates to the project and the Owner standards

2.2 MANUFACTURERS

- A. Approved Manufacturers:
 - 1. Panasonic Monitor Cast 4
- B. Requests for substitutions will be considered in accordance with provisions of Division 1. In the absence of direction by Division 1, substitution request must be submitted no less than ten (1) business days from the time of proposal.

2.3 SERVERS AND USER INTERFACE

- A. Owner Provided / Owner Installed.

2.4 ACCESS CONTROL SYSTEM (ACS)

- A. General: The ACS is a modular and networked based system providing physical access control security to a Wide Area campus enterprise. The system shall be capable of controlling and integrating multiple security functions including the configuration, management and monitoring of cardholder access, locking hardware units, events, alarms, visitors, and real-time tracking and reporting. The ACS is to be alterable at any time depending on the facility requirements and will allow for easy upgradeability or modification of network processors, controller, interface modules, card data, inputs, outputs, and remote workstations. The ACS shall include, but is not be limited to, the following:
 - 1. Client/Server model operating central server host software modules and client workstation software applications in a multi-user and a multi-tasking environment.
 - a. The ACS to permit multiple instances of client software applications to run simultaneously on the network. The base system shall include one (1) software application licenses per site with an unlimited number of licenses available subject to connection fees.

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2. Partitioning: The system to support security partitioning enabling system administrator to segment the configuration database and group multiple entities within the security partition.
 - a. Security partitions limit what users can view in the configuration database. Administrators, who have all rights and privileges, can segment a database into multiple security partitions. A user who is given access to a specific partition will only be able to view entities (components) within the partition they have been assigned.
3. Encryption: The system to support encrypted communication between the central server software and client software applications (server-to-server and client-to-server) using a 128-bit AES encryption algorithm (at a minimum).
 - a. Communication between the central server host software module and system controllers to be encrypted if supported by the controllers.
 - b. The ACS client software applications to be password protected with passwords stored in the central server database in an encrypted manner.
4. Distributed Processing: The system is a fully distributed processing application allowing information, including time, date, zones, valid codes, tasks, access levels, and similar data, to be downloaded from the central host station to controller interface devices allowing access-control decisions with or without central host station communication. If communications to a central host station are lost, the controllers will automatically buffer event transactions until communications are restored and events are automatically uploaded to the central host station.
 - a. Provide for a higher level of distributed database management at defined perimeter access points such that no single point of failure will allow more than two access points to fail, or affect more than two access points at perimeter points system wide.
5. Single Data Base: The system to support a single database for access control site setup, credential and identity file creation, alarm and control setup, and system user operation and command functions.
6. System Access Management: The system to allow operators through password authentication the ability to make access granted or denied decisions, define access levels, time zones, holidays, assign cardholders, access groups, develop tasks, and generally manage access control, alarm monitoring and response activities system wide from a single login. Operator and user privileges are managed by a system administrator allowing for different levels of system access and system control. Authorization management is fully Owner definable.
7. Cardholder Management: The system to include a cardholder management system integrated within the access control system. This cardholder management functionality allows the enrollment of cardholders into the database, and import / export of employee data.
8. Access Groups and Access Levels: The system to provide adequate access groups and access level assignment capability to meet Owner requirements for the specified project. If required, software application can be expandable to support unlimited access groups and access levels.
9. Alarm Monitoring: The system is able to monitor, report, and provide information about the time and location of alarms, along with their priority.
10. Event Monitoring: The system is able to monitor, report, and archive network access control activity.
11. Transaction Logs: The system to support an unlimited number of logs and historical transactions (events and alarms) with the maximum allowed being limited by the amount of hard disk space available.
12. System Monitoring: The system to have ability to report on the integrity of all network assigned devices, circuits and communications and provide a diagnostics screen showing field level communications system wide

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13. Lock/Unlock Commands: The system to allow an operator to manually lock and unlock doors overriding scheduled access control restrictions and configurations if necessary.
 14. Hardware Interface: The system to integrate with and control specified electrified hardware, signaling and monitoring devices.
 15. Report Generator: The system to have the ability to generate and output reports with any and all combinations of system fields and data including, but not limited to: by cardholder, by door, by site, by time, by groups of doors and by cardholder field. Any and all combinations of fields must be available for reporting. The report feature to allow exporting of generated reports over a network connection or by remote printing.
 16. Multi-User/Web Based Network Capabilities: The system to support multiple operator workstations via local area network/wide area network (LAN/WAN), the Internet, or VPN. The system to be capable of supporting minimum of concurrent users/clients with software expansions to an unlimited number of workstations based on the Owners network requirements.
 17. Systems Integration: The system to have the ability to be fully and seamlessly integrated with existing or specified IDS and VMS.
- B. Open Architecture: The access control system infrastructure will be based on an open architecture design capable of supporting multiple access control hardware manufacturers and integrate with multiple non-proprietary network processors, controllers, interface modules, integrated locking hardware, remote card readers, keypads and display terminals, and other third party applications.
- C. Open Protocol: The ACS manufacturer to provide non-proprietary, open protocol hardware for the system control processors and associated device sub-controllers. Systems utilizing a single manufacturer solution that encompasses combined proprietary software and integrated electronic hardware combinations are not acceptable. In addition, integrated electronic locking hardware requiring a processor or sub-controller module upgrade, or extensive access control firmware upgrades to accommodate integrating with an alternate software package, will not be considered.
- D. Network Support: Communication network connecting the central server host software modules, client workstation software applications, and hardware controllers to be designed to support all of the following:
1. LAN/Ethernet enterprise ring topology and localized star topology based on TCP/IP.
 2. Direct-connected RS-232 and RS-485 communication cabling.
 3. Dial-up modem connection using a standard dial-up telephone line.
- E. Provide local communication port at each panel for local configuration of system with laptop.
- F. Locate all main control panels in MDF and IDF rooms of each building.
- G. Provide 120v at all controller and power supply locations.
- H. Provide and transfer all required licensing to the owner.
- I. Provide local communication port at each panel for local configuration of system with laptop.

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- J. Provide and install all software and/or hardware connections required to connect the system to IDS and VMS.
- K. Integrated Elevator Destination Dispatch Control Solutions
 - 1. The ACS shall provide means of integration with the following elevator systems destination dispatch control solution. Integration shall be by software or input/output connection (software, if available between the specified ASC and Elevator System):
 - a. Otis
 - b. Krone
 - c. Thyssen-Krupp
 - 2. The destination dispatch control solution shall provide the following functions:
 - a. Provide card reader security within the elevator(s) as required.
 - b. Provide card reader security at the Destination Dispatch kiosk(s), as required.
 - c. Allow Default Floor call registration upon card swipe.
 - d. Allow for card flags such as VIP and ADA from a card swipe
 - e. Enforce elevator access levels
- L. Integrated Video Management Systems: The ACS shall support integration of DVR and/or NVRs from the following manufacturer. Integration to be completed by the system installer:
 - 1. Video Insight

2.5 ACCESS CONTROL PANEL HARDWARE

- A. Enclosure:
 - 1. Typical 4-Door System Enclosure:
 - a. Power supply board 75W, 6A/12V or 3A/24V | Secondary voltage power supply, 5-18V adjustable @ 4A max, class 2 power limited output | Eight output smart distribution module, fused at 3A per output | Four port network monitoring module | Enclosure, Size with backplate to accommodate the specified hardware.
 - 2. Typical 8-Door System Enclosure:
 - a. Power supply board 150W, 12A/12V or 6A/24V | Secondary voltage power supply, 5-18V adjustable @ 4A max, class 2 power limited output | 16 auxiliary DC outputs class 2 power limited at 2.5A per output | Eight output smart distribution module, fused at 3A per output | Four port network monitoring module | Enclosure, (23W x 32H x 6.5D) with backplate to support the mounting of the specified hardware.
 - 3. Power supplies shall be connected to the Owner's network, allowing for remote management, including but not limited to the following:
 - a. Allow the user to connect any network connected power within a local network or via the internet from any remote location.
 - b. Allow for all connected power supplies to be monitored for status and firmware revision on a single screen.
 - c. Allow batch firmware updates to maintain the latest feature sets and cybersecurity standards.

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- B. System Control Processor: Intelligent two portal two reader combination system controller with 10/100Base-T Ethernet connectivity and dual reader interface module, minimum of 6MB RAM, 1 RS-232/485 host port, with a secondary RS-232/485 host port for redundancy, 1 two wire RS-485 channel for communication to a maximum of 31 I/O modules, support for up to two magstripe or Wiegand readers. Includes a minimum of two (2) door contacts, two (2) request to exit inputs, two (2) door strike relays, four (4) programmable inputs and two (2) output relays
- C. Door Controllers: Two Portal Two Reader interface module - support for up to two magstripe or Wiegand readers. Includes: two door contacts, two requests to exit inputs, two door strike relays, four programmable inputs and four output relays
- D. Input Monitor Modules: 16 normally open or closed, supervised or non-supervised inputs for monitoring vital alarm points or for providing elevator floor selection control. Includes: 2 programmable output relays and (32) 1K ohm resistors for supervisory wiring
- E. Output Control Modules: 16 programmable output relays with the option of being configured as fail-safe or fail-secure. These relays support "On", "Off" or "Pulse" modes for a variety of applications such as elevator control or any device requiring dry contacts.
- F. System Back-Up Battery: Contractor to backup batteries as required to furnish ninety (90) minutes of run time to the complete system, including but not limited to lock power and system power.
- G. RS-485 Communications Multiplexer: Provide a multiplexer at each control board that is utilizing a RS-485 communication channel to panel interface modules and/or RS-485 type door hardware. There shall be no more than eight (8) RS-485 connections made on a single multiplexer.

2.6 FIELD DEVICES

- A. General: Coordinate with door hardware and access control schedule as to whether each access control portal is wireless or directly connected to a control panel. Provide all Controllers, Sub-Controllers, and licensing as required to connect all card reader locations shown on plan.
- B. Card Readers: Provide card readers as shown on the floor plans, access control schedule, and access control details.
 - 1. Wall Mount – HID iClass SE R40
 - 2. Mullion Mount – HID iClass SE R10
 - 3. Keypad – HID iClass SE RK40
- C. Credentials: Coordinate Facility Code, External Start Number, and Internal Start number with the Owner prior to procuring credentials.
 - 1. HID Seos 500x
- D. Miscellaneous Devices: Provide the following devices as designated per the project floor plans, access control schedules, and access control details:
 - 1. DP/DT Door Position Sensors (Door Contacts)
 - 2. PIR Motion Request to Exit Sensor
 - 3. Lockdown Buttons
 - 4. Door Release Buttons
 - 5. Video Intercom Door Stations
 - 6. Video Intercom Master Stations

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- E. Door Station
 - 1. Aiphone IX Series Video Intercom System

2.7 WIRING

- A. Ethernet cabling shall be provided by the Structured Cabling System Installer. In the event that there is not ACS installer on the project, cabling shall be provided and installed by the Access Control System Integrator and shall comply with the Division 27 Structured Cabling specification.
- B. Conventional access control cable shall be a jacketed composite cable. The minimum conductor requirement shall be as follows:
 - 1. Standard
 - a. Lock Power: 4-conductor, 18AWG, shielded
 - b. Card Reader: 6-conductor, 22AWG, OA shielded
 - c. Door Contact: 2-conductor, 22AWG, shielded
 - d. Request to Exit/Spare: 4-conductor, 22AWG, shielded
 - 2. Extended Distance
 - a. Lock Power: 4-conductor, 16AWG, shielded
 - b. Card Reader: 6-conductor, 18AWG, OA shielded
 - c. Door Contact: 2-conductor, 18AWG, shielded
 - d. Request to Exit/Spare: 4-conductor, 18AWG, shielded
- C. Wire scheme and conductor quantity shall be as required by the manufacture's specifications. Contractor to provide and install shielded cable as required.
- D. All 120v Power shall be furnished by the Division 26 contractor. In the event that a division 26 contractor is not contracted for the project, the system installing contractor shall contract a licensed electrical firm to provide and install all materials required to furnish a complete and operational system.
- E. All Security Conduit as required for a complete installation of this system shall be furnished by the division 26 contractor as part of their scope of work. In the event that a division 26 contractor is not contracted for the project, the system installing contractor shall provide and install all conduit required.
- F. Coordination with the Division 26 contractor is the responsibility of the Security Contractor to ensure all conduit is in place for a complete installation.
- G. All systems shall be connected to a dedicated circuit and on an emergency power source if available.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All wiring shall be in accordance with the National Electrical Code, Local Codes, and article 760 of NFPA Standard 70. All wiring sizes shall conform to recommendations of the equipment manufacturer, and as indicated on the engineered shop drawings.
- B. All wire shall be UL Listed CL2 for limited energy (300V) applications and shall be installed in conduit. Limited energy MPP wire may be run open in return air ceiling plenums provided such wire is UL Listed for such applications and is of the low smoke producing fluorocarbon type and complies with NEC Article 760 if so, approved by the local authority having jurisdiction.

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- C. No AC wiring or any other wiring shall be run in the same conduit as security alarm wiring.
- D. All wire shall be installed in an approved conduit/raceway system (except where permitted by NEC and the local authority having jurisdiction). Maximum conduit "fill" shall not exceed 40% per NEC.
- E. Minimum conduit size shall be 3/4" EMT. Install conduit per engineered shop drawings.
- F. Systems utilizing open wiring techniques with low smoke plenum cable shall provide conduit in all inaccessible locations, inside concealed walls, all mechanical/electrical rooms, or other areas where wiring might be exposed or subject to damage.
- G. All vertical wiring and all main trunk/riser wiring shall be installed in a complete raceway/conduit system. All riser boxes shall be adequately sized for the number of conductors transversing the respective box as well as the number of terminations required.
- H. Network Connection Cable: Provide a 4 pair Category 6 data cable from the Master Control Panel to the MDF network rack. Category 6 cable shall be purple in color.
- I. All plenum wiring is to be installed parallel and perpendicular to the building structure. Install wiring tight up against structure for protection. Cable shall be bundled on a maximum of 2'-6" and secured to the structure at a maximum of 5' on center. Bundling and support shall be with plenum rated cable ties.
- J. Contractor is required to provide all mapping and software configuration required to operate system as per manufacturer's recommendations.

3.2 CABLE PATHWAYS

- A. Cable Support:
 - 1. All wire not installed inside conduit or a designated cable tray system shall be installed in a dedicated cable support system for the entire run of each cable. Including, but not limited to service loops.
 - a. Approved Cable Support Product:
 - 1) Panduit
 - 2) Arlington
 - 3) Caddy
 - 4) Support system shall be sized appropriately for the number of wires being installed. Reference the manufacturer's specifications for the suggested maximum cables per support size.
 - 2. The approved cable support system shall be attached directly to the building steel at a serviceable height. In the event that the building steel is not 5' of the finished ceiling, the contractor shall provide a dedicated threaded rod extending within 5' of the finished ceiling and mount the J-MOD™ support hook to the treaded rod.
 - 3. J-MOD™ cable support shall be installed at a maximum of 5' on center.
 - 4. All cable installed shall be attached to the J-MOD™ support system with plenum rated Velcro and a plenum rated Velcro tie shall be installed between each J-MOD™ cable support to keep wires neatly bundled throughout the entire run. Tie wraps will only be allowed to be used inside the control panels as required to manage the wires within each type of panel.
 - 5. Absolutely no cable, not installed in conduit, will be allowed to be attached directly to the building's steel or supported in any other method than that stated above.

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6. It is the responsibility of the installing contractor to coordinate with all other trades on the project to ensure that the pathway of this system does not interfere with the installation of the other trades and to prevent the installed product of other trades from putting strain on the installed wiring.
- B. Conduit / Raceway:
 1. All wire shall be installed in an approved conduit/raceway system (except where permitted by NEC and the local authority having jurisdiction). Maximum conduit "fill" shall not exceed 40% per NEC.
 2. Conduit and raceway system shall be installed as specified under the general electrical section of the specifications, and per NEC.
 3. Minimum conduit size shall be 3/4" EMT. Install conduit per engineered shop drawings.
 4. Systems utilizing open wiring techniques with low smoke plenum cable shall provide conduit in all inaccessible locations, inside concealed walls, all mechanical/electrical rooms, or other areas where wiring might be exposed or subject to damage.
 5. All conduit ends shall have a protective bushing to prevent cable damage. Bushings must be installed prior to installing cable. Cutting bushing to install around installed cables will not be accepted.

3.3 SYSTEM ZONING AND PARTITIONING

- A. The system shall employ intelligent initiating devices and interface devices capable of being recognized and enunciated at the main system keypad and devices partition keypad.

3.4 TESTING

- A. Submit a written test report from an authorized representative of the equipment manufacturer that the system has been 100% tested and approved. Final test shall be witnessed by Owner and the project's Technology Consultant and performed by the equipment supplier. Final test report must be received and acknowledged by the Owner prior to substantial completion.
- B. Provide instruction as to proper use and operation of system, for the Owner's designated personnel.

3.5 WARRANTY

- A. Entire system shall be warranted against defects in materials and workmanship for a period of one (1) year from the date of substantial completion.

3.6 SOFTWARE

- A. Provide two electronic copies of the final programming and program software to the Owner's Security Supervisor after final approval.

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SECTION 282000

VIDEO SURVEILLANCE SYSTEM (VSS)

PART 1 - GENERAL

1.1 RELATED WORK

- A. The following, in their entirety and as applicable, shall apply to this section. Including any associated drawings.
 - 1. Conditions of the Contract
 - 2. Division 1
 - 3. Division 26
 - 4. Division 27
 - 5. Division 28

1.2 GENERAL PRODUCT REQUIREMENTS

- A. The software used shall be designed for enterprise level use, with an expected use period of 24/7. It shall be the Manufacturer's official software.
- B. The software shall incorporate open standards and published protocols and use standardized components.
- C. The Video Management System provider shall be defined as the provider of the video management software, and the party responsible for rigorous self-testing of the video management software prior to the release of the software.

1.3 GENERAL SYSTEM DESCRIPTION

- A. The Video Management System shall support both centralized and decentralized configurations as well as hybrid options for architecture. Centralized management shall be available no matter the surveillance architecture. The system shall allow for integration with other security devices and products and be designed to allow for leveraging of those products to improve the user experience of the VMS.
- B. The VMS shall not require a central management server.
- C. The VMS shall make the user experience seamless to the end user irrespective of the system architecture.
- D. The VMS must be capable of each server being able to handle an unlimited number of cameras for recording.
- E. The VMS must support Windows Server 2008, 2012, and Windows Server 2016 for the server side. Client- side software must be available for Windows 7, 8 and 10, Mac OSX, iOS 6 and above, and Android. The operating system shall have all current and available patches.
- F. The VMS shall include the following without additional license fees:
 - 1. Client software for Windows.
 - 2. Client software for Mac OSX.
 - 3. Client software for iOS 6 and above.
 - 4. Client software for Android-based platforms.

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5. Client software using a web-based interface.
 6. Standalone clients designed to provide fixed displays.
 7. Video Wall functionality.
 8. SmartSearch.
 9. Access Control Integration.
 10. Full Access Control software platform.
 11. Failover server functionality.
 12. A separate health monitor application.
- G. The VMS shall not require a separate application for administration and user-based roles. Limitations for non-administrative users shall be handled via permissions.
- H. The system shall support running in Virtual Servers for both the server application and client applications

1.4 SECTION INCLUDES

- A. Video Management Systems:
1. Server application.
 2. Desktop application.
 3. Mobile application.
- B. Servers:
1. Owner Provide / Owner Installed
- C. IP security cameras.
- D. VMS software licenses.
- E. Encoders and decoders.
- F. Controller systems.
- G. Accessory products.

1.5 REFERENCES

- A. Code of Federal Regulations (CFR).
- B. Institute of Electrical and Electronics Engineers (IEEE):
1. 802.3 Ethernet Standards.
- C. International Electrotechnical Commission (IEC).
- D. International Organization for Standardization (ISO):
1. ISO / IEC 10918 - Information technology -- Digital compression and coding of continuous-tone still images: Requirements and guidelines; JPEG.
 2. ISO / IEC 14496-10 - Information Technology - Coding Of Audio-Visual Objects - Part 10: Advanced Video Coding; MPEG-4 Part 10 (ITU H.264).
 3. ISO / IEC 23008-2 - High Efficiency Coding and Media Delivery In Heterogeneous Environments - Part 2: High Efficiency Video Coding; MPEG-H Part2 (ITU H.265, HEVC).

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- E. Federal Communications Commission (FCC):
 - 1. FCC Rules and Regulation of Title 47 of CFR Part 15 Subpart B Class A.
- F. Open Network Video Interface Forum (ONVIF):
 - 1. ONVIF - Profiles S Specification.
- G. Underwriters Laboratories (UL):
 - 1. UL listed.

1.6 DEFINITIONS

- A. Abbreviations:
 - 1. ARP - Address Resolution Protocol.
 - 2. DHCP - Dynamic Host Configuration Protocol.
 - 3. DNR - Digital Noise Reduction.
 - 4. DDNS - Dynamic Domain Name Server.
 - 5. FPS - Frames Per Second.
 - 6. GUI - Graphical User Interface.
 - 7. HDD - Hard Disk Drive.
 - 8. HTTP - Hypertext Transfer Protocol.
 - 9. ICMP - Internet Control Message Protocol.
 - 10. IGMP - Internet Group Management Protocol
 - 11. IP - Internet Protocol.
 - 12. iSCSI - Internet Small Computer System Interface.
 - 13. JBOD - Just a Bunch of Disks.
 - 14. JPEG - Joint Photographic Experts Group.
 - 15. MJPEG - Motion JPEG.
 - 16. MP - Megapixel.
 - 17. MPEG - Moving Pictures Experts Group.
 - 18. NAS - Network Attached Storage.
 - 19. NTP - Network Time Protocol.
 - 20. POS - Point of Sale.
 - 21. PPPoE - Pont to Point Protocol over Ethernet.
 - 22. RAID - Redundant Array of Independent Disks (Drives).
 - 23. RTP - Real-Time Transport Protocol.
 - 24. RTCP - Real-Time Control Protocol.
 - 25. RTSP - Real-Time Streaming Protocol.
 - 26. SMTP - Simple Mail Transfer Protocol.
 - 27. SNMP - Simple Network Management Protocol.
 - 28. SSL - Secure Sockets Layer.
 - 29. TCP - Transmission Control Protocol.
 - 30. UDP - User Datagram Protocol.
 - 31. UPnP - Universal Plug and Play.
 - 32. VMS - Video Management System.
 - 33. PoS - Point of Sales.
 - 34. VA - Video Analytics.
 - 35. PnP - Plug and Play.
 - 36. ARB - Auto Recovery Backup.
 - 37. NVR - Network Video Recorder.
 - 38. RAID - Redundant Array of Independent Disks.

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B. Definitions:

1. JBOD: A collection of hard disks that have not been configured to act as a redundant array of independent disks (RAID) array.
2. GOV (Group of Video object planes): A set of video frames for H.264 and H.265 compression, indicating a collection of frames from the initial I-Frame (key frame) to the next I-Frame. GOV consists of 2 kinds of frames: I-Frame and P-Frame.
3. Dynamic GOV: Dynamic assignment of GOV length based on the complexity of the scene to efficiently manage bitrate of the video stream and reduce the storage required.
4. Dynamic fps: Dynamic assignment of frames per second based on the complexity of the scene to efficiently manage bitrate of the video stream and reduce the storage required.
5. ARB (Auto Recovery Backup): Automatic backup mechanism that enables cameras to store videos on to SD card during failures and stream it to the storage device after recovery.
6. Failover: A feature that automatically switches to a redundant or standby device upon failure or unexpected shutdown of an active device.

1.7 SUBMITTALS

A. Project Initiation:

1. Within fourteen (14) days of Notice to Proceed, the data network system installer shall furnish the following in a single consolidated submittal:
 - a. Permits: The Contractor shall obtain all required permits and provide copies to the Owner / Architect / Engineer.
 - b. Product Literature: Complete manufacturer's product literature for all material, hardware, and equipment to be used in the installation of the specified system. In addition, whenever substitutions for recommended products are made, samples (when requested by the Owner / Designer) and the manufacturer's supporting documentation demonstrating compatibility with other related products shall be included. The submittal shall have some type of distinguishing marker or pointer to indicated what specific product is to be provided
 - c. Construction Schedule: A time-scaled Construction Schedule, indicating general project deadlines and specific dates relating to the installation of the cable distribution system.
 - d. Specification Compliance: A letter shall be provided stating, by section and subsection, that the SCS installer complies with the entire specification section. If the installer intends to deviate from any portion of the specifications, a detailed explanation of reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter. No deviations shall be acceptable until they have been approved by the Owner.
 - e. Each Submittal must have a detailed parts list. Quantities will not be required as the quantity of any portion of this system shall be as required for a complete and functional system and in conjunction with the contract documents.
 - f. Certifications: The contractor shall submit all certifications for approved products and the certifications must contain dates which are valid from the date of proposal and not expirer any sooner than 12 months after substantial completion of the project.

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- 1) Physical Security Professional (PSP) Certification: This certification must be held by an on-staff, full-time employee of the system installer. The holder must be staffed out of the office that is located within 75 miles of the projected.
 - 2) Manufacturer Authorized Dealer Certification must be held by the system installer's office that is located within 75 miles of the project and shall be a company certification, not and individual certification.
 - 3) Installer Certifications: Certification indicating that an individual has successfully completed installer training, issued by the VMS and Cameras Manufacturers specified herein, must be held by at least 25% of the, on-site, staff and be made available at the site if requested by the owner, architect, and/or project's technology consultant.
- B. Shop Drawings:
1. Submit the following items, for Owner review and approval, within twenty-eight (28) days of notice to proceed:
 - a. Proposed cable routing and grouping plan.
 - b. In addition to the cable routing, the submitted drawings shall indicate the following, even if the following is expected to be provided by the project's electrical or general contractor:
 - 1) Location of sleeved wall and floor pass-thru
 - 2) Size of sleeve at each location installed
 - 3) Quantity of cable passing through each sleeve
 - 4) Location of devices and head end equipment.
 - 6) Conduit routing, size, and quantity
 - c. Drawing Compliance: A letter shall be provided stating that the system installer complies with the entire project drawing, including all general, keyed, and notes to contractor. If the installer intends to deviate from any portion of the specifications, a detailed explanation of reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter. No deviations shall be acceptable until they have been approved by the Owner.
 - d. All subcontractors shall provide submittals to general contractor for normal distribution to Architects, Engineers and the Owner's project managers.
- C. At Substantial Completion: Provide drawings, to the Owner, to reflect installed cabling with correct labeling and cable routing.
- D. Close-out Procedures:
1. Two (2) copies of the following documents shall be delivered to the building owner's representative at the time of system acceptance. Close out technology documents shall be separated from all other trade's documents. The close out finals shall include:
 - a. Inspection and Test Reports: During the course of the Project, the Contractor shall maintain an adequate inspection system to ensure that the materials supplied, and the work performed, conform to contract requirements. The Contractor shall provide written documentation that indicates that materials acceptance testing was conducted as specified. The Contractor shall also provide documentation, which indicates that all cable termination testing was completed and that all irregularities were corrected prior to job completion.

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- b. Include the Name, address and telephone of the authorized factory representative with a 24-hour emergency service number.
- c. The manual shall also include Manufacturer's data sheets and installation manuals/instructions for all equipment installed a list of recommended spare parts.
- d. Generic or typical owner's instruction and operation manual shall not be acceptable to fulfill this requirement.
- e. An up-to-date record ("as-built") set of approved shop drawing prints that have been revised to show each and every change made to the structure cabling system from the original approved shop drawings. Drawings shall consist of a scaled plan of each building showing the placement of each individual item of the technical cabling system equipment as well as raceway size and routing, junction boxes, and conductor size, quantity, and color in each raceway.
- f. As-built Drawings shall include cable pathways, camera locations with correct labeling and MDF/IDF locations. A copy of the As-Built drawings reflecting the final locations of all cabling shall be given to the designated Owner's representative. The as-built drawings shall be prepared using AutoCAD 2012 or later. Provide the Owner with electronic versions of the as-builts on CD media.
- g. All drawings must reflect final graphic numbering, point to point wiring, device address and programmed characteristics as verified in the presence of the engineer and/or the end user unless device addressing is electronically generated, and automatically graphically self-documented by the system.
- h. A copy of the manufacturer's warranty on the installed system.
- i. Any keys to cabinets and/or equipment and special maintenance tools required to repair, maintain, or service the system.
- j. Operating and Maintenance Instructions for all devices within the system. These instructions shall reflect any changes made during the course of construction, and shall be provided to the Owner, for their use, in a three-ring binder labeled with the project name and description. (4 copies)
- k. Upon completion of the work and at a time designated by the Architect or owner, provide formal training sessions for the Owner's operating personnel to include location, operation, and maintenance of all included systems and equipment. Minimum amount of training time shall be at least 4 hours.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Minimum 5-year experience manufacturing similar products.
- B. System Integrator shall provide the following as part of the System Solution:
 - 1. Complete product and technical data specification sheets that include all material and equipment and shall be available freely online.
 - 2. List of all equipment with part numbers, manufacturer, firmware, and assigned IP addresses.
 - 3. Locations and details for all components to be installed under this scope of work.
 - 4. Placement Diagram showing the proposed location of all system hardware devices.
 - 5. System Calculation of all network bandwidth and storage requirements for System Servers to ensure proper planning of computing and networking infrastructure.

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- C. Installer Qualifications: Minimum 10-year experience installing similar products. Installers shall be trained and authorized by the Manufacturer to install, integrate, test, and commission the system.

1.9 PRE-INSTALLATION MEETINGS

- A. Convene minimum two weeks prior to starting work of this section.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store products in manufacturer's unopened packaging bearing the brand name and manufacturer's identification until ready for installation.
- B. Handling: Handle materials to avoid damage.

1.11 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.12 SEQUENCING

- A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.13 WARRANTY

- A. The security system VMS software and labor furnished by the System Integrator including wiring, software, hardware and third-party products shall be fully warranted for parts, materials and labor for a minimum of 1 year from date of the final acceptance of the Video Surveillance System.
- B. Manufacturer shall provide a limited 3-year warranty for the product to be free of defects in material and workmanship.
- C. Software Licensing and Warranty:
 - 1. Software licensing should be on a per device basis (e.g. 1 x license for 1 IP Camera or I/O device) with no base license for additional features or capabilities.
 - 2. The VMS Software should be completely free for live streaming or playback of offline media files (images, videos).
 - 3. Lifetime software upgrades shall be provided by the Manufacturer without cost and without the need for an annual maintenance agreement.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer:
 - 1. Video Insight as Manufactured by Panasonic, provided by Diamond Partner

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2.2 VSS SERVER

- A. Shall be Contractor Provided/Contractor Installed

2.3 VI MONITORPLUS

- A. VI MonitorPlus will be a thick client for viewing live and recorded video, along with handling administrative tasks.
- B. The software shall not require a client license to operate.
- C. The thick client will support an encrypted XML file for storing settings. The file can be set up to be shared between many clients, allowing the administrator to update all clients with a single file push.
 - 1. Clients will be able to use Active Directory to authenticate users.
 - 2. Clients will be able to use Novell E-directory to authenticate users.
 - 3. VI MonitorPlus shall have a searchable timeline for multiple events.
 - 4. Motion.
 - 5. Access Control (integration required).
 - 6. Rules.
 - 7. LPR (License Plate Recognition).
 - 8. VCA (Video Content Analytic).
- D. VI MonitorPlus will display the servers it's connected to along with the server's cameras in a tree view on the left-hand side.
 - 1. The tree view will allow the user to see the status of the servers that the instance of VI MonitorPlus is aware of.
 - 2. The tree view will also include access to custom layouts, facility maps and action buttons.
 - 3. There will be an option to hide the tree on startup of VI MonitorPlus.
 - 4. The user shall be able search for cameras using a searchable box on the left-hand tree.
- E. The thick client will not be limited in the number of servers it can connect to.
- F. Live view will allow views of 1, 2, 4, 8, 9, 10, 13, 16, 25 and 36 cameras. A widescreen option for 18 and 24 cameras will also be available.
 - 1. Layouts will be selectable via icon.
 - 2. Layouts will not be limited to cameras from a single server.
 - 3. Users will be able to get layouts to cycle in the client's workspaces.
 - 4. Layouts shall be able to be put into groups.
- G. If motion is detected on a camera, the software shall have the option to indicate it by highlighting the edge of the live window.
- H. Live view will allow cameras to be dragged and dropped onto the live view from the left-hand tree. Cameras can be duplicated in a view.
- I. Users will be able to invoke a digital zoom by drawing a box.
- J. After invoking the digital zoom, VI MonitorPlus shall support the use of picture in picture within the zoomed image.

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- K. Digitally zoomed areas will be treated as a digital PTZ.
- L. PTZ Presets shall be listed in a drop-down menu in the Dynamic Tab.
- M. Users shall be able to move the PTZ movements simply by clicking on the image, through onscreen PTZ controls. Zoom functionality can also be controlled via the scroll wheel of the mouse.
- N. Live view will support a full screen mode that hides the UI. User shall be able to start VI MonitorPlus in this full screen mode with a setting.
- O. Live view shall allow the user to de-warp the video from panoramic lenses and cameras.
- P. Right clicking on a camera in live view will have the following behaviors:
 - 1. Right clicking on a camera within live view will allow the user to be able to review the recently recorded video for that camera.
 - 2. Right clicking on a camera within live view will also allow access to the properties dialog box for that camera.
 - 3. Right clicking on a camera will bring up the option to save a still image of the live view.
 - 4. Live audio will be able to be accessed by right clicking on a camera in the live view.
 - 5. Allowing access to recorded video.
 - 6. Right-clicking on the Camera tile will allow the users to send video or messages to other users in the form of a popup window.
- Q. Recorded video Synchronized playback will allow for cameras to simply be dragged and dropped into the player.
- R. The exporting of video in VI MonitorPlus shall have Region of Interest capability within a recorded image. This will enable segregation of image for export.
- S. The thick client will include a repair utility for corrupted video.
- T. VI MonitorPlus will be able to display logging information such as: changes to the server, lost camera signals, who exported recorded video, when did users log-on/off and other errors. This functionality will be limited to administrative users. The log will be exportable as txt or to the Windows clipboard.
- U. VI MonitorPlus shall also provide real time status updates for server status and camera status, including the CPU usage, disk usage, bandwidth usage, licensing and number and names of users who are logged in.
- V. The system will support an Alarm Log to make it easier to find DIO based events.
- W. Facility maps will be available in the software for viewing.
 - 1. When the user hovers over a camera in the facility map it will display the camera in a window off the side of the map.
 - 2. While a camera is displayed it will allow access to recorded video from that camera as well as the live stream.
 - 3. Cameras will display where they are pointed.
 - 4. Embedded layouts will change the layout of VI MonitorPlus if they are clicked on.
 - 5. Embedded Facility maps will cause the current map to change to the embedded map if clicked on.

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- 6. The user will have the option of importing and placing doors from supported access control partners on the map. This shall allow them to see badge events as well as alarm events. It shall also support the ability to lock and unlock doors from the map.
- 7. Integrated Panic button events will be visible on the facility map.
- X. VI MonitorPlus will support the DCZ Joystick as well as standard USB joysticks.
- Y. The software shall support the ability to open a live window that can be moved around. This window will be able to access the view of any camera or layout the user has access to.
- Z. VI MonitorPlus will support multiple screen user environments for dynamic user interface.
- AA. The user will be able to enable or disable the following settings:
 - 1. Server name in the live view.
 - 2. Camera Name in the live view.
 - 3. Audio notification on motion.
 - 4. Forcing aspect ratio.
 - 5. Use Direct Show for display.
 - 6. Double clicking to change the server layout.
 - 7. Double clicking expands the camera.
 - 8. Allowing multiple live windows.
 - 9. Block live windows from popping up.
 - 10. Live window always on top.
 - 11. The speed in which layouts cycle.
 - 12. Hiding left tree on start up.
 - 13. Launching Facility maps on start up.
- BB. Users with Administrator privileges will be able to configure the server and camera settings. Users will also be able to test SMTP settings and database settings.
 - 1. Users will be able to configure the framerate of the camera, including the option to have the server record continuously from 1 to 3 fps with the option to go to the cameras designated frame rate on motion detection.
 - 2. Users will be able to select various time-lapse options for the camera.
 - 3. Users will be able to select the camera stream type.
 - 4. Users will be able to select camera or server-side motion detection.
- CC. Users will be able to access a graphic representation of what the server's motion detection settings are picking up through the timeline.
- DD. Users will be able to configure user settings as well as layout settings from within the thick client.
- EE. VI MonitorPlus will allow users to send video to other users, allowing for remote live pop ups of video of important events.
- FF. VI MonitorPlus will support Layout touring. Selecting a layout will cycle through a list of cameras.
- GG. User shall be able to allow for remote support via VI MonitorPlus.
- HH. VI MonitorPlus will allow Region of Interest searches (a.k.a. SmartSearch functionality).

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2.4 WEB CLIENT

- A. The Web Client shall be a truly thin client with no download required other than an internet web browser or standard web browser plugins.
- B. The Web Client shall be platform independent and run within Microsoft Edge, Internet Explorer, Firefox, Safari, and Google Chrome.
- C. Users will not be able to change any settings within IP Server via the thin client without Admin privileged.
- D. Users will be able to select layouts for live viewing, or individual cameras or groups of cameras.
- E. Users will be able to access recorded video.
- F. Users will be able to download recorded video from the system.
- G. Users will be able to use the motion log to find recorded video.
- H. The Web Client shall support the use of facility maps.
- I. The Web Client will support the use of custom layouts.
- J. The Web Client shall allow remote access for iPhone, Blackberry, Windows Mobile, and Android mobile phones without the installation of an app.

2.5 HEALTH MONITOR

- A. Front end, or by sending out an e-mail to one or more users.

2.6 VIDEO WALL

- A. The VSS shall support video wall applications by connecting and controlling multiple workstations and monitors simultaneously.

2.7 VSS MOBILE APPLICATION

- A. The VSS shall support module applications that run on the following Operating Systems:
 - 1. Google Android.
 - 2. Android 4.0: Ice Cream Sandwich thru the most current version
 - 3. Apple iOS: 5 thru the most current version
- B. The App will have access to live cameras.
- C. PTZ functionality will be available in the App.
- D. The App will have access to recorded video.
- E. Snapshots will be able to be e-mailed from the App.

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2.8 SERVERS

A. Rackmount Servers:

1. Server sizes and quantities shall be provided on storage and server calculations conducted by the system installer, based on the minimum parameters stated within the contract documents.
2. Server Requirements shall meet the specifications of the VSS Manufacturer. The following specifications shall be considered minimum requirements:
 - a. Record Video and Audio: 470 Mbps.
 - b. Send data from video cameras to a hard disk array of 1 to 8 HDDs within a rack mountable format and enable playback of video and audio from the hard disk array.
 - 1) Pre-configured with VSS software.
 - 2) Remote monitoring environment for video and audio over network using a remote computer.
 - 3) SQLite, a free database technology included in the installation package.
 - c. General Properties:
 - 1) Camera Search and Discovery: Search network for connected compatible cameras via Onvif Profile S.
 - a) Cameras are Searched or Discovered:
 - b) Cameras automatically registered and current camera information (fps, days of recording) displayed.
 - c) Ability to selectively register as many as cameras can be found.
 - 2) Support dual monitor out.
 - 3) Support server backup if multiple servers are in the hive for failover for redundancy.
 - 4) Recording and Playback Functions:
 - a) Support recording 128 dual streams (256 streams) from 352 x 288 (CIF) up to 4000 X 3000 (12 MP) per channel.
 - b) 470 Mbps network camera recording throughput.
 - c) Simultaneous Playback Capability: 128 video channels.
 - d) Compression Support: H.265, H.264, and MJPEG.
 - e) NVR to record and stream AAC, PCM, g726, and MPS audio.
 - f) View status of internal connected storage hardware.
 - g) Set recording schedules.
 - h) Set up triggered recording based on:
 - (1) Sensor (input) detection.
 - (2) Motion Detection.
 - (3) Video loss detection.
 - i) Available recording settings by channel for standard and event-based recording types:
 - (1) Compression type.
 - (2) Resolution.
 - (3) Images per second.
 - (4) Quality.
 - (5) Data transfer limit.
 - (6) Pre-event and post-event record duration.

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- (7) I-frame and full frame recording.
 - j) Available actions upon reaching full HDD storage capacity:
 - (1) Stop recording.
 - (2) Overwrite.
 - k) Search recorded data by time, event trigger, motion alarms, events.
 - 5) Storage: Four, 8 TB HDDs in JBOD configuration for a maximum of 32TB.
 - a) USB connection for memory/storage device for video clip backup and settings export.
 - 6) Live View:
 - a) Remote monitoring using VSS supplied viewer.
 - b) Streams: H.265, H.264, MJPEG.
 - c) Offline Media: AVI, MKV, MP4, MOV, TS, M2TS, MPEG, MPG, FLV, WMV, 3GP, JPG, PNG, GIF, BMP, and TIFF.
 - d) Configure and exercise functions for connected PTZ cameras, including functionality with compatible USB joystick.
 - e) Capture and save snapshot images.
 - f) Record current video in AVI format.
 - 7) Remote Access:
 - a) Multicast or Unicast: Simultaneous access is unlimited.
 - b) Mobile Device:
 - (1) Supported Platforms:
 - (a) Andriod.
 - (b) IOS.
 - (2) Supported Remote Users: Unlimited amount either live or playback.
 - (3) Dynamic DNS (DDNS) support.
 - 8) VGA and High Definition (HDMI) local monitor outputs live viewing, playback, and backup functions.
 - 9) ONVIF Profile S compliance.
 - 10) Alarm Connections: None on server. Use of I/O software module to support I/O control.
- d. System:
- 1) Processor: Intel Core i5-7500 3.4 GHz.
 - 2) Memory: 8 GB DDR4.
 - 3) Operating Systems: Windows 10 IoT Enterprise.
 - 4) USB Ports: 4x USB 3.0(rear), 1x USB 3.0 Type-C (rear), 2x USB 2.0(front).
 - 5) Video Output: 2x HDMI (rear), 1x DVI (rear).
 - 6) Wi-Fi: IEEE 802.11ac.
 - 7) Other Ports: 1x PS2, 2x Wi-Fi Antennas, 3.5 mm audio in/out, 1x SPDIF out.
 - 8) Keyboard and Mouse: Included.
- e. RAID Support: None.
- f. Video Compression: H.265, H.264, and MJPEG.

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- g. Recording:
 - 1) Channel Capability: No limit but recommended to use VSS Calculator.
 - 2) Bit Rate: 470 Mbps.
 - 3) Resolution Range: 352 x 288 to 4000 X 3000.
- h. Events and Response Actions:
 - 1) Triggers:
 - a) Motion.
 - b) Video loss.
 - c) Event defined by camera.
 - 2) Response Actions:
 - a) Record.
 - b) E-mail.
 - c) Activate PTZ preset.
 - d) Event Trigger program.
 - e) Sound output.
- i. Playback:
 - 1) Number of simultaneous channels: Not limited.
 - 2) Bandwidth: 470 Mbps.
- j. OS Drive: OS Drive Bays: 1, 256 GB SSD internally mounted.
- k. Storage:
 - 1) Internal:
 - a) Number of HDDs Bays: 1 to 8 Bays
 - b) Capacity: 1 to 8 TB per HDD.
 - 2) External Types: USB HDD/Flash drive for backup of video clips, firmware update, settings backup/restore, log export.
- l. Network:
 - 1) Connectivity: 1000 Base-T Ethernet, 2 x RJ-45 connectors.
 - 2) Protocols Supported:
 - a) Transmission Control Protocol (TCP), Internet Protocol (IP) v4 and v6, User Datagram Protocol (UDP).
 - b) Configuration: Dynamic Host Configuration Protocol (DHCP).
 - c) Web Services: Hypertext Transfer Protocol (HTTP), Secure HTTP (HTTPS).
 - d) Network Services: Address Resolution Protocol (ARP), Domain Name System (DNS), Internet Control Message Protocol (ICMP): Network Time Protocol (NTP), Simple Network Management Protocol (SNMP v1/2c/3 – MIB-2), Universal Plug and Play (UPnP).
 - e) Media: Real-Time Transport Protocol (RTP), Real-Time Control Protocol, Real-Time Streaming Protocol (RTSP).
 - f) Multicast: Internet Group Management Protocol (IGMP).
 - g) Notifications: Simple Mail Transfer Protocol (SMTP).
 - h) Remote Access: Point-to-Point Protocol over Ethernet (PPPoE).
 - 3) DDNS: Support DDNS services offered by the Manufacturer and other publicly available service offerings.

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- 4) Security Features:
 - a) User password protection with group restrictions.
 - b) IP address filtering, list of allowed or blocked IP addresses.
 - c) HTTPS(SSL) login authentication.
 - d) User access log.
 - e) 802.1x authentication.
 - f) Restriction of network access/web viewer access.
- 5) Discovery: Manufacturer shall offer a discovery program to identify all devices of his manufacture on the network, as well as ONVIF Profile S conformant devices.
- m. Alarm/Sensor Interface:
 - 1) Input (0): NO or NC, selectable.
 - 2) Output (0): NO or NC, selectable.
 - 3) Use of I/O software module to support I/O control.
- n. Audio:
 - 1) Direction: Bi-directional.
 - 2) Compression: AAC (16/48KHz), G.711 u-law, G.726 selectable.
 - 3) Output: Line level (RCA).
 - 4) Output: Line level (RCA).
- o. Electrical:
 - 1) Power: 100 to 240 VAC.
 - 2) Power Supply: 800 W Redundant.
- p. Mechanical and Environmental:
 - 1) Color: Black / metal.
 - 2) Front Bezel and lock.
 - 3) Form Factor 2U Rack Mount Chassis. Sliding rails included.
 - 4) Mouse and Keyboard: Included.
 - 5) Dimensions (W x H x D): 17.2 x 3.5 x 26 inch (438 x 87.0 x 660 mm)
 - 6) Weight: 30.86 lbs. (14kg).
 - 7) Temperature; Operating and Storage: 32 to 122 degrees F (0 to 50 degrees C)
 - 8) Humidity: 5 to 85 percent, RH non-condensing.
- B. All equipment shall be delivered to the site following the schedule provided. Provide full manufactures warranty for all server equipment.
- C. Servers shall be preprogrammed to include a floor plan graphic of all applicable sites and the exact camera locations and name of cameras. Field verification of camera names is required to complete this task.
- D. In response to proposal, contractor shall provide owner with amounts for annual service maintenance agreement that can be purchased after warranty period has expired.

2.9 CLIENT WORKSTATIONS

- A. Contractor to provide one (1) client workstation with the installation location to be determined at the time of install. Additional workstation will be furnished by the Owner as required.
- B. Contractor shall include configuration of two (2) additional, owner furnished workstations.

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2.10 CAMERAS

- A. Camera Types:
 - 1. Tamper resistant with all movable parts enclosed behind a protective cover.
 - 2. Integrated Smoked Dome In-Ceiling flush mount.
 - 3. Water resistant.
 - 4. 3-year warranty on all cameras.
- B. Color Cameras
 - 1. Acceptable Manufacturers:
 - a. Panasonic iPRO IP PoE Cameras
 - 1) Interior IP Camera – WV-S2231L
 - 2) Interior Fish-Eye IP Camera – WV-S4550L
 - 3) Exterior IP Camera – WV-S2531LN
 - 4) Exterior Multi-Sensor IP Camera – WV-S8530N
 - 5) Exterior Pole-Mounted IP Camera – WV-S2550L
 - 6) Exterior PTZ IP Camera – WV-X6533LN
- C. Field of View Determination by the contractor as necessary for fixed camera locations shall be performed at no additional cost to provide the view desired by the owner. Contractor shall coordinate all final camera views and locations with owner for final approval.
- D. Surge Suppression
 - 1. All exterior cameras shall be provided with surge suppression to protect the camera, data, and power.
 - 2. Surge suppression shall be provided at each end with a surge suppression device at the camera and rack-mounted surge suppression in the applicable MDF/IDF room.
 - 3. All surge suppression shall be grounded at each end.
 - 4. Models
 - a. Field End – Ditek DTK-MRJPOES
 - b. Telecom Room End – Ditek DTK-VM12RM, DTK-VM6WM, or DTK-MRJPOEM

2.11 ADDITIONAL HARDWARE OR EQUIPMENT REQUIRED

- A. Licensing
 - 1. Provide the owner with all licenses as required for installation

PART 3 - EXECUTION

3.1 PREPARATION

- A. System Integrator: Confirm the solution proposal planning and design with the installing contractor.
- B. The network design and configuration to be verified for compatibility and performance with the input/output devices.
- C. Network Configuration: Tested and qualified by Contractor prior to remote device installation.
- D. Equipment to be tested and configured in accordance with instructions provided by the manufacturer prior to installation.

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- E. All firmware found in products to be the latest and most up to date provided by the manufacturer, or of a version as specified by the provider of the Video Management Application (VMA).
- F. All equipment requiring users to log on using a password to be configured with user/site-specific password/passwords. No system/product default passwords shall be allowed.
- G. Confirm hardware will be stored in an environment where temperature and humidity are in the range specified by the Manufacturer.

3.2 INSTALLATION

- A. General
 - 1. Install products per manufacturer's recommendations and approved submittals.
 - a. Comply with documentation provided by the System Integrator to ensure all steps have been taken to provide a reliable, easy-to-operate system.
 - 2. Contractor personnel must comply with all applicable state and local licensing requirements.
 - 3. Before permanent installation of the system, the Contractor will test the system in conditions simulating the final installed environment witnessed by the System Integrator. Adjust as required until proper operation is achieved.
- B. Cable Support:
 - 1. All wire not installed inside conduit or a designated cable tray system shall be installed in a dedicated cable support system for the entire run of each cable. Including, but not limited to service loops.
 - 2. The approved cable support system shall be attached directly to the building steel at a serviceable height. In the event that the building steel is not 5' of the finished ceiling, the contractor shall provide a dedicated threaded rod extending within 5' of the finished ceiling and mount the J-MOD™ support hook to the treaded rod.
 - 3. Cable support shall be installed at a maximum of 5' on center.
 - 4. All cable installed shall be attached to the support system with plenum rated Velcro and a plenum rated Velcro tie shall be installed between each cable support to keep wires neatly bundled throughout the entire run. Tie wraps will only be allowed to be used inside the control panels as required to manage the wires within each type of panel.
 - 5. Absolutely no cable, not installed in conduit, will be allowed to be attached directly to the building's steel or supported in any other method than that stated above.
 - 6. It is the responsibility of the installing contractor to coordinate with all other trades on the project to insure that the pathway of this system does not interfere with the installation of the other trades and to prevent the installed product of other trades from putting strain on the installed wiring.
 - 7. Do not route cable through webbing of structural steel.
- C. Conduit / Raceway:
 - 1. All wire shall be installed in an approved conduit/raceway system (except where permitted by NEC and the local authority having jurisdiction). Maximum conduit "fill" shall not exceed 40% per NEC.
 - 2. Conduit and raceway system shall be installed as specified under the general electrical section of the specifications, and per NEC.
 - 3. Minimum conduit size shall be 3/4" EMT. Install conduit per engineered shop drawings.

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4. Systems utilizing open wiring techniques with low smoke plenum cable shall provide conduit in all inaccessible locations, inside concealed walls, all mechanical/electrical rooms, or other areas where wiring might be exposed or subject to damage.
 5. All conduit ends shall have a protective bushing to prevent cable damage. Bushings must be installed prior to installing cable. Cutting bushing to install around installed cables will not be accepted.
- D. Fire Wall Penetrations: The Contractor shall avoid penetration of fire rated walls and floors wherever possible. Contractor shall also seal all floor, ceiling and wall penetrations in fire or smoke barriers and in the wiring closet.
- E. Wall Penetrations: Where penetrations are necessary, they shall be sleeved with metallic conduit and resealed with an Underwriter Laboratories (UL) approved sealant.
- F. Provide three-sided pre-finished metal hood and seal to wall where conduit penetrates exterior wall.
- G. Install new roof mounted conduits on portable pipe supports – (low profile type), as manufactured by Portable Pipe Hangers or Advanced Support Products. Provide roof protection pads under each support. Coordinate location and routing with design engineer prior to rough-in or installation of system.
- H. Do not install wall mounted cameras into metal fascia. Ensure they are mounted into brick, and sealed top and sides (not bottom).
- I. Interior ceiling cameras shall be mounted utilizing Caddy 512HD, double-gang backbox, and dual gang mud ring.

3.3 EQUIPMENT RACK CONFIGURATION

- A. Cable Placement: Cable installation in the wiring closet must conform to the Project Drawings. All cabling shall be routed so as to avoid interference with any other service or system, operation, or maintenance location. Avoid crossing areas horizontally just above or below any riser conduit. Lay and dress cables to allow other cables to enter the conduit/riser without difficulty at a later time by maintaining a working distance from these openings.
- B. Cable shall be routed as closely as possible to the ceiling, floor or corners to ensure that adequate wall or backboard space is available for current and future equipment. All cable runs within the wiring closet shall be horizontal or vertical within the constraints of minimum cable bending radii. Minimum bend radius shall be observed. Cables shall not be tie-wrapped to electrical conduit or other equipment.
- C. All incoming cables shall be routed on the cable tray and neatly dressed down to the patch panels.

3.4 WIRING INSTALLATION

- A. General:
1. Cabling between wiring closet and camera locations shall be made as individual home runs. No intermediate splices may be installed or utilized between the wiring closet and the camera location.
 2. All cable must be handled with care during installation so as not to change performance specifications.

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- B. Placement: All cabling and associated hardware shall be placed so as to make efficient use of available space. All cabling and associated hardware shall be placed so as not to impair the Owner's efficient use of their full capacity.

3.5 DOCUMENTATION

- A. Labels: The Contractor shall label all outlets using permanent machine engraved labels approved by the Owner. Label patch panels in the wiring closet to match those on corresponding camera locations. The font shall be at least one-eighth inch (1/8") in height, block. All labels shall correspond to as-builts and to final test reports.
- B. Contractor shall ensure complete typed labeling of all cameras with numbers that correspond to locations on video server. Labeling system shall correspond to the Owner's labeling system. Verify with Owner. Provide tags (black letters on white labels, plastic coated) on all cables and outlets.
- C. All cables shall be labeled at both ends with a machine label and all terminations shall be stenciled with a typed label for quick circuit identification. Labeling shall conform to TIA/EIA standard 606 and include interconnect cable identification numbers.
- D. A floor plan, clearly labeled with all numbered camera locations, shall be included in the as-built plans.

3.6 CABLE TESTING - BY MANUFACTURER'S REQUIREMENTS

- A. Notification: The Owner/Architect/Engineer shall be notified one week prior to any testing so that the testing may be witnessed.
- B. Final Acceptance: Before requesting a final acceptance, the Contractor shall perform a series of end-to-end installation performance tests. The Contractor shall submit for approval a proposal describing the test procedures, test result forms and timetable for all copper and fiber optic cabling.
- C. Procedures: Trained personnel shall perform all testing. Acceptance of the test procedures discussed below is predicated on the Contractor's use of the recommended products and adherence to the inspection requirements and practices set forth. Acceptance of the completed installation shall be evaluated in the context of each of these factors.
- D. Errors: When errors are found, the source of each error shall be determined, corrected and the cable retested. All defective components shall be replaced and retested. Retest results must be entered on the test results form. All corrections shall be made prior to final acceptance test.

3.7 INSPECTION

- A. Conformance to the installation practices covered above are to be verified when completed. In some cases, the Owner/Architect/Engineer may observe before acceptance.

3.8 WARRANTY

- A. Guarantee and warrant all equipment provided for a period of 3 years following date of substantial completion, or a period equal to the stated guaranty/warranty offered by the product manufacturer, whichever is the longest in duration.
- B. All such warranties shall include all parts (DVR's, and Power Supplies).

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- C. Labor and all other costs as necessary to maintain the equipment in operating condition as intended by the product manufacturer after a period of 1 year shall be negotiated with the owner upon project completion

END OF SECTION

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SECTION 283100

INTRUSION DETECTION SYSTEM (IDS)

PART 1 - GENERAL

1.1 RELATED WORK

- A. The following sections shall associate with this specification as applicable.
 - 1. General Conditions
 - 2. Supplementary Conditions
 - 3. Division 1
 - 4. Division 26 in its entirety.
 - 5. Division 27 in its entirety.
 - 6. Division 28 in its entirety.

1.2 WORK INCLUDED

- A. The Contractor shall expand existing microprocessor based Intrusion Detection System (IDS) as specified herein. The IDS shall include, but not be limited to, all control equipment, power supplies, power circuits, signal initiating and signaling devices, conduit, wire, fittings, and all other accessories required to provide a complete and operable system.
- B. IDS devices indicated are for reference and coordination purposes only. The installing contractor shall design and provide a complete system, meeting the requirement of specification. The Contractor shall provide all security system devices required for complete system perimeter coverage acceptable to all governing authorities, Architect and Owner.
- C. The IDS shall include intrusion detection coverage as shown on the system floor plans. Whether shown on the floor plans or not, complete coverage of the following areas shall be included:
 - 1. All access points into the building(s), including but not limited to:
 - a. Doors
 - b. Roof hatches
 - c. Windows
 - 2. Interior space motion detection at the following locations:
 - a. All level 1 spaces with window and/or doors
 - b. All entrances on any level
- D. The IDS shall be the product of a single manufacturer and consist of, but not be limited to the following:
 - 1. Control Panels
 - 2. Enclosures
 - 3. Locks and Keys
 - 4. Power Supplies
 - 5. Accessories required to provide a complete IDS
 - 6. System O and I Manuals
 - 7. System Programming
 - 8. Batteries
 - 9. Wiring

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- E. The IDS installer shall be responsible for, but not limited to:
 - 1. Tagging of all conductors and cables at each end.
 - 2. Provision and installation of IDS control panels.
 - 3. Provision and installation of IDS devices.
 - 4. Full coverage of all windows, doors, roof hatches.
 - 5. Preconstruction meeting with Owner's personnel, installing technician and project superintendent.
- F. The contractor shall connect this location to the Owner's monitoring station as designated by the owner.
- G. The Contractor shall be responsible for identifying requirements for permits, from the local the Local Authority Having Jurisdiction (AHJ), for the installation of the alarm system specified herein and shall assist the Owner in obtaining the relevant alarm permits.
- H. All conduits and back boxes shall be provided and installed by the project's electrical contractor. In the event that there is no electrical contractor on the project, responsibility will be that of the IDS installer.

1.3 CODES AND STANDARDS

The system shall comply with the applicable Codes and Standards as follows:

- A. National Electric Code, Article 760.
- B. National Fire Alarm Code (NFPA 72).
- C. Life Safety Code (NFPA 101)
- D. Administrative Council for Terminal Attachments (ACTA):
 - 1. ANSI/TIA-968-A-2002 Technical Requirements for Connection of Terminal Equipment to the Telephone Network.
- E. American National Standards Institute (ANSI):
 - 1. ANSI C63.4 Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
- F. California State Fire Marshal (CSFM):
 - 1. Title 19, California Code of Regulations, Building Material Listing Program (BML).
- G. Federal Communications Commission (FCC):
 - 1. Title 47 C.F.R. Part 15; Class B – Radiated and Conducted Emissions.
 - 2. Title 47 C.F.R. Part 68; rules governing the connection of Terminal Equipment (TE) to the Public Switched Telephone Network (PSTN).
- H. The National Institute of Standards and Technology of the United States of America (NIST):
 - 1. Federal Information Processing Standards Publications 197 (FIPS 197) – Advanced Encryption Standard (AES).
- I. International Organization For Standardization (ISO):
 - 1. 9001 - Quality System.

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- J. Underwriters Laboratories, Inc. (UL):
 - 1. UL 50 - Enclosures for Electrical Equipment.
 - 2. UL 294 – Access Control System Units.
 - 3. UL 365 - Police Station Connected Burglar Alarm Units and Systems.
 - 4. UL 609 - Local Burglar Alarm Units and Systems.
 - 5. UL 864 - Control Units System for Fire-Protective Signaling System.
 - 6. UL 985 - Household Fire Warning System Units.
 - 7. UL 1023 - Household Burglar Alarm System Units.
 - 8. UL 1076 – Proprietary Burglar Alarm Units and Systems
 - 9. UL 1610 - Central Station Burglar-Alarm Units.
 - 10. UL 60950-1 - Information Technology Equipment - Safety.
 - 11. UL 636 – Hold up alarms
- K. Local & State Building Codes
- L. Requirements of Local Authorities having Jurisdiction
- M. Requirements of American Disabilities Act (Public law 101-336).
- N. Texas Accessibility Standards (T.A.S.)
- O. State Fire Marshall.
- P. State Insurance Code.

1.4 QUALITY ASSURANCE

- A. Contractor Qualifications:
 - 1. The installing contractor shall be the authorized representative of the IDS authorized/certified to sell, install, and service the proposed manufacturer's equipment. The installing contractor shall have represented the IDS manufacturer's product for at least five (5) years.
 - 2. The installing contractor shall be certified to install and setup the IDS software with Security Engine and Access Engine Modules attached.
 - 3. The installing contractor shall be licensed by the State of Texas as a security services contractor to design, sell, install, and service security alarm systems and access control system.
 - 4. The installing contractor shall provide 24 hour, 365 day per year emergency service with factory trained service technicians.
 - 5. The installing contractor shall have personnel on their staff that has been actively engaged in the business of designing, selling, installing, and servicing security alarm systems for at least ten (10) years.
 - 6. All Contractors must submit to the owner prior to starting any work the factory training certificates for all personnel that will be working on the specified IDS. No person is allowed to work on the IDS without proper manufacturer's certification.

1.5 SUBMITTALS

- A. The installing contractor and/or equipment supplier shall provide complete and detailed shop drawings and include:
 - 1. Control panel wiring and interconnection schematics.
 - 2. Complete point to point wiring diagrams.
 - 3. Riser diagrams.

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4. Complete floor plan drawings locating all system devices.
 5. Factory data sheets on each piece of equipment proposed.
 6. Detailed system operational description. Any specification differences and deviations shall be clearly noted and marked.
 7. Complete system bill of material.
 8. Line by line specification review stating compliance or deviation.
- B. All submittal data will be in bound form with Contractor's name, supplier's name, project name, and state security license number adequately identified.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS AND INSTALLERS

- A. Acceptable Manufacturer: Bosch Security Systems, Inc.; 130 Perinton Parkway; Fairport, NY 14450. ASD. Toll Free Tel: 800-289-0096. Tel: 585-223-4060. Email: request info (presales.support@us.bosch.com). Web: www.boschsecurity.us.
- B. Requests for substitutions will be considered in accordance with provisions of Division 1.

2.2 CONTROL COMMUNICATOR (Panel)

- A. The IDS control panel shall be Bosch Security Systems, Inc. model B9512G comprising a fully integrated intrusion and residential fire control system. The control panel shall support the following:
1. The IDS system is capable of being utilized as a combination Intrusion and Commercial Fire system per code. Fully integrated intrusion and fire functions allow users to interface with 1 system instead of 2.
 2. Optional Telephone Line Module, programmable for signaling and supervision. 32 programmable areas with perimeter and interior partitioning.
 3. Integrated Conettix IP based communication provides high-speed, secure alarm transport and control.
 4. 32 programmable areas with perimeter and interior partitioning.
 5. 8 on-board, hardwired points with expansion capability for a total of 599 using a combination of wired or wireless points.
 6. Compatibility with Color Graphic Touch Screen, 2-line alpha numeric capacitive touch, ATM style LCD or 2-line LCD style Alarm Keypads
 7. Local or remote programming, test, and diagnostic capability via a computer running the Remote Programming Software (RPS).
 8. The system shall support the use of an Apple iOS device and/or Android device for control. Functions to include arming, disarming and control of outputs and access door, viewing of connected IP cameras. This application shall connect directly to the IDS using internet, wifi or cellular communications and shall not require a third party server or network operations center (noc).
 9. The IDS will allow integration with up to 16 Bosch IP video cameras using the built-in Ethernet connection, allowing the cameras to act as inputs and outputs.
 10. The IDS shall support integration with the Bosch Video Management System (BVMS) using the built-in Ethernet adapter.
 11. The IDS shall support up to thirty-two (32) custom functions allowing the installer to combine up to 6 functions into one command. These custom functions shall be operated by keypad command, point activation, keyfob button, or programmable schedule
 12. The IDS shall support up to 32 keypad shortcuts which allow the installer to define which commands are available at each keypad.

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13. The system shall offer multiple language support that can be assigned per keypad. Languages supported must include English, Latin American Spanish, Portuguese and/or Canadian French.
14. The IDS shall support flash firmware upgrades of systems firmware for the control panel and peripherals, allowing for future updates.
15. Integrated real time clock, calendar, test timer and programmable scheduling capability for relay control and automatic execution of system functions based on a time / event.
16. Provide 1.4 amps of power for standby operation and 2.0 amps of alarm power, both rated at 12 VDC.
17. 3 configurable form 'C' wet or dry-contact relay outputs with expansion capability for up to an additional 472 dry-contact relay outputs.
18. Integrated battery charger with reverse hook up protection, battery supervision and battery deep discharge protection.
19. Supervision of peripheral devices and communications interface(s).

B. Point Functionality and Expansion:

1. Each point in the system shall be programmable to provide the following type of response in the system:
 - a. Always on (24 hour response).
 - b. On when the system is Master Armed.
 - c. Only on when the system is Perimeter Armed.
 - d. Displays / Does Not Display at the ACC when the point is activated.
 - e. Provides / Does Not Provide entry warning tone.
 - f. Sounds / Does Not Sound audible alarm indication.
 - g. The Point is bypassable / not bypassable.
 - h. Alarm Verification with programmable verification time.
 - i. Relay activation by Point.
 - j. Provides / Does Not Provide "watch point" capability.
 - k. Provides Swinger Bypass.
 - l. Defers Bypass Report.
 - m. Can return to the system after being force armed and then restoring.
 - n. Can return to the system after being bypassed and then restoring.
 - o. Keyswitch arming (maintained or momentary)
 - p. Activate by Custom Function
 - q. Activate following an output
 - r. Gas Alarm
2. The system shall support a programmable Monitor delay functionality for supervision of points during disarmed periods. These points may be programmed to ignore status from 1 to 60 minutes and will activate only if the point is off-normal for this time period.
3. The system shall support a programmable delay response functionality for supervision of points during armed or disarmed periods. These points may be programmed to ignore status from 1 to 60 minutes and will activate only if the point is off-normal for this time period.
4. The system shall support virtual points and outputs for customized programming of events
5. The IDS shall be capable of supporting "group zoning." Group zoning refers to the combining of points into a separately identifiable and separately annunciated (programmable text) areas.
6. The IDS shall be capable of allowing variable point response times via programming. Point response times shall be programmable over a range of 300 milliseconds to 4.5 seconds.

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7. The IDS shall have the capability to expand up to 599 separately identifiable points, of which 8 are on-board and 472 are off-board wired, addressable or wireless points.
 - a. The 8 on-board points shall be able to accommodate powered class B functionality using a powered loop interface module.
 - b. Point Expansion Modules (Wired and Wireless) shall be able to be located remote to the main panel to a maximum distance of 1000 feet.
 - c. Addressable modules shall be able to be located remote to the panel to a maximum of 500 feet.
 8. The IDS shall have the capability to expand up to 99 separately identifiable points, of which 8 are on-board and 91 are off-board addressable points connected to multiplexed backbone trunks via wired modules and/or wireless receivers.
 - a. The 8 on-board points shall be able to accommodate powered class B functionality using a powered loop interface module.
 - b. Point Expansion Modules (Wired and Wireless) shall be able to be located remote to the main panel to a maximum distance of 1000 feet.
 - c. Addressable modules shall be able to be located remote to the panel to a maximum of 500 feet.
- C. Areas/Accounts:
1. The IDS shall support 32 independent areas. Each of the 32 areas shall have custom text associated with the armed state, disarmed state and point-off-normal state.
 2. The IDS shall be capable of assigning 1 to 4 account identifiers to the areas depending on the distribution of areas per account.
 3. The IDS shall be capable of assigning 1 to 2 account identifiers to the areas depending on the distribution of areas per account.
 4. All of the areas must be capable of Master (All) and/or Perimeter (Part) arming (excluding predefined Interior protection).
 5. The IDS shall be capable of logically grouping 1 or more points into an area, or conversely, dividing 2 or more points into two or more areas.
 6. Any area shall be configurable to allow arming by specific users when a programmable number of devices are faulted or bypassed.
 7. Areas shall be independently controlled by their corresponding ACC.
 8. Area(s) shall accommodate assignment of independent account numbers to define annunciation, control, and reporting functions.
 9. The IDS shall be capable of linking multiple areas to a shared area which may be automatically controlled (hallway or lobby).
 10. The IDS shall accommodate conditional area arming dependant on the state of other areas (master or associate). Any area can be configured for perimeter and interior arming, not requiring a separate area for this function.
- D. Output Relay Expansion: The IDS shall provide the capability for output relay expansion using relay expansion modules. Independent control of relay functions by area shall be possible through programming assignments.
1. The IDS shall be capable of activating 472 additional relay outputs for auxiliary functions based on its classifications (area vs. panel wide). Output Expansion Modules shall be able to be located remote to the main panel to a maximum distance of 1000 feet. 8 relays (Form C) are to be provided per octo-relay module.
 2. The IDS shall be capable of activating 64 additional relay outputs for auxiliary functions based on its classifications (area vs. panel wide). Output Expansion Modules shall be able to be located remote to the main panel to a maximum distance of 1000 feet. 8 relays (Form C) are to be provided per octo-relay module.

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3. The IDS shall be capable of controlling relays and automatically executing system functions based on a time / event scheduling program. The program can be hour, day of week or day of month based.
 4. Relays and other outputs may be programmed to follow up to 14 different area conditions or up to 12 panel conditions. Relays may also be programmed to follow individual points or groups of points.
 5. The IDS shall support 5 different types of alarm output selections: Steady, Pulsed, California Standard, Temporal Code 3 and Temporal Code 4.
- E. Scheduling: The IDS shall support scheduling capabilities with the following characteristics:
1. Arm / Disarm specific area(s) based on open/close windows.
 2. Bypass / Unbypass point(s).
 3. Activate / Deactivate relay(s).
 4. Send test reports.
 5. Up to 4 programmable holiday schedules of 366 days each (includes leap year). Based on the holiday settings, different time windows for open/close and other system functions can be executed.
 6. Automatic adjustment of system clock for daylight savings time.
- F. Alarm Keypads:
1. The IDS shall accommodate connection with up to 32 ACCs, each capable of displaying custom English, Latin American Spanish, Portuguese or Canadian French text on a liquid crystal display.
 2. The Alarm Keypads shall accommodate viewing and configuration of system parameters including:
 - a. Network Parameters:
 - 1) DHCP Enable/Disable for the selected network module.
 - 2) UPnP Enable/Disable for the selected network module.
 - 3) IP Address for the selected network module
 - 4) Subnet Mask for the selected network module.
 - 5) Default Gateway for the selected network module.
 - 6) Port Number for the selected network module - The module's port number shall range from 0 to 65,535.
 - 7) DNS Server Address for the selected module's DNS server IP address
 - 8) DNS Host Name for the selected module. The DNS host name shall contain up to 63 characters.
 - 9) AES Encryption Key Size – Enable/Disable encryption by selecting the AES encryption key size for the selected network module.
 - 10) AES Encryption Key String - The user shall be able to display, add and modify the AES encryption string based upon the key size previously configured for the selected network module.
 - b. Point Parameters:
 - 1) Point Selection between one and the maximum number of points in the control panel.
 - 2) Point Registration to allow system response from a specific physical point on any one of the expansion modules; On-board or Point expansion modules (wired or wireless)
 - 3) Wireless points shall be able to be enrolled in the system via an auto enrollment feature.
 - c. Event Routing Parameters to allow programming of up to 4 report routing groups as well as configuration of primary and secondary paths.

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- G. User Passcodes and Authority: Passcodes shall be programmable with authority levels to allow users to operate any or all areas.
1. Up to 2000 different passcodes shall be accommodated
 2. Up to 500 different passcodes shall be accommodated.
 3. Each passcode shall be 3 to 6 digits (variable) and be assigned a 32-character user name
 4. User access to System features and functions shall be configurable based on 14 individually programmable levels of authority assigned to the user passcode. Additionally, the system shall have the capability to assign to the user passcode, a different authority level in each of the areas. A service passcode can be assigned to the servicing agent allowing the agent limited access to system functions. User-programmable / activated functions include:
 - a. Arming the system: All areas, specific area(s) only, perimeter instant, perimeter delayed, perimeter partial, watch mode, and arming the system with a duress passcode.
 - b. Disarming the system: All areas, specific area(s) only and disarming with a duress passcode.
 - c. Viewing system status: Faulted points, event memory, bypassed points, area status and point status.
 - d. Implementation functions: Bypass a point, unbypass a point, reset sensors, silence bell, activating relays, initiating the remote programming function locally to allow programming the system from a remote location.
 - e. Testing the system: Local Walk test, Service Walk test, Fire test, send report to remote DACR to check the telephone link, and programming the time and date for the next test report transmission.
 - f. Change system parameters: ACC display brightness, system time and date, and add/delete/change passcodes.
 - g. Extend the closing time of the system.
 - h. Transmitting special alerts and activating audible and visible signals.
 - i. Executing multiple commands / ACC keystrokes from a single Menu / Command List item. This function shall be able to have a 32 character (alphanumeric) title to identify it on the ACC display.
 - j. Editing of time / event based scheduling program from the ACC.
 - k. The IDS shall also provide a "service menu" to implement functions such as viewing and printing the system log, displaying the system firmware revision number, and defaulting (toggling) text displays between custom and default text displays for troubleshooting.
 5. The IDS shall allow users to change their own user passcode from the Alarm Keypad (ACC). Managers shall be capable of changing the user passcodes and authority assignments by area of other users from the ACC.
 6. The IDS shall incorporate a programmable "Passcode Follows Scope" feature to allow users to arm or disarm only the area they are entering with one simple command or control all areas from one ACC.
- H. Communication: The IDS shall be capable of reporting system events and supervisory reports including alarm, trouble, missing modules, restorals, system status, AC failure, battery status to primary and secondary off-site DACR's. The following features shall be supported.
1. The IDS shall be capable of communicating via dial-up analog telephone lines, over a LAN/WAN/Internet using a wired network interface module, or over a cellular network using a CDMA Cellular interface module. The installed system will require B430 phone line module.

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2. The Bosch Modem4 communications format shall be utilized for optimum system performance. The Modem4 format provides the maximum data information to the receiver for alarms, troubles, restorals, bypasses, relay activation, opening/closings, and card access. The detailed information includes the point numbers with text, peripheral device numbers, user numbers with text, and area information. As an alternative format, Contact ID may be used although it will include less detailed information like point or user text.
 3. The IDS shall be capable of sending text (SMS) messages to compatible devices without requiring that these message are sent to a monitoring center
 4. The IDS shall have the capability of communicating with up to 8 different DACRs using up to 4 different phone numbers, up to 24-digits in length and/or 4 URL/IP addresses over a network.
 5. The IDS shall report to a Commercial Central Station that is using a Bosch D6600 Receiver/Gateway or a Bosch D6100i Receiver using Modem4 as a preferred format or Contact ID as an alternate format.
 6. The DACR shall provide the transmission information sent from the IDS that includes alarms, troubles, restorals, bypasses, relay activation, opening/closings, and card access. When using the Modem4a² format the detailed information includes the point numbers with text, peripheral device numbers, user numbers with text, and area information.
 7. The IDS reports shall be classified, by event, into eleven subcategories or "report groups." Each group represents similar types of events. Individual events within each group shall be selectively enabled or disabled for transmission. The eleven report groups shall be as follows:
 - a. Fire Reports.
 - b. Burglar Reports.
 - c. User Reports.
 - d. Test Reports.
 - e. Diagnostic Reports.
 - f. Relay Reports.
 - g. Auto Function Reports.
 - h. RPS Reports.
 - i. Point Reports.
 - j. User Change Reports.
 - k. Access Reports.
 8. The IDS shall have the capability to verify the integrity of the remote communications path and switch to alternate paths when a communications failure occurs.
 9. The IDS shall be capable of unattended mode of operation whereby programming and configuration updates are automatically transferred using the Remote Programming Software (RPS). These updates can initiate from either the control panel or the remote computer using RPS.
- I. Network Communication: The IDS shall be capable of network communications over a LAN, WAN, Intranet, or the Internet. The system shall include supervision of the network communication utilizing configurable periodic heartbeats to the Digital Alarm Communications Receiver (DACR). The DACR shall provide notification of the loss of communications from a networked system after a programmable timeframe since the last communication. The notification options shall be programmable and include local annunciation or indication to automation software.
1. The network interface module shall be capable of supporting Dynamic Host Communication Protocol (DHCP) to obtain an IP Address.

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2. The system shall support a method of authentication between the control panel and the receiver to ensure that the control panel has not been compromised or replaced.
3. The network interface modules shall be capable of supporting encryption using a minimum of 256-bit AES Encryption (Rijndael) certified by NIST (National Institute of Standards and Technology) utilizing the Cipher Block Chaining (CBC) method.
4. The network interface module shall support a 10/100BaseT connection to an Ethernet network.
5. The control panel shall be capable of network communication with a programmable poll time to send periodic heartbeats to the receiver, programmable ACK Wait time, and programmable retry time. In the situation where a communication path is unsuccessful, the control panel shall be capable of attempting backup communication through an available communication method to the same receiver or a backup receiver.
 - a. The control panel shall have the ability to automatically adjust the heartbeat rate of a backup path that is using cellular to the heartbeat rate of the primary path in case of a primary path failure. Upon restoral of the primary path, the heartbeat rate of the backup path shall automatically restore to the original rate. This allows a system utilizing cellular communications to keep the wireless charges low.
 - b. The network communication between the control panel and the receiver shall use Modem4 or Contact ID.
 - c. The control panel shall be capable of two-way communication using a wired network interface module with a 10/100BaseT on a LAN/WAN/Internet configuration or with a cellular module on the Internet.
 - d. The control panel shall be capable of configuring the destination of the receiver using a URL or static IP Address.
 - e. The control panel shall be capable of using DNS to lookup the IP Address of the receiver when programmed with a URL.
 - f. The control panel shall support UPnP for automated Port Forward configuration in the router where the control panel is installed.
 - g. The control panel shall support AutoIP to enable the RPS software to connect to the control panel locally using an IP Direct connection.
 - h. The control panel shall support configuration of the IP parameters from the keypad eliminating the need for a PC to configure the IP device.
 - i. The control panel shall support network diagnostics from a keypad to allow local testing of network connectivity. The diagnostics should include, Ethernet cable connected, gateway configuration ok, DNS lookup operational, and external network connectivity (such as the Internet) operational.
 - j. The system shall be capable of meeting DCID 6/9 and UL 2050 standards.
- J. Event Log: The IDS shall maintain a log of events indicating time, day, month, year type of event, account number, area number, user ID, point text, user text and primary/secondary event route. The system shall allow the following characteristics:
 1. The IDS shall be capable of storing up to 10,000 events
 2. The IDS shall support viewing of logs locally at the ACC and remotely via an upload to a remote central station computer running the RPS software.
 3. The IDS shall provide notification via a report to the DACR when the event log reaches a programmable "percent full capacity". This allows retrieval of stored events via RPS to prevent any loss of event history.
 4. Group, signal type and area can route events to specific receivers.

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5. Each DACR shall be designated as a primary, backup, or duplicate destination for each report group. Assigning an event to multiple routing groups provides for duplicate destinations for the event. The transmission of grouped events allows the reporting of different types of information to different remote DACRs.
- K. Testing, Diagnostic, and Programming Facilities: The IDS shall be capable of sending (manually or automatically) test and status reports to remote DACRs.
1. The IDS shall be capable of sending automatic tests daily, weekly or once every 28 days. Automatic test times shall be programmable to provide an offset of up to 24 hours from the current time.
 2. Automatic test reports shall be programmable to be deferred by one test interval if any other report is transmitted in the current interval.
 3. Automatic test reports and remote system access for diagnostics shall be supported via a remote central station computer with Remote Programming Software (RPS).
 4. The IDS shall be programmable locally or remotely. Programming shall be accomplished via a Keypad or a computer with a remote programmer and diagnostic software package (RPS).
 5. The IDS shall allow an on-site user to initiate remote programming while on-line with the servicing location. The remote programming device must provide a compare feature and allow for downloading either the stored program or the (un)modified program copied from the panel.
 6. The IDS shall allow the local programming option to be disabled and must provide a method to program a panel while no one is on premises, when the panel shares a line with an answering machine.
 7. The IDS shall accommodate IP Diagnostic to verify settings and operation of the network interface modules; Host name, MAC address, IPV4 address assignment. The IP Connection test shall include; Link test to verify physical cable integrity, Ping test to verify gateway response, ping test to verify address on the internet.
 8. Wireless point diagnostics shall include signal strength and device states of registered wireless points in the system.
 9. The number of system testing and programming sessions shall be restricted via the use of program locking features and passwords. Passcode protection in excess of sixteen million combinations is required.
 10. New modules support enhanced diagnostics through RPS.
- L. Miscellaneous Features: Programmable alarm output timer, 4 programmable entry delay times, exit delay programmable by area, individually programmable point of protection text, point bypassing, key switch arming capability with LED outputs, and fire verification.
- M. False Alarm Reduction: The IDS shall comply with all ANSI SIA CP-01 2010 requirements for false alarm reduction.
- N. Ambush Detection: The IDS shall include an early ambush feature that requires that the user disarm, and then inspect the facility within a specified time period, before entering their passcode or a different authorized passcode again. If the user does not enter a passcode a second time, a duress event is generated. If the user does enter a passcode within the specified time period, the system disarms.
- O. Two man rule: The IDS shall include a programmable feature that requires 2 separate passcodes to be entered to disarm the system. After 1 passcode is entered, the system will prompt for a second passcode to be entered on the same ACC. Without the second passcode, the system shall not disarm.

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- P. Dual Authentication: The IDS shall support Dual Authentication by area. Areas programmed for Dual Authentication require activate of a card and a passcode to allow access to system functions, arm/disarm, or access control doors.
- Q. Area Re-Arm: The System shall support programmable area re-arm time of 1 minute to 24 hour.
- R. User-Programmable Features: The IDS shall provide a menu driven interface to provide a user-friendly command structure for programming / customizing the system to the operational criteria of the application. The IDS shall be capable of being operated via:
 - 1. The Command Structure.
 - 2. Menu / Command List.
- S. Command centers shall be microprocessor-based, UL listed, with built in: Model D1255 White Alpha IV Command Center.
 - 1. 16 character illuminated alpha-numeric display.
 - 2. Burglary and fire sounders.
 - 3. Backlight 15-key touchpad.
 - 4. Pre-warn tone.
 - 5. The arming station shall have the ability to annunciate the English language format via the 16 character alphanumeric display by the following:
 - a. Master zone (alarm, service, faulted, and function), POPIT (alarm, service, faulted, missing, extra, function, and location), arm/disarm status (system diagnostics, time/day/date, and user prompts).
 - 6. Additional features shall include local system test, sensor reset, panic and/or medical and/or duress alarm initiation, independent master zone by-pass with automatic restoration to normal status to next system arming, perimeter watch mode, user changeable pass codes, remote programming initiation, and system/monitoring service test.
 - 7. Radionics model B930 keypad, and shall be functional at each of the locations shown on the floor plans.
- T. Modules and Accessories (as Required)
 - 1. ZONEX (Zone Expansion B299)
 - 2. B208 Octo Input module
 - 3. B308 Octo output module
 - 4. B426 Ethernet module.
 - 5. Auxiliary power supplies as required for powering of motion detectors.
 - 6. D9127U and D9127T POPIT.
 - 7. B430 Phone Line module (Required).

2.3 FIELD DEVICES

- A. Ceiling mounted, 360-degree dual technology, infrared sensors/microwave motion sensors. Model DS 9370.
 - 1. Bracket for direct mounting to standard 3-1/2" and 4" electrical backboxes.
 - 2. All units to have areas of coverage, which would cause false alarm signals to be generated, masked out and adjusted to reduce false signals.
 - 3. Contractor to provide a dedicated POPIT for each motion detector on the project.
- B. Wall mounted, high performance, TriTech PIR/Microwave sensor, Model DS970.
 - 1. Low Profile Bracket for directional mounting to standard 3-1/2" and 4" electrical backboxes.

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2. All units to have areas of coverage, which would cause false alarm signals to be generated, masked out and adjusted to reduce false signals.
 3. Provide in gymnasiums/cafeteria wall mounted areas. Provide protective wire cover in gymnasium areas.
 4. Contractor to provide a dedicated POPIT for each motion detector on the project.
- C. Magnetic Door/Hatch Contacts MODEL Sentrol 2500 Series 2505L
1. Where exposed contacts are used, they shall be heavy duty switches protected by die cast aluminum housing. The contact leads shall be encased in steel armor jacket.
 2. Magnetic Door/Hatch Contacts MODEL Sentrol 2505A door contact
 3. Contractor to provide a dedicated POPIT for each motion detector on the project.
- D. Glass Break Detector
1. Bracket for direct mounting to standard 3-1/2" and 4" electrical backboxes.
 2. Protective wire cage as required in areas where damage to detectors is possible such as athletic corridors, gymnasiums, activity centers, kitchens, etc.
 3. GE Solution 2000.

2.4 WIRING

- A. All wiring shall be by the manufactures (Bosch/Radionics) specifications. All cable shall be shielded as required.
- B. All 120v Power shall be furnished by the Division 26 contractor.
- C. All Security Conduit as show on the drawings shall be furnished by the division 26 contractor as part of there scope of work.
- D. Coordination with the Division 26 contractor is the responsibility of the Security Contractor to ensure all conduit is in place for a complete installation.
- E. All systems shall be connected to an emergency power source as available.
- F. Color code of all security intrusion detection system and access control wiring shall be purple in color.
Approved Products:
1. 18/2 unshielded:
Belden #6300UE 0071000
Tappan Wire & Cable, Inc. #P40020.122
 2. 18/4 unshielded:
Belden #6302UE 0071000
Tappan Wire & Cable, Inc. #P41387.28

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All wiring shall be in accordance with the National Electrical Code, Local Codes, and article 760 of NFPA Standard 70. All wiring sizes shall conform to recommendations of the equipment manufacturer, and as indicated on the engineered shop drawings.

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- B. All wire shall be UL Listed CL2 for limited energy (300V) applications and shall be installed in conduit. Limited energy MPP wire may be run open in return air ceiling plenums provided such wire is UL Listed for such applications and is of the low smoke producing fluorocarbon type and complies with NEC Article 760 if so approved by the local authority having jurisdiction.
- C. No AC wiring or any other wiring shall be run in the same conduit as security alarm wiring.
- D. All wire shall be installed in an approved conduit/raceway system (except where permitted by NEC and the local authority having jurisdiction). Maximum conduit "fill" shall not exceed 40% per NEC.
- E. Minimum conduit size shall be 3/4" EMT. Install conduit per engineered shop drawings.
- F. Systems utilizing open wiring techniques with low smoke plenum cable shall provide conduit in all inaccessible locations, inside concealed walls, all mechanical/electrical rooms, or other areas where wiring might be exposed or subject to damage.
- G. All vertical wiring and all main trunk/riser wiring shall be installed in a complete raceway/conduit system. All riser boxes shall be adequately sized for the number of conductors transversing the respective box as well as the number of terminations required.
- H. Telephone Cable: Provide a 4 pair Category 5E telephone cable from the Master Control Panel to the Telephone Equipment Room.
- I. Each motion sensor is to be connected into a dedicated POPIT module for point identification.
- J. Each set of magnetic door contacts that protect one room are to be connected through one POPIT module for point identification of that room.
- K. Magnetic door contacts protecting separate hallways or entry areas to be connected into separate POPIT modules for separate identification.
- L. Provide and install (1) dedicate POPIT for each device installed on the project. Including, but not limited to glass break detectors.
- M. All POPIT Modules shall be installed inside a 4"x4" junction box with a cover. Junction box shall be mounted on the wall nearest to the device the POPIT Module is associated with and the module shall be mounted to the mounted to the back box at each location.
- N. Integrate the security system to the remote monitoring station. Provide all hardware and cabling as required. Coordinate with Owner for approved remote monitoring service.
- O. All popits on project shall be mounted above ceiling in easily accessible area. All popit modules are required to be located on as-built drawings delivered to owner at completion of project.
- P. All keypads and sirens shall have dedicated wiring homeruns from each keypad or siren back to panel. Do not daisy chain keypads or sirens.
- Q. Contractor shall install communication wire from freezer/cooler control panels to burglar alarm panel to notify panel should freezer/cooler encounter high temperature condition. Coordinate programming and final terminations with Owner.

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3.2 CABLE PATHWAYS

A. Cable Support:

1. All wire not installed inside conduit or a designated cable tray system shall be installed in a dedicated cable support system for the entire run of each cable. Including, but not limited to service loops.
 - a. Approved Cable Support Manufacturer:
Panduit Corporation
Erico/Caddy
B-Line
Supports shall be sized appropriately for the number of wires being supported. Reference the manufacturer's specifications for the suggested maximum cables per support size.
2. The approved cable support system shall be attached directly to the building steel at a serviceable height. In the event that the building steel is not 5' of the finished ceiling, the contractor shall provide a dedicated threaded rod extending within 5' of the finished ceiling and mount the cable support hook to the treaded rod.
3. J-MOD™ cable support shall be installed at a maximum of 5' on center.
4. All cable installed shall be attached to the cable support system with plenum rated Velcro and a plenum rated Velcro tie shall be installed between each cable support, to keep wires neatly bundled throughout the entire run. Tie wraps will only be allowed to be used inside the control panels as required to manage the wires within each type of panel.
5. ABSOLUTELY NO CABLE, NOT INSTALLED IN CONDUIT, WILL BE ALLOWED TO BE ATTACHED DIRECTLY TO THE BUILDING'S STEEL OR SUPPORTED IN ANY OTHER METHOD THAN THAT STATED ABOVE.
6. IT IS THE RESPONSIBILITY OF THE INSTALLING CONTRACTOR TO COORDINATE WITH ALL OTHER TRADES ON THE PROJECT TO ENSURE THAT THE PATHWAY OF THIS SYSTEM DOES NOT INTERFERE WITH THE INSTALLATION OF THE OTHER TRADES AND TO PREVENT THE INSTALLED PRODUCT OF OTHER TRADES FROM PUTTING STRAIN ON THE INSTALLED WIRING.

B. Conduit / Raceway:

1. All wire shall be installed in an approved conduit/raceway system (except where permitted by NEC and the local authority having jurisdiction). Maximum conduit "fill" shall not exceed 40% per NEC.
2. Conduit and raceway system shall be installed as specified under the general electrical section of the specifications, and per NEC.
3. Minimum conduit size shall be 3/4" EMT. Install conduit per engineered shop drawings.
4. Systems utilizing open wiring techniques with low smoke plenum cable shall provide conduit in all inaccessible locations, inside concealed walls, all mechanical/electrical rooms, or other areas where wiring might be exposed or subject to damage.

3.3 SYSTEM OPERATION

A. When an alarm condition is detected by any of the alarm initiating devices, the following functions shall occur:

1. The system keypad's interior audible device shall sound until silenced by using proper security code or after system time out.

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2. A custom system alarm message shall be displayed on the LCD display. This display will show the alarm device location in plain English. Location and partition custom messages shall be field programmable.
3. The remote signaling tie connection shall be activated at the Owner's approved central security monitoring location and/or other Owner designated location.
4. Printer shall provide printed copy of events recorded in logger. Install adjacent to security panel.

3.4 SYSTEM ZONING AND PARTITIONING

- A. The system shall employ intelligent initiating devices and interface devices capable of being recognized and enunciated at the main system keypad and devices partition keypad.
- B. All zoning/device locations shall be field programmable.
- C. Input control zones shall be coordinated with the owner prior to final programming:

3.5 TESTING

- A. Submit a written test report from an authorized representative of the equipment manufacturer that the system has been 100% tested and approved. Final test shall be witnessed by Owner, Engineer, Electrical Contractor and performed by the equipment supplier. Final test report must be received and acknowledged by the Owner prior to substantial completion.
- B. Provide instruction as to proper use and operation of system, for the Owner's designated personnel.

3.6 WARRANTY

- A. Entire system shall be warranted against defects in materials and workmanship for a period of one (1) year from the date of substantial completion.

3.7 SOFTWARE

- A. Provide two electronic copies of the final programming and program software to the Owner's Security Supervisor after final approval.

END OF SECTION

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SECTION 284600

FIRE DETECTION AND ALARM SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Provide all detailed engineering, documentation, materials and devices, installation, calibration, software programming and check-out necessary for a complete and fully operational fire detection and alarm system in accordance with the full intent and meaning of the drawings and specifications including, but not limited to, the following:
 - 1. Supply, install and connect all hardware necessary to provide a complete and operational fire detection and alarm system.
 - 2. Supply, install and wire all field hardware, fire alarm control panel, power supplies, power circuits, alarm initiating devices, audible and visual alarm devices, auxiliary control relays, signal initiating and signaling devices, conduits, wires, fittings and all accessories required for the system to perform as specified as required.
 - 3. Supply, install, debug and test all software required to provide all software functions described in accordance with the full intent and meaning of the drawings and specifications.
 - 4. Coordinate the work specified under this Section with other trades and contractors to assure a complete and fully operational system.
- B. The intent of fire detection and alarm system work is specified in this section and indicated on the drawings. The installing contractor shall design and provide a complete system, meeting the requirement of this specification. The Contractor shall provide all fire alarm and initiation devices required for a complete system acceptable to all governing authorities. Provide proper spacing and coverage of all devices.
- C. Expand existing fire alarm system to provide detection coverage for building addition. Provide new Voice Evacuation System for building addition, to be triggered by existing fire alarm system.

1.2 RELATED SECTIONS

- A. Divisions 22, 23 and 26
- B. Sprinkler Systems
- C. Elevators
- D. Food Service

1.3 CODES / STANDARDS / REFERENCES (LATEST EDITIONS)

- A. National Fire Protection Association (NFPA):
 - 1. NFPA 1 Fire Code
 - 2. NFPA 13 Systems, Installation
 - 3. NFPA 17 Dry Chemical Extinguishing Systems
 - 4. NFPA 70 National Electrical Code
 - 5. NFPA 72 National Fire Alarm and Signaling Code.
 - 6. NFPA 80 Fire Doors and Fire Windows

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7. NFPA 90A Standard for the Installation of Air Conditioning and Ventilating Systems.
 8. NFPA 92A Smoke Control Systems
 9. NFPA 101 Life Safety code.
 10. NFPA 105 Smoke Control Door Assemblies
 11. NFPA 1221 Standard for the Installation, Maintenance and Use of Emergency Services Communications Systems.
 12. NFPA 2001 Fire Extinguishing Systems, Clean Agent
- B. UL: Underwriters Laboratories, Inc.
1. 217 Single and Multiple Station Smoke Detectors.
 2. 268 Smoke Detectors for Fire Protective Signaling Services.
 3. 864 Control Units for Fire Protective Signaling Services, 9th Edition.
 4. 864 Transient protection
 5. 1480 Speakers for Fire Protective Signaling Systems
 6. UL Fire Protection Equipment Directory.
 7. UL Electrical Construction Materials Directory.
- C. Factory Mutual P7825 Approval Guide
- D. American National Standards Institute (ANSI).
- E. National Electrical Manufacturer's Association (NEMA).
- F. Institute of Electrical and Electronic Engineers (IEEE).
- G. Electronic Industries Association (EIA-232-C): Interface between Data Terminal Equipment and Data Communication Equipment Employing Serial Binary Data Interchange.
- H. Requirements of American Disabilities Act (Public Law 101-336).
- I. Local Accessibility Standards
- J. State Fire Marshall or Requirements of Local Authorities having Jurisdiction
- K. State Insurance Code
- L. International Building and Fire Code Adopted by Local Authority Having Jurisdiction
- M. Local & State Building Codes
- N. In addition the above requirements, comply with all local codes. Where discrepancies exist between codes, drawings or specifications, the more stringent requirement shall prevail. Installation shall be subject to approval, inspection and test of applicable regulatory agencies.

1.4 MANUFACTURER'S, PLANNER'S AND INSTALLER'S QUALIFICATIONS

- A. The manufacturer shall regularly and presently produce, as the manufacturer's principle products, the equipment and material of the type and design specified for this project, and shall have manufactured the item for at least 5 years.
- B. Manufacturer's product shall have been in satisfactory operation on three installations of similar size, type and design as this project, for approximately 3 years.

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- C. Manufacturer shall submit at the time of bid a list of installations where the products have been in operation.
- D. The installing contractor shall have been actively engaged in the business of designing, selling, installing, and servicing fire alarm systems for at least ten (10) years.
- E. The entire Fire Detection and Alarm System shall be installed by an authorized representative of the Fire Alarm Manufacturer and certified by the manufacturer to distribute, sell, and install the specified fire alarm and smoke detection system. Include all components, elements, and testing and acceptance procedures.
- F. If the submitted system is being supplied by an authorized distributor of the equipment manufacturer, the distributor shall have been actively engaged in the sale, installation and service of the type of system proposed for this project for a minimum of 10 years.
- G. Any proposed installer who cannot show evidence of such qualifications may be rejected. The services of a technician provided and certified by the equipment manufacturer shall be provided to supervise the installation and tests of the system.
- H. Furnish evidence there is an experienced and effective service organization, which carries a stock of repair parts for the system to be furnished.
- I. The installing contractor shall be licensed by the State Fire Marshall to design, sell, install, and service fire alarm systems as required by the State Insurance Code.
- J. The installing contractor shall have on his staff a minimum of two (2) Fire Alarm Planning Superintendent (APS) licensed by the State Fire Marshall's office for such purpose and under whose supervision installation, final connections, and check out will take place as required by the State Insurance Code.
- K. The APS shall be a certified NICET Level III state licensed fire alarm planner under whose supervision system design shall take place. In lieu of a NICET certified state licensed fire alarm planner, the contractor or supplier may provide design supervision by a registered professional engineer, who regularly engages in the design of fire alarm systems as required by the Texas Board of Professional Engineers.
- L. The installing contractor shall provide 24-hour, 365 days per year emergency service with factory trained, state licensed service technicians.
- M. Material shall be new and in perfect condition when installed.
- N. Electrical or electronic equipment provided under this Division which has been damaged, exposed to weather, or is, in the opinion of the Architect/Engineer otherwise unsuitable because of improper fabrication, storage, or installation, shall be removed and replaced with new equipment, at no additional cost to the owner.
- O. Quality Control Assurance:
 - 1. All components of the fire alarm system shall be products of an Underwriters Laboratories, Inc. listed fire alarm manufacturer, and shall bear the UL Label. Partial listing shall not be acceptable.
 - 2. All components of the fire alarm systems shall use the most current technology available.
 - 3. Only new parts shall be installed at the time of initial installation and to repair the system during the warranty period. No reconditioned parts shall be used.
 - 4. All devices shall be tested and certified that they meet or exceed the "Service Life Expectancy Rating" as outlined by UL and NFPA.

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1.5 COORDINATION

- A. It shall be the responsibility of the installing contractor to coordinate all requirements surrounding installation of the fire alarm system with all other trades.
- B. Contractor shall schedule a pre-construction meeting with Owner/Architect regarding the Fire Detection and Alarm System.

1.6 DEFINITIONS

- A. General: Wherever mentioned in this specification or on the drawings, the equipment, devices and functions shall be defined as follows:
 - 1. Alarm Signal: A signal, which signifies a state of emergency requiring immediate action and immediate notification of the Fire Department. These are signals such as:
 - a. The operation of a manual station.
 - b. The operation of a fire suppression system switch.
 - 2. Pre-Alarm Signal: A signal, which indicates a detection device, has operated. These signals require and immediate response, but do not require immediate notification of the Fire Department.
 - 3. Supervisory Signal: A signal, which signifies the impairment of fire protection system, which may prevent its normal operation.
 - 4. Trouble Signal: A signal, which indicates that a fault, such as an open circuit or ground, has occurred in the system.
 - 5. Alarm Zone: An alarm initiating device or combination of devices connected to a single alarm initiating device circuit.
 - 6. Pre-Alarm Zone: A detector or group of detectors connected to a single detector circuit, which can send an alarm to the central control panel.
 - 7. Supervision Zone: A supervisory signal initiating device or combination of such devices connected to a single supervisory signal circuit.
 - 8. Communication Zone: A fire alarm indicating device or series of devices arranged to visually and/or audibly indicate a fire alarm signal.

1.7 SUBMITTALS

- A. Contractor shall meet with Owner's Fire Alarm System representative prior to submission of formal/final shop drawings to Architect to allow the Owner and Architect to review a preliminary draft copy of the submittal to verify compliance with the specifications and any detailed requirements of the project. After the draft submittal has been reviewed by the Architect / Owner / Engineer, and formal shop drawings have been reviewed by Architect and returned to the Contractor, the required pre-construction meeting shall take place with Owner / Architect / Engineer.
- B. Before the final set of shop drawings are submitted to Architect / Engineer, submit drawings to the jurisdictions for approval. All approvals shall be noted on the drawings or by letter from the authorities having jurisdiction (AHJ).
- C. All preliminary and as-built design drawings and supporting documentation shall include: Floor Plan Drawings, riser diagrams, control unit wiring diagrams, point to point wiring diagrams, and typical wiring diagrams as described herein.
 - 1. Name of Owner and Occupant
 - 2. Date
 - 3. Location, including street address.
 - 4. Provide a complete written, item-by-item, line-by-line, specification review stating compliance or deviation in full description.

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5. Device Legend
6. Input/output programming matrix
7. Licensed Designer Information – Registered Professional Engineer or Alarm Planning Superintendent (APS)
8. Battery calculations
9. Notification appliance circuit voltage drop calculations
10. Floor Plan
 - a. Floor identification
 - b. Point of compass
 - c. Correct graphic scale
 - d. All walls and doors
 - e. All partitions extending to within 15 percent of ceiling height
 - f. Room descriptions
 - g. Fire alarm device / component locations
 - 1) Signal notification devices
 - 2) Initiation devices
 - 3) Smoke control systems
 - 4) Initiation of automatic extinguishing equipment
 - 5) Doors that unlock or close automatically
 - 6) Zone verification for detection devices
 - 7) Fire/Smoke damper control
 - 8) Fire alarm panel location
 - 9) Fire alarm annunciators
 - 10) Control valves to Fire Protection System
 - 11) Duct smoke detectors
 - 12) Supervisory devices
 - 13) Elevator location
 - 14) Elevator recall system location
 - h. Location of fire alarm primary power connections
 - i. Location of monitor/control interfaces to other systems
 - j. Riser locations
 - k. Methods for compliance with NFPA 72 24.3.13 for survivability (emergency voice systems) as required in NFPA 72 12.4 where applicable.
 - l. Ceiling height and ceiling construction details
 - m. Fire alarm system riser diagram
 - 1) General arrangement of the system, in building cross-section
 - 2) Number of risers
 - 3) Type and number of circuits in each riser
 - 4) Type and number of fire alarm components/devices on each circuit, on each floor or level
11. Control unit wiring diagrams shall be provided for all control equipment, power supplies, battery chargers, and annunciators and shall include the following:
 - a. Identification of control equipment depicted
 - b. Location(s)
 - c. All field wiring terminals and terminal identification
 - d. All indicators and manual controls, including the full text of all labels
 - e. All field connections to supervising station signaling equipment, releasing equipment, and fire safety control.
 - f. Typical Wiring Diagram shall be provided for all initiating devices, notification appliances, remote light emitting diodes (LEDs), remote test stations, and end-of-line and power supervisory devices.
12. Complete system bill of material of all hardware components.
13. Detailed system operational description. Any specification differences and deviations shall be clearly noted and marked.

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14. Submittal sheets sequentially numbered with the format: sheet number of number total. For example: 1 of 3.
15. Complete set of manufacturer's operating instructions, circuit diagrams and the information necessary for proper installation, operation and maintenance.
16. Manufacturers catalog cut sheets shall be provide for each piece of equipment with the appropriate model or part number highlighted in cases where multiple model numbers or part numbers are shown.
17. Fire detection and alarm system's panel configuration complete with peripheral devices, batteries, power supplies, and interconnection diagrams.
18. Indicate visual alarm device initial candela setting required for coverage.
19. Sample of proposed graphic/text annunciation.

1.8 OPERATION AND MAINTENANCE MANUALS

- A. Submit complete sets of operation and maintenance manuals. Manual, less as-builts, and sign-off sheets, shall be provided upon completion of the work. Approval of the manual will be required prior to substantial completion.
- B. The Operation and Maintenance Manual shall consist of the following:
 1. The manual shall include the names, addresses and telephone numbers of each Contractor installing products, and of the nearest service representative for each product. The manual shall have a Table of Contents and tab sheets. Update manuals to include modifications made during installation, checkout and acceptance. The manual shall include the sections described in the following paragraphs.
 2. The Functional Design Section shall identify the operational requirements for the system and explain the theory of operation, design philosophy, and specific functions. Hardware and software functions, interfaces, and requirements shall be provided for system operating modes.
 3. The Hardware Section shall describe equipment provided, including general description and specifications, installation and checkout procedure, electrical schematics and layout drawings. Alignment and calibration procedures, manufacturer's repair parts list indicating source of supply, interface definition, signal identification and wiring diagrams. Also, include a complete parts list of all components as well as a list of recommended spare parts. The spare parts list shall include, for each item, the manufacturer's name, the model of the part, and serial number, if appropriate, and a physical and electrical description of the part.
 4. The Software Section shall describe programming and testing, starting with a system overview and proceeding to a detailed description of each software module, to instruct the user on programming or reprogramming any portion of the system and other information necessary to enable proper system usage.
 5. The Operation Section shall provide instructions for operation of the system, including system start-up procedures, use of system and applications software, alarm presentation (where applicable), failure and recovery procedures, preventive maintenance schedule, parameter schedules and sequence definition, and system access requirements.
 6. The Maintenance Section shall provide descriptions of maintenance for equipment including inspection, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective components.
 7. The Shop Drawings section shall include copies of all approved shop drawings and submittal materials updated to "AS BUILT".

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1.9 AS-BUILT DRAWINGS

- A. Prepare and submit detailed "As-Built" drawings. The drawings shall include certified test of the system, testing and acceptance sign-off sheets, and other items specified elsewhere to be performed after initial submission of operation and maintenance manuals, complete wiring diagrams showing connections between all devices and equipment, both factory and field wired. Include a riser diagram and drawings showing the as built location of all devices and equipment. The drawings shall show the system as installed, including all deviations from both the project drawings and the approved shop drawings. The drawings shall be prepared on uniform sized sheets, the same size as the project drawings. The plan drawings shall be 11x17 inch and inserted in the specified Operations and Maintenance Manuals. Provide electronic copies in PDF and Autocad.dwg format.

1.10 OPERATIONAL INSTRUCTIONS

- A. Provide a typeset printed or a laser jet printed instruction card mounted behind a lexan plastic or glass cover in a stainless steel or aluminum frame. Install the frame in a conspicuous location observable from the Fire Alarm Control Panel (FACP). The card shall show those steps to be taken by an operator when a signal is received as well as the functional operation of the system under all conditions, normal, alarm, and trouble. The instructions shall be approved by the Architect/Engineer before being posted.

1.11 WARRANTY

- A. The fire alarm system, including labor and material, shall be free from defects in workmanship and materials, under normal use and service, for a period of one year from the date of substantial completion. Major components including but not limited to the main fire alarm panel, sub-panels, panel extenders, power supplies and remote annunciators. Any equipment or workmanship shown to be defective shall be repaired, replaced or adjusted during normal working hours at no cost to the owner within 4-hour notification. Any equipment replaced shall be complete with full factory warranty for that part beginning on the date of installation.
- B. Repair services and replacement parts for the system to be furnished under this Contract shall be available for a period of ten years after the date of final acceptance. Service during the warranty period shall be provided within four hours after notification and all repairs shall be corrected within 24 hours after notification throughout the warranty specified in this section.
- C. The installing contractor shall provide 24 hour, 365 days per year emergency service with factory trained, state licensed service technicians.
- D. The equipment manufacturer shall be represented by a local service organization and the name of such shall be furnished to the Owner, Architect, and Engineer.
- E. Provide a certified fire alarm test of the complete system no earlier than 30 days prior to the end of the warranty period and correct any and all items to bring the system to an approved status at no cost to the Owner. Clean all smoke detectors and replace all defective parts at no cost to the Owner.
- F. Guarantee labor, materials, and equipment provided under this contract against all defects for a period of one year after the date of final acceptance and receipt and approval of "As-Built" drawings and schematics of all equipment.

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- G. All manufacturer's warranties which extend past final completion shall be fully transferred to the Owner.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturers acceptable contingent upon Products' compliance with the specifications:
1. Silent Knight – Provided and installed by Engineered Systems Distributor for Farenhyt, Notifier, or Gamewell.
 - a. Existing panel: 5820XL
 - b. Voice Evacuation System: SKE-Series

2.2 SYSTEM DESCRIPTION

- A. System shall be a completely multiplexed addressable fire detection and alarm system, tested and left in first class operating condition. Voice evacuation systems where required or specified, shall have voice alarm notification wherever audible notification is required.
- B. The system shall provide communication with initiating and control devices individually. All of these devices shall be individually annunciated at the fire alarm control panel. Annunciation shall include the following conditions for each point:
1. Alarm
 2. Trouble
 3. Open
 4. Short
 5. Device missing/failed
- C. System circuits shall be wired as follows: Initiating device circuit (IDCs) shall be Style B, indicating appliance circuit (IACs) shall be Style Y, and signal line circuit (SLCs) shall be Style 4 as describe in NFPA 72.
- D. The system shall contain independently supervised initiating device circuits. The alarm activation of any initiation circuit shall not prevent the subsequent alarm operation of any other initiation circuit. All addressable loops shall have loop isolation protection devices to maintain partial fire alarm system integrity should a fault occur. A loop isolation device shall not exceed a maximum of 20 devices.
- E. There shall be supervisory service initiation device circuits for connection of all sprinkler water flow switches and valves. Device activation shall cause a general alarm at the fire alarm control panel. Each flow and tamper switch shall have an individual address.
- F. There shall be independently supervised and independently fused indicating appliance circuits for all alarm signaling devices. Disarrangement conditions of any circuit shall not affect the operation of other circuits.
- G. Auxiliary manual controls shall be supervised so that an "off normal" position of any switch shall cause an "off normal" system trouble.
- H. The incoming power to the system shall be supervised so that any power failure must be audibly and visually indicated at the fire alarm control panel. A green "power on" LED shall be displayed continuously while incoming power is present at the building fire alarm control panel.

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- I. The system batteries shall be supervised so that a low battery condition or disconnection of the battery shall be audibly and visually indicated at the building fire alarm control panel.
- J. The system modules shall be electrically supervised for module placement. Should a module become disconnected, the system trouble indicator shall illuminate and the audible trouble signal shall sound.
- K. The system shall have provisions for disabling and enabling all circuits individually for maintenance or testing purposes.
- L. The system shall be provided with sufficient battery capacity to operate the entire system upon loss of normal 120 VAC power in a normal or supervisory mode for a period of 24 hours with 20 minutes of alarm operation at the end of this period as a minimum. The system shall automatically transfer to the standby batteries upon power failure. All battery charging and recharging operations shall be automatic. If batteries are fully discharged, the charger shall recharge them back to full charge in four hours.
- M. All external circuits requiring system operating power shall be 24 VDC and shall be individually fused at the respective fire alarm control panel.
- N. All addressable devices shall have the capability of being disabled or enabled individually from the fire alarm control panel.
- O. A maximum of 75 percent capacity of addressable devices shall be multi-dropped from a single pair of wires. Systems that require factory reprogramming to add or delete devices within the capability of the designed system are unacceptable. Expansion of the designed system shall be accomplished by factory reprogramming.
- P. The communication format to the addressable devices shall be a completely digital poll/response protocol to allow t-tapping of the circuit wiring. A high degree of communication reliability must be obtained by using parity data bit error checking routines for address codes and check sum routines for the data transmission portion of the protocol.
- Q. Each addressable device must be uniquely identified by an address code. The system must verify that proper type device is in place and matches the desired software configuration. All remote or external panels shall have an individual address for monitoring.
- R. Wiring type, distances, survivability, and wiring configuration types shall be approved by the equipment manufacturer. The system shall allow a line distance of up to 2,500 feet to the furthest addressable device on a Style Y circuit. Plenum rated fire alarm cable shall have an outer jacket insulation color of red. Minimum wire size shall be #18 AWG.
- S. Each panel extender shall have an individual address.

2.3 FIRE ALARM CONTROL PANEL (FACP)

- A. The FACP shall be capable of communicating with the types of addressable devices specified below. It shall display only those primary controls and displays essential to operation during a fire alarm condition. Keyboards or keypads shall not be required to operate the system during fire alarm conditions. Panel shall support a minimum of 500 addressable points.

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- B. The fire alarm control panel (FACP) shall be fully enclosed in a lockable steel enclosure as specified herein. All operations required for testing or for normal care and maintenance of the system shall be performed from the front of the enclosure. If more than a single unit is required to form a complete control panel, the unit enclosures shall match exactly. The system shall operate at 24 VDC.
- C. Panel shall be large enough to accommodate all components and also to allow ample gutter space for interconnection of all panels as well as all field wiring. Each enclosure and each component shall be identified by an engraved red laminated phenolic resin nameplate. Lettering on the nameplate shall not be less than 1" high. Individual components and modules within the cabinets shall be identified by engraved laminated phenolic resin nameplates.
- D. A local audible device shall sound during alarm, trouble, or supervisory conditions. This audible device shall sound differently during each condition to distinguish one condition from another without having to view the panel. This audible device shall also sound during each key press to provide an audible feedback to ensure that the key has been pressed properly.
- E. The following primary controls shall be visible through a front access panel:
 - 1. Minimum 3-lines, minimum 40 alphanumeric characters per line display.
 - 2. Individual red system alarm LED.
 - 3. Individual yellow supervisory service LED.
 - 4. Individual yellow trouble LED.
 - 5. Green "power on" LED.
 - 6. Alarm acknowledge key.
 - 7. Trouble acknowledge key.
 - 8. Alarm silence key.
 - 9. System reset key.
 - 10. Additional control buttons as directed by Owner.
- F. Under normal condition, the front panel shall display a "SYSTEM IS NORMAL" message and the current time and date.
- G. Should an abnormal condition be detected, the appropriate LED (Alarm, Supervisory or Trouble) shall flash. The panel audible signal shall pulse for alarm conditions and sound steady for trouble and supervisory conditions.
- H. The alphanumeric display shall provide the following information relative to the abnormal condition of a point in the system.
 - 1. 40-character custom location label.
 - 2. Type of device (i.e. smoke, pull station, water flow).
 - 3. Point status (i.e. alarm, trouble).
 - 4. Addressed device physical location to correspond to the actual graphic room numbers.
- I. Alarm conditions shall be displayed on the alphanumeric display. The top line of 40 characters shall be the point label and the second line shall be the device type identifier. The system alarm LED shall flash on the control panel until the alarm has been acknowledged. Once acknowledged, this same LED shall latch on. A subsequent alarm received from another zone shall flash the system alarm LED on the control panel. The alphanumeric display shall show the new alarm information.
- J. Each independently supervised circuit shall include a discrete readout to indicate disarrangement conditions per circuit.

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- K. Acknowledgment for each abnormal condition shall be provided. Acknowledge keys shall not be pass code protected. Acknowledge keys shall be protected by the locked enclosure only. After all points have been acknowledged, the LEDs shall glow steady and the audible device be silenced. The total number of alarms, supervisory and trouble conditions shall be displayed, along with a prompt to review each list chronologically. The end of the list shall be indicated by the message, "END of LIST".
- L. Pressing the appropriate acknowledge button shall display the first unacknowledged condition in the appropriate list (either alarm, supervisory or trouble), and shall require another acknowledge button for each subsequent alarm condition. Press to acknowledge shall only silence the displayed point.
- M. Alarm silencing:
1. Should the "Alarm Silence" button be pressed, all audible alarm signals shall cease operation.
 2. Visual signals shall not be extinguished during alarm silence inhibit mode.
- N. System reset:
1. The "System Reset" button shall be used to return the system to its normal state after an alarm condition has been remedied. The alphanumeric display or reset LED shall step the user through the reset process with simple English Language messages.
 2. Should an alarm condition continue to exist, the system shall remain in an abnormal state. System control relays shall not reset. The audible device and the alarm LED shall be on.
 3. Should the alarm silence inhibit function be active, the System Reset and alarm silence key shall be ignored.
- O. Additional function keys, or their equivalent, shall be provided to access status data and control the function for the following points:
1. HVAC - Bypass
 2. Indicating appliance circuits bypass
 3. Auxiliary relays points bypass
 4. All other input/output points bypass.
 5. Additional control buttons as directed by Owner.
- P. The following status data or their equivalent shall be available:
1. Primary state of point.
 2. Device, PID and card type information.
 3. Current priority of outputs.
 4. Disable/enable status.
 5. Verification tallies of initiating devices.
 6. Automatic/manual control status of output points.
 7. Acknowledge status.
 8. Relay status.
- Q. LED supervision: Where provided, all slave module LEDs shall be supervised for burnout or disarrangement. Should a problem occur the alphanumeric display shall display the module and LED location numbers to facilitate location of that LED.
- R. System trouble reminder: should a trouble condition be present within the system and the audible trouble signal silenced, the trouble signal shall resound at pre-programmed time intervals to act as a reminder that the fire alarm system is not 100% operational. Both the time interval and the trouble reminder signal shall be programmable.

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- S. The fire alarm control panel features shall include, but not be limited to:
1. Setting of time and date.
 2. LED testing.
 3. Alarm, trouble, and abnormal condition listing.
 4. Enabling and disabling of each monitor point separately.
 5. Activation and deactivation of each control point separately.
 6. Changing operator access levels.
 7. Walk test enable.
 8. Running diagnostic function.
 9. Displaying software revision level.
 10. Displaying historical logs.
 11. Displaying card status.
 12. Point listing.
 13. For maintenance purposes, the following lists, or their equivalent, shall be available from the system program and/or the point lists menu:
 - a. All points list by address.
 - b. Monitor point list.
 - c. Signal list.
 - d. Auxiliary control list.
 - e. Feedback point list.
 - f. LED/switch status list.
 - g. Additional control buttons as directed by Owner.
 14. Fire Drill:
 - a. Fire drill activation switch shall activate all audio/visual devices only. Fire drill shall not enter into the alarm sequence of operation, shall not close smoke or fire/smoke dampers, shall not deactivate any HVAC systems, kitchen hoods, etc.
 - b. Activation of any trouble or alarm condition shall supercede the evacuation drill.
 - c. Fire drill shall be canceled by the system reset key, alarm silence, or drill key.
 15. Scrolling through menu options or lists shall be accomplished in a self-directing manner. These controls shall be located behind an access door.
 16. The alphanumeric display shall have an alpha numeric, back-lighted LCD, LED, or gas plasma display. The display shall support numeric and both upper and lower case letters. Lower case letters shall be used for soft key titles and prompting the user. Upper case letters shall be used for system status information. A cursor shall be visible when entering information.
 17. The system shall be capable of being tested by one person. The actuation of the "enable walk test" program at the fire alarm control panel shall activate the "Walk Test" mode of the system, which shall cause the following to occur:
 - a. The remote monitoring circuit connection shall be bypassed.
 - b. Control relay functions shall be bypassed.
 - c. The control panels shall show a trouble condition.
 - d. The panel shall be capable of selecting either: the alarm activation of any initiation device causing the audible signals to activate for two seconds or the alarm activation of any initiation devices causing the audible signals to code a number of pulses to match the zone number.
 - e. The panel shall automatically reset itself after signaling is complete.
 - f. Any momentary opening of an initiating or indicating appliance circuit wiring shall cause the audible signals to sound for 4 seconds indicating a trouble condition.

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- g. The control panel shall be capable of supporting up to 8 separate testing groups whereby one group of points may be in a testing mode and the other (non-testing) groups may be active and operate as programmed per normal system operation. After testing is considered complete, testing data may be retrieved from the system in chronological order to ensure device/circuit activation.
 - h. Should the walk test feature be on for an inappropriate amount of time, it shall revert to the normal mode automatically.
18. Provide three (3) access levels with level 3 being the highest level. Level 1 action shall not require a pass code. Pass codes shall consist of up to ten (10) digits. Changes to pass codes shall only be made by Level 3 authorized personnel.
- a. When entering a pass code, the digits entered shall not be displayed. All key presses shall be acknowledged by a local audible sound and/or visual "*" in the 80 character display.
 - b. When a correct pass code is entered, the new access level shall be in effect until the operator manually logs out or the keypad has been inactive for ten (10) minutes.
 - c. Should an invalid code be input, access shall be denied.
 - d. Access to a level shall only allow the operator to perform all actions within that level plus all actions of lower levels, not higher levels.
 - e. The following keys/switches, or their equivalent shall have access levels associated with them:
 - Set time/date.
 - Manual control
 - Disable/enable
 - Clear historical alarm log
 - Clear historical trouble log
 - Walk test
 - Change alarm verification
 - f. The following keys/switches shall not be pass code protected and shall be protected by the lockable enclosure:
 - Alarm Silence
 - System Reset
 - Acknowledge
19. The fire alarm system shall allow for loading and editing special instructions and operating sequences as required. The system shall be capable of being reprogrammed to accommodate system expansion and facilities changes in operation. All software operations shall be stored in a non-volatile programmable memory within the fire alarm control panel. Loss of primary and secondary power shall not erase the instructions stored in memory.
20. Resident software shall allow for full configuration of initiating circuits so that additional hardware shall not be necessary to accommodate changes in, for instance, sensing of normally open contact devices to sensing of normally closed contact devices, or from sensing of normally open contact devices to sensing a combination of current limited and non-current limited devices on the same circuit and being able to differentiate between the two, or changing from a non-verification circuit to a verification circuit or vice-versa.
21. Resident software shall also allow for configuration of indicating appliance and control circuits so that additional hardware shall not be necessary to accommodate change in, for instance changing a non-coded indicating appliance circuit to a coded circuit.

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22. The main fire alarm panel shall have the resident ability to store a minimum of 600 system events in chronological order of occurrence. Event history shall include all system alarms, troubles, operator actions, unverified alarms, circuit/point alterations, and component failures. Events shall be time and date stamped. Events shall be stored in non-volatile buffer memory. Access to history buffer shall be secured via 5-digit password security code. The system shall have the capability of recalling alarms and trouble conditions in chronological order for the purpose of recreating an event history. Loss of primary or secondary power shall not erase the events stored in the memory. Each recorded event shall include the time and date of that event's occurrence.
 - a. The following Historical Alarm log events shall be stored:
 - Alarms
 - Alarm acknowledgment
 - Alarm silence
 - System reset
 - Alarm historical log cleared
 - b. The following historical trouble log events shall be stored:
 - Trouble conditions
 - Supervisory alarms
 - Trouble acknowledgment
 - Supervisory acknowledgment
 - Alarm verification tallies
 - Walk tests results
 - Trouble historical log cleared
 23. Alarm verification shall be by device, whereby only verification from the same device will confirm the first activation and cause the alarm sequence to occur.
 24. The control panel shall have the capability to display the number of times (tally) a device has gone into a verification mode. Should this verification tally reach a pre-programmed number, a trouble condition shall occur.
 25. The control panel shall have a dedicated supervisory service LED and a dedicated supervisory service acknowledge key. Pressing the supervisory service acknowledge key shall silence the supervisory audible signal while maintaining the supervisory service LED "ON" indicating the off-normal condition.
 26. Activation of an auxiliary bypass key shall override the selected automatic functions.
 27. The system shall have keys that will allow the operator to display all alarms, troubles, and supervisory service conditions including the time of each occurrence.
 28. RS-232-C output: the fire alarm control panel shall be capable of operating remote generic consumer type printers; output shall be ASCII from an EIA RS-232-C connection with an adjustable baud rate. Each RS-232-C port shall be capable of supporting and supervising a remote display and printer. Data amplifiers shall be used to increase data line distance when required.
 29. Panel shall be sized to accommodate all required equipment. Panel shall be equipped with locks and transparent door, providing freedom from tampering yet allowing full view of the various displays and controls.
- T. The fire alarm control panel shall have a 25% spare initiating point and battery capacity for future use.

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- U. The power supply shall provide all control panel and peripheral power needs with filtered power as well as unregulated 24VDC power for external audio-visual devices. The audio-visual power shall be increased as needed by adding additional modular expansion power supplies. All power supplies shall be designed to meet UL and NFPA requirements for POWER-LIMITED operation on all external signaling lines, including initiating circuits and indicating circuits. Design the system power supplies and power trunk wiring for all annunciation devices required, and to add a minimum of five (5) 110cd visual devices in the future. Individual design loading shall not exceed 70% of power supply and system wiring capacity.
 - 1. Input power shall be 120VAC 60Hz. The power supply shall provide internal supervised batteries and automatic charger. The power supply shall provide positive and negative ground fault supervision, battery/charger fail condition, AC power fail indicators. The power supply shall also provide supervision of modular expansion power supplies as may be required.
 - 2. Surge protection shall be integral to the control panels.
 - 3. Each power supply shall be monitored and have an individual address.
- V. Digital Fire Alarm Communicator:
 - 1. Two line primary and secondary telephone line connections
 - 2. Automatically seizes telephone line.
 - 3. Automatic verification between panel and receiving station.
 - 4. Transmits common trouble and supervisory conditions.
 - 5. Dialer status LED.
 - 6. Multiple communication formats including Ademco Contact ID.
 - 7. Dual tone multi-frequency (DTMF) or Pulse modes.
 - 8. Programming password protected.
 - 9. UL approved.
- W. IP Internet and Digital Cellular Communicator:
 - 1. UL 864 listed
 - 2. Supervise IP Ethernet connection every 90-seconds or less
 - 3. Upload/Download capable
 - 4. Transmit all signals and information from the DTMF communicator
- X. Detector sensitivity shall be programmable from the control panel from the following sensitivities: 0.5, 1.0, 1.5, 2.0, 2.5, 3.0 and 3.7% obstruction. Detectors shall be able to be programmed to alert a trouble signal at a lower obstruction and shall report an alarm if the smoke density increases to a predetermined set point. Control Panel and Detectors shall be capable of "Day-Night" automatic sensitivity adjustments.
- Y. Control Switches:
 - 1. Acknowledge/step Switch
 - 2. Signal Silence Switch
 - 3. System Reset Switch
 - 4. System Test Switch
 - 5. Lamp Test
- Z. Automatic Detector Test: The system shall include a special automatic detector test feature, which permits reading and adjustment of the sensitivity of all intelligent detectors from the main control panel. An automatic detector test shall occur automatically fourteen times each twenty-four hour period or be initiated manually from the FACP as desired. In addition, the automatic test feature shall also permit the functional testing of any "intelligent" detector or addressable interface device individually from the main control panel. Automatic detector test sequencing shall be terminated upon receipt of an alarm condition. Detector test shall report all unprogrammed devices installed and report all programmed devices not installed.

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AA. Emergency voice alarm communication system:

1. The emergency voice and tone communication system shall be a pre-built system and shall only require two wires from a polarity reversal circuit or a dry contact for activation. It shall supervise the NO dry contact (if used) and provide a form C trouble relay activation in the event of a system fault. The Voice Communication System shall incorporate minimum 50 watts true RMS amplifiers for both tone and speech amplification. The system shall have a load capacity of up to 100 watts. Optionally, the Voice Communication System shall be capable of providing 50 watts of audio with full backup. The Voice Communication System shall be capable of operating as a stand-alone system or follow the activation of the fire alarm/suppression system. The Voice Communication System shall include a regulated power supply and shall be capable of charging and housing its own batteries. There shall be no need to calculate the load requirements or draw any energy from the fire alarm/suppression system. The Voice Communication System shall come with one speaker supervisory zone as a standard and shall be capable of supervising any combination of up to 11 speaker and/or strobe monitoring modules.
2. A full set of control switches including an all call, tone interrupt, trouble silence and reset shall be available at the Voice Communications System. The Voice Communications System control panel shall also have a green POWER ON LED, a red ALARM LED, a yellow BROWN OUT LED and a yellow SYSTEM TROUBLE LED.
3. The Voice Communication System shall be able to detect a short on any speaker or strobe zone during the normal and alarm mode. The shorted zone shall be isolated from the system and a dedicated LED on the supervised zone shall indicate the short circuit condition. The system shall produce an audible and visual signal indicating that a trouble condition has occurred. Similarly an open circuit shall create a trouble condition and corresponding LED annunciation at the affected zone and at the main control module. Zones that are not shorted or opened shall remain operational.
4. The Voice Communications System shall be able to detect a brownout condition on the AC supply. In the brownout condition the Voice Communication System shall activate a dedicated LED and an audible trouble signal. Ground faults shall activate the system trouble LED and the audible trouble signal, as well as specific LEDs indicating negative and positive ground faults.
5. The Voice Communication System shall be field configurable for 25 or 70.7 volt RMS audio output via program jumpers.
6. The Voice Communication System shall have a digital message player / recorder. The digital message player / recorder shall be capable of storing alert and evacuation tones as well as an emergency voice message. It shall be possible to modify the digital message and tones in the field using a built-in acoustic microphone or headphone jack connected to an audio device. There shall be no need for the burning of eproms in order to program the digital message player / recorder. The digital message player / recorder shall be supervised by the Voice Communication System. The Voice Communications System shall provide a backup evacuation tone in the event of a digital message player / recorder failure.
7. An alarm condition shall cause an audible signal and a red LED to activate. A Voice Communication System with a digital message player / recorder shall produce an ALERT tone followed by an emergency voice message, and in turn followed by an ALARM tone. The number of tone repetitions shall be configurable by the setting of DIP switches on the digital message player / recorder.
8. The sheet metal enclosure shall include a hinged deadfront allowing easy access to all the Voice Communication System components for the purposes of wiring, setting the system configuration and servicing. A door with a key lock shall be part of the Voice Communication System enclosure.

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2.4 FIELD DEVICES

- A. All devices shall be supervised for trouble conditions. The fire alarm control panel shall be capable of displaying the type of trouble condition (open, short, device missing/failed). Should a device fail, it shall not hinder the operation of other system devices.
- B. Visual Signals:
 - 1. Strobe lights shall be of the electronic flashing strobe type and operate on 24 VDC. The strobe light shall be capable of producing 75 candela on axis to comply with ADA and UL 1638 requirements, and 15, 30, or 110 candela to comply with UL 1971 requirements. Visual signals in common areas of illumination shall have synchronized flash. Provide white with red letters.
 - 2. All wall mounted visual devices installed in gymnasiums, corridors shall have a protective cover.
- C. Combination Alarm Signal and High Intensity Visual Signals:
 - 1. Strobe lights shall operate on 24 VDC. The strobe light shall be capable of producing 75 candela on axis to comply with ADA requirements, and 15, 30 or 110 candela to comply with UL 1971 requirements. Visual signals in common areas of illumination shall have synchronized flash. Each unit shall provide a Code 3 Temporal tone. The horn shall be capable of an output of 95dB at 10', and intensity adjusted accordingly for the area of coverage. Electronic Mini-Sounder or horn set on low setting shall be provided in interior rooms 900 square feet or less. Mini-sounder shall not be used in any corridors, mechanical electrical rooms and similar large spaces and areas of high ambient noise level. Provide white with red letters.
 - 2. All combination audio / visual devices mounted in student toilets / restrooms, gymnasiums, and student locker / dressing rooms shall have a protective cover.
 - 3. The audible emergency alarms shall produce a sound that exceeds the prevailing sound level in the room or space by at least 15 dba or shall exceed any maximum sound level with a duration of 60 seconds by 5 dba, whichever is louder with or without protective cover. Sound levels for alarm signals shall not exceed 110 dba at the minimum hearing distance from the audible appliance.
- D. Exterior Audible / Visual Signal:
 - 1. Provide semi-flush mounted, molded of high impact red thermoplastic and listed for exterior weatherproof locations.
- E. Combination Voice Signal and High Intensity Visual Signals:
 - 1. Strobe lights shall operate on 24 VDC. The strobe light shall be capable of producing 75 candela on axis to comply with ADA requirements, and 15, 30 or 110 candela to comply with UL 1971 requirements. Visual signals in common areas of illumination shall have synchronized flash.
 - 2. If required to be wall mounted in student toilets, gymnasiums, corridors, student locker / dressing rooms provide wire guard protective cover.
 - 3. The visual signal lens housing shall be white with red lettered FIRE or as approved by Architect. The speaker and visual signal shall be mounted to a common white speaker baffle. The visual signal shall flash at a rate of minimum of 1 Hz and maximum of 3 Hz, and shall use a strobe type lamp or other high intensity long life light source. The lamp intensity shall be a minimum of 75 candela.
 - 4. The speaker shall be UL 1480 compatible with the control equipment. Unit shall operate within a temperature range of 150°F to -30°F. High output speakers, UL minimum 87dB at 10 feet with speaker taps of .33.66/1.25/2.5 watts. Standard output speakers, UL 75-81 dB at 10 feet with speaker taps of .5/1/1.75/2.75 watts. Capacitor for line supervision.

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- F. Ceiling mounted recessed mounted speakers shall be UL 1480 compatible with the control equipment. Unit shall operate within a temperature range of 150°F to -30°F. UL minimum 78-87 dB at 10 feet with speaker taps of .25, .5/1.0/2.0 watts. Round, white baffle in gypboard or plaster ceilings, provide 2x2 lay-in grid with UL enclosure, tile bridge supports when recessed in lay-in ceiling tiles Capacitor for line supervision.
- G. Surface mounted speakers shall be UL 1480 compatible with the control equipment. Unit shall operate within a temperature range of 150°F to -30°F UL minimum 100 dB at 15 watts at 10 feet. Speaker taps via 7-position selector switch, 25-vol., .48/.94/1.8/7.5/15 watts. Fully enclosed wiring terminals. Capacitor for line supervision. Raco #911 Series Life Safety Appliance back box and adapter, or appliance manufacturer back box.
- H. Manual Pull Station: Addressable pull stations shall contain electronics that communicate the station's status (alarm, normal) to the control panel over two wires which also provide power to the pull station. They shall be manufactured from high impact red Lexan with white lettering. Station shall mechanically latch upon operation and remain so until manually reset by opening with a key common to all system locks. Pull stations shall be double action without glass rods. The front of the station shall be hinged to a back plate assembly and shall be opened with a key to reset the station. The key shall be common with the control panels. The addressable manual station shall have address setting programmed electronically and automatically from the fire alarm control panel. Manual stations shall be designed for semi-flush (surface) mounting on standard electrical box. All pull stations units shall have a protective cover, STI Stopper II #STI-1130 surface mounted cover with local alarm horn. Provide STI, Weather Stopper II #STI3150 for locations where dampness, water or dust is present, and in Natatoriums, except when mounted next to main FACP, staff supervised locations and remote annunciators. Verify cover does not interfere with the operation or key reset function.
- I. Intelligent Photoelectric Smoke Detectors:
1. The detectors shall use the photoelectric principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the ANALOG level of smoke density. The detector shall provide automatic sensitivity "drift" compensation. The detector shall also provide a "maintenance alert" feature whereby the detector shall initiate a trouble condition should the unit's sensitivity approach the outside limits of the normal sensitivity window.
 2. The detectors shall provide address-setting means electronically and automatically at the control panel and programmed for alarm verification.
 3. The detectors shall provide operational status and alarm state LED. Under normal conditions, the LED shall flash, indicating the detector is operational and in regular communication with the control panel. An output connection shall also be provided in the base for connecting an external remote alarm LED.
 4. The detector shall be semi-flush ceiling mounted and be provided with modular detector head with twist-lock base. No radioactive material shall be used.
 5. Voltage and RF transient suppression techniques shall be employed as well as smoke signal verification circuit and an insect screen.
- J. Duct photoelectric smoke detectors:
1. Detectors shall be analog addressable type.
 2. To minimize nuisance alarms, detectors shall have an insect screen and be designed to ignore invisible airborne particles or smoke densities that are below the factory set alarm point. No radioactive material shall be used.
 3. Removal of the detector head shall interrupt the supervisory circuit of the fire alarm detection loop and cause a trouble signal at the control panel.

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4. Voltage and RF transient suppression techniques shall be employed as well as smoke signal verification circuit and an insect screen.
 5. Remote alarm/power LED indicator with test switch shall be provided. Unit shall be wall or ceiling mounted in readily visible and accessible area near the location of detector; exact location of unit to be approved by the Architect/Engineer.
 6. Detectors shall operate on the same principles and exhibit the same basic characteristics as area type photoelectric smoke sensors. The detector shall operate in air velocities of 300 FPM to 4,000 FPM. Each detector shall interface directly to the system SLC loop without the requirement of interface zone modules.
 7. The unit shall consist of a clear molded plastic enclosure (or remote mounted LED status indicator shall be provided next to the smoke detector) with integral conduit knockouts to provide visual viewing of detector/sensor for monitoring sensor operation and chamber condition. The duct housing shall be provided with gasket seals to insure proper seating of the housing to the associated ductwork. Each unit's sampling tubes shall extend the width of the duct and be provided with porosity filters to reduce sensor/chamber contamination.
 8. The detectors shall provide alarm and power status indication by LED. Under normal conditions, the LED shall flash, indicating the detector is operational and in regular communication with the control panel. Steady illumination of the LED shall indicate that the control panel has detected and verified an alarm condition. An output connection shall also be provided in the base for connecting an external remote alarm LED.
 9. The detectors shall provide address setting means electronically and automatically from the control panel and programmed for alarm verification.
- K. Intelligent Thermal Detectors:
1. The detectors shall use dual electronic thermostats to measure temperature levels in its chamber and shall, on command from the control panel, send data to the panel representing the analog temperature level.
 2. The detectors shall provide address-setting means electronically and automatically at the control panel.
 3. The detectors shall provide operational status and alarm state LED. Under normal conditions, the LED shall flash, indicating the detector is operational and in regular communication with the control panel. An output connection shall also be provided in the base for connecting an external remote alarm LED.
 4. The detector shall be semi-flush ceiling mounted and be provided with modular detector head with twist-lock base.
 5. Thermal Detectors shall be combination rate-of-rise and fixed-temperature- rated at 135°F for areas where ambient temperatures do not exceed 100°F and shall be 200°F for areas where ambient temperatures exceed 100°F but not 150°F. The fixed temperature element shall consist of a fusible alloy retainer and actuator shaft. Detectors shall have a smooth ceiling rating of 2,500 square feet. Detectors shall be located as specified and where required by local code authority.
 6. Provide fixed temperature 190°F detector in kitchen and kiln room in lieu of combination rate-of-rise / fixed-temperature type.
- L. Addressable Carbon Monoxide Detection:
1. System sensor #CO1224 with addressable identification of the CO Detector's alarm and trouble contact status. UL listed to Standard 2075 Standard for Gas and Vapor Detectors and Sensors.
 2. Unit to be powered by the fire alarm system non-resettable 24 VDC supervised power supply.
 3. Electro-chemical CO detection.

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4. Integral 85db local alarm with local hush/test switch for silence or test.
 5. Alarm contacts and trouble contacts for detector trouble, loss of power, and end of life.
- M. Auxiliary AHU Relays: Air Products model MR-101C relays shall be provided for HVAC and AHU control and interface. Relays shall be heavy-duty type with contacts rated up to 10 amps at 120V AC, 60 HZ. Relays shall be provided with NEMA I dust cover assembly and be provided with DPDT contacts as well as activated LED indicator.
- N. Voltage sensing relays: Addressable control modules for voltage sensing relay interface shall be FCM-1.
- O. Monitor Module:
1. Addressable monitor modules shall be provided where required to interface to contact alarm devices.
 2. The monitor module shall provide address-setting means electronically and automatically at the control panel. A status/alarm LED shall be provided which shall indicate that the monitor module is operational and in regular communication with the control panel, and indicate detection of an alarm condition.
- P. Control Module
1. Control/relay modules shall be provided where required to provide audible alarm interface and/or relay control interface. The control module may be optionally wired as dry contact (form C) relay.
 2. The control module shall provide address-setting means electronically and automatically at the control panel. A status/alarm LED shall be provided which shall indicate that the control module is operational and in regular communication with the control panel and indicate when the device is actuated via the fire alarm control panel.
- Q. Auxiliary Interface Points: All auxiliary input points (fire suppression hoods, water flow, fire pump, AHU shut-down points, tamper switches, fire extinguishing systems etc.) shall be connected as required, and addressed as a separate initiating point of annunciation at the fire alarm panel and any remote annunciator as required.
- R. Water flow switches / Valve supervisory switches shall be provided and installed by the fire protection contractor and connected by the fire alarm contractor. Wiring of these field devices to the fire alarm system shall be the responsibility of the fire alarm contractor. It is the responsibility of this contractor to ensure the proper function of the system. Each fire protection zone (flow switch) and (Valve switch) shall be addressed electronically and automatically at the control panel as a separate point of annunciation at the fire alarm panel. Coordinate exact location with fire protection contractor and civil drawings.
- S. Beam detectors:
1. Microprocessor based beam detectors, consisting of a separate transmitter and matching receiver.
 2. Coverage up to 350 ft. X 60 ft.
 3. LED status indicators for normal (green), alarm (red), and trouble (yellow).
 4. The detectors shall provide address setting means electronically and automatically at the control panel.

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2.5 VESDA – VERY EARLY WARNING ASPIRATING SMOKE DETECTION SYSTEM

- A. Approved Manufacturers:
 - 1. System Sensor (FASAST) – Detection devices for Cooler / Freezer areas 200 square feet or larger, atriums / high ceiling areas with difficult access.
 - 2. Xtralis (VESDA) – Detection devices for Cooler / Freezer areas 200 square feet or larger, atriums / high ceiling areas with difficult access.
- B. The system shall consist of highly sensitive LASER-based Smoke Detectors with aspirators connected to networks of sampling pipes, intelligent filtration arrangement with fail-safe operation, sub-sampling probe (inertial separator), built-in clean air zero capability, local USB configuration port and Ethernet networking port. VESDA detection system shall be networked with the specified Notifier Fire Alarm Control Panel.
- C. Design Requirements
 - 1. The system shall consist of an air sampling pipe network to transport air to the detection system, supported by calculations from a computer-based design modeling tool.
 - 2. It shall be tested and approved to cover up to 2,000m² (20,000 sq.ft).
 - 3. It shall have a built-in simple user interface indicating alarm and fault status and include a reset / disable button.
 - 4. It shall provide absolute smoke detection.
 - 5. It shall be approved to provide very early warning smoke detection and provide four alarm levels corresponding to Alert, Action, Fire 1 and Fire 2. These levels shall be programmable and able to be set at sensitivities ranging from 0.05-20% obs/m (0.016–6.4% obs/ft.).
 - 6. The detector shall be specifically designed for industrial applications.
 - 7. It shall consist of a highly sensitive LASER-based smoke detector with in-field clean air zero capability, aspirator, intelligent filter and secondary filter.
 - 8. It shall be modular, with field replaceable detection chamber, aspirator, intelligent filter and secondary filter.
 - 9. It shall have four pipe inlets for sample air.
 - 10. It shall incorporate per pipe ultrasonic flow monitoring and provide staged airflow faults.
 - 11. It shall have a built-in and field replaceable intelligent filter placed after the flow monitoring circuitry.
 - 12. Intelligent filter shall:
 - a. Dilute the sampled air for prolonged detector life.
 - b. Combine sample air from all pipe inlets.
 - c. Divide sampled air into filtered clean air and unfiltered air before mixing them together.
 - d. Use HEPA filter with more than 99% efficiency for filtered clean air i.e. removing more than 99% of contaminant particles of 0.1microns or larger, to provide clean air for dilution.
 - e. Use a mesh/screen for the unfiltered air for protection against lint type of particles.
 - f. Be fail-safe and supervised for correct operation with built-in capability to alert for when replacement is required.
 - g. Maintain consistent detector sensitivity over time.
 - h. Have ultrasonic airflow monitoring of the unfiltered sampled air through the intelligent filter.
 - 13. It shall have a field replaceable aspirator after the intelligent filter where the diluted sampled air flows through the aspirator prolonging its life.

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14. The aspirator shall be a purpose-designed rotary vane air pump. It shall be capable of allowing for multiple sampling pipe runs up to 360m (1,200ft) in total, (4 pipe runs per detector) with a transport time per applicable local codes.
15. It shall have a sub-sampling probe (inertial separator) after the aspirator for reduced dust intake in to the detection chamber.
16. It shall have a secondary foam filter after the sub-sampling probe (inertial separator) where the sub-sampled air flows through the foam filter prolonging detection chamber life. The foam filter shall be capable of filtering particles in excess of 20 microns from the sampled air.
17. It shall have a field replaceable smoke detection chamber which stores the calibration values with the chamber assembly.
18. It shall have capability for in-field clean air zero to provide absolute smoke detection.
19. It shall have capability to measure blockages in the air path in to or out of the detection chamber.
20. It shall have an enclosure rating of IP54.
21. The detector shall allow for direct wall mounting or using a supplied mounting plate.
22. It may be inverted as required in specific applications.
23. It shall be self-monitoring for filter contamination.
24. It shall be configured via local USB port with Ethernet port for remote monitoring.
25. It shall have Fire and Fault relay outputs in addition to three configurable relays. The relays shall be software programmable to the required functions and must be rated at 2 AMP at 30 VDC.
26. It shall have at least one general purpose input (GPI).
27. It shall have Power In and Power Out connections to allow powering more than one detector from one power supply.
28. Optional equipment may include a dedicated Xtralis VSM graphics package.
29. It shall report any fault on the unit by using configurable fault relay outputs or via PC based configuration and monitoring system.
30. The detector shall have built-in event and smoke logging. It shall store smoke levels, alarm conditions, operator actions and faults. The date and time of each event shall be recorded. Each detector (zone) shall be capable of storing up to 18,000 events.

D. Programming Requirements

Using either USB or Ethernet port the detector shall allow programming of:

1. IP address and related fields to support Ethernet based networking
2. Four smoke threshold alarm levels
3. Time delays
4. Configurable relay outputs for remote indication of detector conditions
5. Holidays and day/night changeover times
6. Major and minor airflow fault limits
7. Aspirator speed
8. General purpose input function
9. Alarm and fault latching

E. Sampling Pipe

1. The sampling pipe shall be smooth bore. Normally, pipe with an outside diameter (OD) of 25mm or 1.05" and internal diameter (ID) of 21mm or ¾" should be used.
2. The pipe material should be suitable for the environment in which it is installed. VESDA pipe material shall be UL 1887 Plenum rated CPVC).
3. All joints in the sampling pipe must be air tight and made by using solvent cement, except at entry to the detector.

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4. The pipe shall be identified as Air Sampling/Aspirating Smoke Detector Pipe along its entire length at regular intervals not exceeding the manufacturer's recommendation or that of local codes and standards.
 5. All pipes shall be supported at not less than 1.5m (5ft) centres, or that of the local codes or standards.
 6. The far end of each trunk or branch pipe shall be fitted with an end-cap and made air-tight by using solvent cement. Use of an end-cap will be dependent on ASPIRE2 calculations.
- F. Sampling Holes
1. Sampling holes shall not be separated by more than allowed for conventional point detectors as required by 30 feet as local codes and standards. Intervals may vary according to calculations. For NFPA the maximum allowable distance is 30ft.
 2. Each sampling point port shall be identified in accordance with Codes or Standards.
 3. Provide per manufacturer's recommendations and standards in relation to the number of sampling points and the distance of the sampling points from the ceiling or roof structure and forced ventilation systems.
 4. Sample port size shall be as specified by ASPIRE2 calculations.
- G. Detection Alarm Levels:
- The laser based ASD system shall have four (4) independently programmable alarm thresholds. The four alarm levels may be used as follows:
- Alarm Level 1 (Alert)
Activate a visual and audible alarm in the fire risk area.
- Alarm Level 2 (Action)
Activate the electrical/electronic equipment shutdown relay and activate visual and audible alarms in the Security Office or other appropriate location.
- Alarm Level 3 (Fire 1)
Activate an alarm condition in the Fire Alarm Control Panel to call the Fire Monitoring Service and activate all warning systems.
- Alarm Level 4 (Fire 2)
Activate a suppression system and/or other suitable countermeasures.
- The alarm level functions as listed are possible scenarios. Program as directed by Owner to the best utilization of these facilities for each application and the requirements of local A.H.J.
- H. Initial Detection Alarm Settings
- | | | |
|----|------------------------|------------------------------|
| 1. | Alarm Level 1 (Alert) | 0.2% obs/m (0.064% obs/ft.) |
| 2. | Alarm Level 2 (Action) | 0.3% obs/m (0.096% obs/ft.) |
| 3. | Alarm Level 3 (Fire 1) | 0.40% obs/m (0.128% obs/ft.) |
| 4. | Alarm Level 4 (Fire 2) | 2.0% obs/m (0.64% obs/ft.) |
- I. Initial (factory default) Alarm Delay Thresholds
- Initial (factory default) settings for the alarm delay threshold shall be:
- | | | |
|----|------------------------|------------|
| 1. | Alarm Level 1 (Alert) | 10 seconds |
| 2. | Alarm Level 2 (Action) | 10 seconds |
| 3. | Alarm Level 3 (Fire 1) | 10 seconds |
| 4. | Alarm Level 4 (Fire 2) | 10 seconds |
- J. Fault Alarms: The Detector Fault relay shall be connected to the appropriate alarm zone on the Fire Alarm Control Panel (FACP) in such a way that a Detector Fault would register a fault condition on the FACP. The Minor Fault and Isolate relays shall also be connected to the appropriate control system. Provide as required by local Codes, Standards or Regulations.

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- K. Power Supply and Batteries: The system shall be powered from a regulated supply of nominally 24V DC. The battery charger and battery shall comply with the relevant Codes, Standards or Regulations. Typically 24 hours standby battery backup is required followed by 30 minutes in an alarm condition.
1. UL 1481 Listed -provided the power supply and standby batteries have been appropriately sized / rated to accommodate the system's power requirements.
 2. Provide 120-volt 20-amp circuit from the life safety branch panel to each power supply.

2.6 AUXILIARY EQUIPMENT MONITORING

- A. The fire alarm system shall monitor for alarm, supervisory, and trouble conditions; and annunciate the status of the following equipment when provided, or is existing to remain, as part of this project. A failed status shall activate the trouble alarm.
1. Emergency Generator: Run Status
 2. Emergency Generator: Trouble Signal
 3. Fire Pump: Run Status
 4. Fire Pump: Trouble Signal
 5. Emergency Service Communications Systems, as required by NFPA 72 and NFPA 1221.

2.7 MAGNETIC DOOR HOLDERS, AUTOMATIC FIRE DOORS / SHUTTERS, AND SECURITY GRILLES AND INTERIOR SPACE CONTROLLED ACCESS EGRESS DOORS WITH AUTOMATIC EMERGENCY EGRESS ELECTRIC LOCK EMERGENCY RELEASE

- A. Magnetic fire door hold open devices, interface for automatic roll down fire doors/shutters, and interface for security grilles and controlled access egress doors with emergency egress shall be provided. Coordinate with Division 8 and Architectural Drawings for exact location.
- B. The operation of any alarm in the fire alarm system shall cause the following:
1. Release of the magnetic fire door holding devices, permitting the fire doors to be closed by the door closer.
 2. Permit the automatic roll down fire doors/shutters to close automatically.
 3. Permit the security grilles with emergency egress to open automatically.
 4. Unlock the electrically controlled access doors in all interior spaces.
- C. The magnetic door holders, automatic roll down fire doors/shutters, security grilles, and interior electrically controlled access doors with emergency egress, shall be associated with two smoke detectors located on the ceiling with one on either side of the fire door/shutter, security grille opening, or interior egress path electrically controlled door. The operation of either of these detectors shall also cause the magnetic holder to release the fire door, the automatic fire door/shutter to close, and the security grille with emergency egress to open.
- D. The operation of smoke detectors associated with a magnetic door holder, automatic roll down fire door, security grille, or electrically controlled access door shall transmit a pre-alarm signal to the fire alarm panel.

2.8 REMOTE ALPHA-NUMERIC DISPLAY ANNUNCIATORS

- A. Remote alpha-numeric annunciator(s) to annunciate all system events and duplicate the displayed status at the main FACP. The annunciator(s) shall be an alphanumeric display similar to the main FACP and operate via the system RS485 or RS232 serial output terminal from the main FACP. The unit shall operate from FACP 24VDC power and function during system power failure while the system resides on standby batteries. The remote annunciator(s) shall include:

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1. Integral time-date clock
 2. System reset
 3. System silence
 4. System acknowledge
 5. Display/step switch
 6. Integral trouble buzzer
 7. LCD contrast adjust
 8. Fire Drill Operation
 9. Owner's list of all additional remote annunciator control buttons.
- B. Annunciator shall upon command display the first system alarm, last alarm, and system alarm count. The following primary controls shall be visible through a front access panel:
1. 80 character alphanumeric display, LCD, LED, or gas plasma
 2. Individual red system alarm LED
 3. Individual yellow supervisory service LED
 4. Individual yellow trouble LED
 5. Green "POWER ON" LED
 6. Alarm acknowledge key
 7. Trouble acknowledge key
 8. Alarm silence key
 9. System reset key
 10. LED test

2.9 REMOTE PAGING UNIT

- A. Remote all-call paging unit or to activate one of the pre-recorded messages over the speaker circuits.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Installation shall include the delivery, storage, setting in place, fastening to the building structure, interconnection of the system components, alignment, adjustment and all other work, whether or not expressly specified, which is necessary to result in a tested and operational system.
- B. All installation practices shall be in accordance with, but not limited to, the specifications and drawings. Installation shall be performed in accordance with the applicable standards, requirements and recommendations of NFPA 72 and the National Electrical Code and any authorities having jurisdiction. Proper protection against corrosion shall be provided on all electrical equipment in accordance with the requirements of the National Electrical Code. The installation shall conform to all manufacturers' recommendations.
- C. All equipment shall be firmly secured in place unless requirements of portability dictate otherwise. Fastenings and support shall be adequate to support their loads with a safety factor of at least three.
- D. All boxes, equipment, etc., shall be plumb and square. The contractor must take such precautions as are necessary to prevent and guard against electrostatic hum, to supply adequate ventilation, and to install the equipment to provide reasonable safety for the operator.

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- E. Visual displays, GUIs, or other indicators for main fire alarm panel and all remote annunciators shall be at maximum 66 inches AFF.
- F. All remote booster and associated equipment panels shall be mounted with top of enclosure maximum 66 inches AFF.
- G. In the installation of equipment and cables, coordinate with Architectural drawings for possible conflicts with millwork, casework, marker boards, furniture, lockers, etc., and notify the architect of any discrepancies. Verify modifications before proceeding with installation.
- H. Mount end-of-line resistor for each box circuit in backbox located at the last manual alarm station or automatic initiating device in a circuit. Mark device accordingly in the field.
- I. Provide three dedicated Cat 6 cables from MDF/IDF to fire alarm panel. Cable shall be installed in 3/4" conduit. Two cables for phone POT lines and one Ethernet data connection.
- J. Upright and/or Wall Post-Indicating Valve: Provide conduit and wiring from fire alarm control panel to post-indicating valve if electronically supervised, coordinate exact location of PIV with fire sprinkler contractor prior to rough-in. Coordinate final location with Civil Drawings and Fire Protection Contractor. Where equipment is located inside a vault, stub required conduit inside vault, turn up and cap.
- K. Contractor shall submit on completion of system verification, a point-by-point check list indicating the date and time of each item inspected and issue a certificate confirming that the inspection has been completed and the system is installed and functioning in accordance with the Specifications prior to date of substantial completion.
- L. Provide remote alphanumeric display annunciators in the administrative area in constantly attended area, as required by the local AHJ, and additional annunciators where indicated on the drawings as directed by Architect / Owner.
- M. Alarm devices shall be ceiling mounted unless indicated specifically otherwise. Alarm devices in Mechanical, Electrical, Communications, IDF / MDF Rooms and Central Plant shall be wall mounted and coordinated with other equipment, piping and ductwork.
- N. Provide combination speaker strobes. Provide strobe only alarms when additional speaker placement will compromise voice intelligibility. Provide horn/strobes in coolers and freezers.
- O. Detectors shall be installed per NFPA 90A and be listed with the fire alarm control panel.
- P. Auxiliary Equipment Monitoring Wiring and connection to equipment shall be the responsibility of the fire alarm contractor.
- Q. Power for magnetic door holders shall be provided from the nearest receptacle circuit wired through fire alarm relay.
- R. Smoke detectors shall be mounted to a 4-inch octagon box with hanger bar or with box secured to building structure.

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- S. Provide power via 120-volt, 20-Amp dedicated circuits with lock-on provisions at the respective circuit breaker for the main fire alarm control panel, each panel extender and each remote power supply at no additional cost to the Owner. The complete fire alarm system shall be powered under emergency power when emergency life safety power is available at the project site. When emergency life safety power is not available at the project site, power shall originate from the nearest available 120-volt panel. Label 120V circuit origination (i.e.: "120-Volt Circuit ELA-3")
- T. Provide smoke detectors in the following locations:
1. All paths of egress and adjoining spaces within the same HVAC envelope including but not limited to: corridors, hallways, stairs, lobbies, and elevator landings.
 2. At each electrical room, telecommunications/data room, elevator machine room, kiln room, and mechanical room not subject to un-treated or un-filtered outside air.
 3. At each computer lab/room.
 4. At each library, library office and library ancillary areas.
 5. At each storage room, stock room, or warehouse space.
 6. At each pre-K and kindergarten classrooms.
 7. At nurse's area/clinic and patient care/cot areas.
 8. At each men's and women's restroom/toilet
 9. At each administrative work room or copy room.
 10. At each student toilet / restroom. Provide STI protective cover. Do not locate over plumbing fixtures or near partitions.
 11. At each special needs, life skills, adaptive behavior, developmental classrooms or similar designated areas without food preparation or cooking equipment.
- U. Provide heat/thermal detectors in the following locations:
1. At each electrical room, telecommunications/data room, elevator machine room and mechanical room subject to un-treated or un-filtered outside air.
 2. At each janitor's/custodial closets and laundry rooms.
 3. At each commercial kitchen and adjoining storage rooms; at each food preparation area.
 4. At each employee break room/lounge.
 5. At each vocational shop.
 6. At each science, physics, chemistry, or biology classroom and their associated preparation and storage rooms.
 7. At each special needs, life skills, adaptive behavior, developmental classrooms or similar designated areas with food preparation or cooking equipment.
- V. Provide carbon monoxide detection and smoke detection devices in all areas designated as day-care for minors.
- W. Provide duct smoke detectors in all air handling units with air volumes of 2,000 cfm or larger. Where duct smoke detectors are installed above ceilings, provide external remote status/alarm LED mounted flush with ceiling in close proximity to the duct detector location. If space is open without ceiling, wall mount remote status/alarm LED in close proximity to the detector between 96 and 108-inches AFF, or as directed by Owner.
- X. Provide duct smoke detectors on outside air units only as required by local Code and / or A.H.J.
- Y. Provide VESDA type detectors at the following locations when appropriate:
1. Atriums to avoid exposed conduits.
 2. High ceiling areas 25 feet and higher where maintenance of spot type detectors will be difficult.

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- 3. Skylights to avoid exposed conduits.
- 4. Coolers/Freezers 200 square feet and larger.
- Z. Provide manual pull stations at each exterior exit and at each exit from all floors only if required by local AHJ or if the building is not fully sprinklered. Provide one manual pull station at the central reception area as directed by Owner.
- AA. Provide weatherproof exterior audio/visual alarm devices mounted on the building at the exact location as directed by Architect:
 - 1. Main entry.
 - 2. Courtyards and outdoor assembly areas adjacent to the building.
 - 3. Mechanical yards adjacent to the building.
 - 4. Covered playgrounds or covered assembly areas adjacent to the building.
 - 5. Additional locations where indicated on drawings.
 - 6. Outdoor paved play areas.
- BB. Provide audio and visual alarm devices in all areas normally occupied by students or minors and all common use areas.
- CC. Provide carbon monoxide detection in classrooms and other instructional spaces served by a fuel-burning appliance, fuel-burning HVAC equipment (including roof mounted equipment), or with gas fuel outlets for connection to portable fuel-burning space heaters and appliances such as Bunsen burners which are typically used in laboratories or science classrooms.

3.2 CABLE AND BOXES INSTALLATION

- A. All fire alarm wiring to be red. All fire alarm circuits shall be identified at each termination and at each 25 feet between terminations. Minimum 18 AWG wire size for data communications, minimum 14 AWG wire size for alarm circuits. Provide minimum 24 inch service loop for every device.
- B. All circuits shall be protected to avoid interruption of service due to short-circuiting or other conditions, which might adversely affect the connected devices. Each individual signaling circuit shall be classified as a circuit pair.
- C. All cabling in racks, cabinets and junction boxes shall be neatly strapped, dressed and adequately supported. Cable installation shall conform to good engineering practices and to the standards of the National Electrical Code.
- D. Cables shall be terminated with the proper connector required for the associated operation of the equipment to which it is connected. Screw terminal blocks shall be furnished for all cables, which interface with racks, cabinets, consoles or equipment modules.
- E. All cables within a rack, console or junction box shall be grouped according to the signals being carried to reduce signal contamination.
- F. Where shielded conductors enter a panel or enclosure, and where power wiring exists, provision shall be made to provide physical isolation of signal and power conductors.
- G. Supply and install all fittings and accessories whether or not they are specified, required for proper, safe and reliable operation of the system.

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- H. All wire shall be installed in an approved conduit/raceway system (except where permitted by NEC and the local authority having jurisdiction). Maximum conduit fill shall not exceed 40%.
- I. Minimum conduit size shall be 3/4" EMT with insulated bushings. Install conduit per engineered shop drawings. All conduit terminations in all boxes shall have insulated bushings, and shall enter or exit the panel from the top only.
- J. Systems utilizing open wiring techniques with low smoke plenum cable shall provide conduit in all inaccessible locations, inside concealed walls, all mechanical/electrical rooms, or other areas where wiring might be exposed to view and or subject to damage.
- K. All vertical wiring and all main trunk/riser wiring shall be installed in a complete raceway/conduit system. All riser boxes shall be adequately sized for the number of conductors transversing the respective box as well as the number of terminations required.
- L. All junction boxes containing fire alarm wiring are to be painted red and labeled.
- M. All plenum wiring is to be installed parallel and perpendicular to the building structure. Cable shall be bundled with plenum rated cable zip ties on a maximum of 2'-6". Install cable in D-ring hangers, secured to the structure at a maximum of 5' on center. Cable shall not lie on ceiling grid or ceiling tiles, light fixtures, piping, ductwork, or foreign equipment.
- N. The system ground is to be connected to the local ground bus. Under no conditions shall the AC neutral either in a power panel or in receptacle outlets be used for a reference ground.
- O. All wiring shall be in accordance with NFPA 72, the National Electrical Code, and Local Codes. All wiring sizes shall conform to recommendations of the equipment manufacturer, and as indicated on the engineered shop drawings.
- P. All wire shall be UL Listed FPL for limited energy (300V) and fire alarm applications and shall be installed in conduit. Limited energy FPLP or MPP wire may be run open in return air ceiling plenums provided such wire is UL Listed for such applications and is of the low smoke producing fluorocarbon type and complies with NEC Article 760 and approved by the local authority having jurisdiction.
- Q. No other wiring shall be bundled with or run in the same conduit as fire alarm wiring.

3.3 FINISHES

- A. Main Fire Alarm Panel color shall be approved by Owner / Architect.

3.4 ALARM SYSTEM SEQUENCE OF OPERATION

- A. General:
 - 1. All fire alarm circuits shall be electrically supervised.
 - 2. Automatic response functions shall be accomplished by the first device initiated. Alarm functions resulting from initiation by the first device shall not be altered by subsequent alarms. An alarm signal shall be the highest priority. A pre-alarm signal shall have second priority and supervisory or trouble signals shall have third and fourth level priority. Signals of a higher level priority shall take precedence over signals of lower priority even though the lower priority condition occurred first.

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- B. Fire alarm operating sequences shall be as follows:
1. Activation of any automatic detector, manual station, fire suppression system, sprinkler flow switch or any other system required by NFPA 72 to be monitored to initiate an alarm condition shall cause the location of the alarm to be identified in an audible and visual manner at the building fire alarm control panel (FACP), and shall initiate the following events:
 - a. The system common alarm LED on the CPU Module shall flash. The internal audible trouble device shall sound. Acknowledging the alarm condition shall silence the audible trouble device and revert the flashing common alarm LED to a steady state.
 - b. The alphanumeric display shall indicate all applicable information associated with the alarm/trouble condition including: device location based on actual room graphic name and number (not architectural plan names and numbers), device type, and time of alarm. Location and zoning messages shall be custom field programmed to respective premises. Provide abbreviations when required to fit the alarm panel's display format (verify exact requirements with Owner). Below are some examples which first indicate the physical location of the device hardware – then the TYPE of device at the end of the descriptor label:
 - 1) "Corr 1100 at Rm 1102 - SMOKE" (at Room number shall be the nearest room door to the device).
 - 2) "Corr 1200 at Rm 1203 - PULL STATION" (at Room number shall be the nearest room door to the device).
 - 3) "Mech Rm 1352 AHU-11 - DUCT SMOKE"
 - 4) "Mech Rm 1467 - WATERFLOW SWITCH"
 - 5) "Mech Rm 1589 - TAMPER SWITCH"
 - 6) "Kitchen 1623 - HOOD FIRE SUPPRESSION SYSTEM"
 - 7) "MDF 1733 - DAS RADIO POWER SUPPLY"
 - 8) "Mech 1855 for Atrium 1863 - VESDA SMOKE"
 - c. Any remote or local annunciator LED's associated with the alarm point shall be illuminated as herein specified.
 - d. The remote signaling connection shall be activated relaying the alarm signal to an approved central station (central station connection and service provided by Owner). Point ID and descriptor must be sent and received.
 - e. All automatic events programmed to the alarm point shall be executed and the associated indicating devices and/or outputs activated.
 - f. De-activate local sound reinforcement systems that are not UL listed nor integrated with the fire alarm system control panel for providing fire alarm or mass notification instructions. Building wide public address systems shall remain active only for manual mass notification. Public address system auxiliary audio inputs used for background music or other remote non-emergency audio sources shall be silenced to only allow priority level manual mass notification using the public address system.
 - g. Activate all audible/visual alarm devices. Where prerecorded voice announcement is required or specified, the prerecorded announcement shall be preceded with attention tone(s), followed by the approved prerecorded announcement and continue in a cycle until the system is reset. Manual voice announcement shall interrupt the prerecorded cycle and the prerecorded cycle shall resume automatically after three minutes.
 - h. De-activate all HVAC systems including low speed high volume (LSHV) circulating blade type fans.
 - i. De-energize the kitchen hood supply/exhaust fans as required by local authority having jurisdiction.

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- j. Close all related smoke dampers.
 - k. Close all related smoke/fire dampers.
 - l. Release all magnetic door hold open devices.
 - m. Release the electric strike, unlocking, but not unlatching, locked doors controlled by an access control system.
 - n. Release Counter Shutters and hold-open devices on all fire and smoke doors.
 - o. Open all security grilles with emergency egress.
 - p. Activate to close all related fire and smoke doors and shutters.
 - q. Activate signaling connection to the elevator as required by the local authority having jurisdiction.
 - r. Signal the building automation system and Owner's security/police personnel as directed by Owner/Architect. The audible alarms shall be inhibited from being silenced for a period of 3 minutes after commencing operation unless alarm is acknowledged, and appropriate action has been taken.
 - s. Activate automatic recall operation of elevators as required by local authority having jurisdiction.
 - t. Record all events on the system printer.
- 2. Activation of duct mounted smoke detector on the HVAC equipment, or a smoke detector mounted in the return/supply air stream of any fan shall shut down all units as required by NFPA. The activation of one of these detectors shall send an alarm signal to the control panel and also initiate the Alarm Sequence of Operation.
 - 3. Activation of a control valve supervisory switch shall initiate the following events:
 - a. The activation of any sprinkler valve supervisory (tamper) switch shall activate the system supervisory service audible signal and illuminate the LED at the building fire alarm control panel (FACP). Differentiation between valve tamper activation and opens and/or grounds on the initiation circuit wiring shall be provided.
 - b. Activation of a sprinkler system control valve supervisory switch shall not prevent the events listed under Article 3.4.
 - c. Restoring the valve to the normal position shall cause the supervisory service audible signal to pulse, indicating the restoration to normal position. The supervisory service reset key shall be provided to silence the audible signal.
 - 4. Activation of the smoke detector and heat detector in the elevator machine room and at top of elevator shaft shall cause the elevators' controllers to be tripped by way of the shut trip breaker, and shall also initiate the events listed under Article 3.4.
 - 5. Any subsequent fire alarm shall reactivate the alarm indicating appliances and activate the respective control sequences described above.
 - 6. Upon silencing the alarm, all visible alarm devices shall remain active until system reset and all local sound reinforcement systems de-activated by the fire alarm system shall resume normal operation.
 - 7. Upon reset of the fire alarm control panel, HVAC units shall be capable of being started, and resume normal operation.
- C. Activation of the manual evacuation (drill) switch shall operate the alarm indicating appliances and de-activate local sound reinforcement system without causing other control circuits to be activated. However, should true alarm occur, all alarm functions should occur as described.

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- D. ALARM VERIFICATION shall be field programmed for each respective detector. Global verification will not be acceptable. The verification sequence is activated after a "check" procedure and the panel will wait a field programmable delay period (0-50 seconds) then proceed to re-sample the detector for continued presence of smoke. If the alarm condition still exists or a non-verified device is actuated during the verification period, the system will then initiate all alarm sequences specified herein. The system shall incorporate the ability to log in memory the number of verification events that have occurred for each selected device.

3.5 EQUIPMENT IDENTIFICATION

- A. Each panel or equipment enclosure shall be provided with a permanently engraved or embossed or silkscreen identification and information tags. The tags shall include the following information:
1. Name of manufacturer.
 2. Manufacturer's equipment description.
 3. Serial number and model number.
 4. Voltage and current rating.
 5. Power circuit source identification with panel name and circuit number.
 6. Additional labeling inside panels: Provide stick-on label with white background indicating installation date (MM/DD/YY) on each battery.
- B. All addressable devices shall be labeled with point and module number. Provide label maker style label on base of device. Provide additional address label on exterior of duct detector housings in addition to label on the duct detector component inside. Verify exact requirements with Owner.
- C. All alarm notification devices and end of line resistors shall be labeled with their alarm circuit number and panel name.

3.6 SPARE PARTS AND TOOLS

- A. Interchangeable Parts: All spare parts furnished shall be directly interchangeable with the corresponding components of the installed system. Spare parts shall be packaged and identified by nameplate, tagging, or stamping. Spare parts shall be delivered to the site in unopened cartons for storage as directed by the Owner.
- B. Spare Parts: Provide minimum of two, or 5% of building total, whichever is greater unless noted otherwise.
1. Spare shut down modules
 2. Spare detectors of each type in the system
 3. Spare alarm indicating devices of each type in the system
 4. Spare manual pull stations
 5. Spare protective covers of each type in the system.
 6. Spare relays/controls required for connection to smoke and fire/smoke dampers
 7. Devices listed above are to be installed as directed by Architect/Engineer or local code authorities at no additional cost to the Owner. Unused spare parts are to be parts for Owner's cabinet.
- C. Provide two copies of the final software programmed into the fire alarm system.
- D. Parts list: Furnish a list, in duplicate, of all other parts and accessories the manufacturer of the system recommends to be stocked for maintenance.

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3.7 KEYS

- A. Keys and locks for all equipment shall be identical. Provide not less than six keys of each type required. Identify keys by an appropriate number stamped on each key or on a metal tag attached thereto. Provide a key numbering chart in each operation and maintenance manual furnished.

3.8 SMOKE DAMPERS AND FIRE/SMOKE DAMPERS

- A. Smoke dampers and combination fire/smoke dampers shall be controlled by an automatic alarm initiating device. Smoke dampers installed to isolate the air handling system shall be arranged to close automatically when the system is in alarm.
- B. Coordinate motor operator voltage with supplier.
- C. Open all dampers prior to starting air handling equipment.
- D. Provide 120V power from nearest general purpose 20A receptacle circuit as required, or as noted otherwise.

3.9 GRAPHIC FLOOR PLANS FOR AHJ SITE PERMITTING INSPECTION AND OWNER USE

- A. It is the intent of these specifications that the fire alarm system shall pass AHJ inspection on the first try. The fire alarm system shall be fully functional, commissioned, and mapped both on fire alarm graphic maps and fire alarm annunciator device descriptions to fully and correctly described the device type and detailed location. Provide color coded floor plans detailed with project name, actual room names, actual graphic room numbers as directed by the Owner and adequate information to direct people to the fire alarm devices in alarm and to exits with non-fading floor plan media. Do not use architectural plan room names and numbers. Fire alarm maps shall include all relevant building information and fire alarm device information as required for the local AHJ permitting site walk-through inspection.
- B. Each plan shall clearly relate the room numbers on the annunciator to the area description on the floor plan. All fire alarm devices located to correspond with the annunciator. Indicate location of all end-of-line resistors.
- C. Provide two color coded floor plans for Owner's use that shall be solvent welded in acrylic plastic.
 - 1. Mount in an extruded aluminum frame next to the main fire alarm control panel and annunciator in main office. Minimum size 30x42 inches. Coordinate exact location with Architect / Owner.
 - 2. Provide a minimum 11 x 17 inch graphic print of building showing all rooms by graphic room numbers. Print shall show all detectors, major equipment and active detection devices. Print shall be framed in an extruded aluminum frame (24"x36") with clear plastic cover. Graphic shall be prepared in AutoCad version 2014 or newer. Data file (xxx.dwg) of graphic shall be provided as a part of the project.
- D. Install graphic floor plans as directed by Architect/Owner prior to substantial completion. Each area or room designation shall be verified with the fire alarm device during testing.

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3.10 OPERATING INSTRUCTIONS

- A. Coordinate with Owner for appropriate off-site monitoring service and communication technology to be used. Provide all necessary programming for interfacing with the Owner's on-site and off-site remote signaling receiving station, including programming of descriptors and addresses at the receiving station.
- B. Provide Fire Alarm System Operating Instructions for the following items including, but not limited to:
 - 1. Alarm Signal
 - a. How to open panel door
 - b. What to read and follow the instruction on display
 - c. How to acknowledge alarm
 - d. How to silence the signals
 - e. How and when to reset the system
 - f. How to return system to normal operation
 - 2. Trouble / Supervisory
 - a. How to open panel door.
 - b. What to read and follow the instruction on display
 - c. How to acknowledge trouble condition
 - d. Appropriate personnel to respond
- C. Provide laminated instructions in extruded aluminum frame. Mount adjacent to the Fire Alarm Control Panel and remote annunciator panel(s) for ready reference.

3.11 ADDITIONAL REQUIREMENTS

- A. The contractor is to ensure all areas of the building are covered with visual and audio alarm devices for occupant notification of a fire alarm, including remote portable or temporary buildings.
- B. Coordinate door hold devices with door and door hardware.
- C. Provide interface with and coordinate shunt-trip circuit breakers and control devices with kitchen hood fire control systems and elevator equipment.
- D. Alarm circuit power supplies and circuiting shall be designed and installed to accept an additional five (5) 110cd visual devices for future expansion. The initial design shall not exceed 70% of the rated power supply and circuit capability.
- E. Not used.
- F. Provide programming or re-programming of all hot keys as directed by Owner including, but not limited to, fire drill, AHU shutdown bypass, horn/strobe disable, elevator test.
- G. Provide one dedicated alarm circuit booster panel and audio amplifier for (future) portable (temporary) building(s) at designated portable building location, at exit door to portable building location.
- H. Provide one dedicated addressable initiating device circuit with a minimum capacity of 50 devices for (future) portable (temporary) building(s) to the nearest man building egress discharge to the designated portable building location. Provide 100 feet of cable coiled and marked "FACP-INITIATING PORTABLES" above an accessible ceiling.

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3.12 COMMISSIONING THE SYSTEM

- A. The installing contractor shall be responsible for verifying that each component of the system is fully operational and in conformity with the specifications. He shall also be responsible for insuring that all elements function together as a system in accordance with the specifications.
- B. A state licensed NICET II minimum and factory trained technical representative of the manufacturer shall supervise the final control panel connections and testing of the system. Upon completion of the acceptance tests, the owner and/or his representatives shall be instructed in the proper operation of the system.
- C. The installing contractor shall functionally test each and every device in the entire system for proper operation and response. Field testing shall include voice intelligibility as required by the latest edition of NFPA 72. Any items found not properly installed or non-functioning shall be replaced or repaired and retested. The final test indicating a fully functional fire alarm system shall be recorded and an electronic Excel and printed copy submitted to the Architect, Engineer and Owner.
- D. The installing contractor shall provide a complete written report in electronic form and printout of the functional test and intelligibility test of the entire system. A copy of the test report shall be provided with the Maintenance and Operation Manuals. The test report shall be signed and dated by the licensed fire alarm superintendent responsible for supervising the final system test and checkout. This test shall be witnessed and accepted by the Owner two weeks prior to testing for the local Fire Marshall to allow time to make corrections, prior to testing for the AHJ.
- E. After the Owner has accepted the fire alarm system, the installing contractor's fire alarm superintendent shall test the entire system in the presence of the local authorities having jurisdiction. The contractor shall be responsible for making any changes, adjustments, or corrections, as may be required by the local authorities. The Contractor shall affix his certification label and installation certificate to the interior of the main fire alarm control panel. This test shall not be used to de-bug or correct deficiencies of the system.
- F. The testing and Owner's acceptance shall be performed within 30 days after the fire alarm installation is completed. The test shall be performed by a minimum of two qualified fire alarm system technicians acceptable to the authority having jurisdiction. The test which is a comprehensive 100 percent inspection and test of all fire alarm system equipment shall include the following:
 - 1. Fire alarm control equipment: a visual and functional test of the fire alarm control and auxiliary control equipment.
 - 2. A visual inspection shall be conducted to establish that all electrical connections and equipment, as required, are properly installed and operating.
 - 3. A functional fault simulation test shall be conducted on all relevant field wiring terminations to ensure that wiring is properly supervised as required.
 - 4. Indicators shall be tested to ensure proper function and operation.
 - 5. Control panel auxiliary functions shall be functionally tested to verify proper operation.
 - 6. Control panel supervisory and alarm current readings shall be taken to verify that the control panel has the appropriate power supplies and standby batteries to operate the system as required. A three-minute general alarm stress test, both under AC power and standby power, shall be conducted to further ensure complete operation of the system.

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7. Fire alarm peripheral devices; All fire alarm peripheral devices shall be functionally tested and the location and testing information recorded for each device.
8. Manual initiating devices:
 - a. Each manual fire alarm station shall be functionally tested for alarm operation.
 - b. Each manual fire alarm station shall be functionally tested for proper wiring supervision.
9. Automatic initiating devices:
 - a. Each automatic initiating device shall be activated in accordance with manufacturer's instructions to ensure proper operation.
 - b. Each automatic initiating device shall be functionally tested for proper wiring supervision.
 - c. Each automatic initiating device shall be inspected to ensure proper placement and mounting as required by specifications.
10. Alarm signaling devices:
 - a. Each alarm signaling device shall be tested and decibel reading taken at 10' from the device and recorded to ensure proper operation. Each area's voice alarm signaling devices shall be tested for intelligibility.
 - b. Each alarm signaling device shall be functionally tested for proper wiring supervision.
 - c. Decibel reading shall be taken to ensure that the alarm signal level can be clearly heard in all areas of the facility.
 - d. All visual alarm indicators shall be functionally tested to ensure proper operation and that they are clearly visible.
11. Elevators: Each elevator shall be tested and automatic recall function verified.
12. Reporting: Upon completion of the initial verification audit, a report shall be sent to the Architect/Engineer indicating that all fire alarm equipment has been tested and is in 100 percent operation. The report shall also contain the audit testing information as to the location and operational status of each peripheral device. The 100 percent audit shall be performed by a factory-trained representative. The report shall include the voice intelligibility performance in each area and indicate compliance with NFPA and local AHJ requirements.

G. It is the intent of these specifications and of the Architect/Engineer that a continued program of system maintenance is to be provided by the Owner in compliance with NFPA 72. It is mandatory that the installing Contractor provide such services and make available these services to the Owner upon completion of the project.

H. Upon completion of installation and full acceptance testing, submit NFPA 72 certificate of compliance that the total fire alarm system, including any subsystems, is fully functional and that the components are UL listed for function intended.

3.13 SUBSTANTIAL COMPLETION

- A. Final acceptance of the FIRE ALARM SYSTEM by the owner, local code authorities and Occupancy Permit has been issued.
- B. All fire alarm system shop drawings, test reports, operating and maintenance manuals, maps and as-built drawings shall be submitted in electronic format to and accepted by the Architect / Owner prior to date of substantial completion.
- C. Acceptance by County or Local Fire Marshall.

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3.14 TRAINING

- A. Provide training course to all fire personnel assigned by Owner's Representative. The training shall include a course syllabus and hands-on participation. Training shall be conducted on a system identical to the one being installed on this project. The system shall be able to perform all system operations and simulate all types or forms of alarm conditions.
- B. Provide a video of the training program to the Owner's Representative to be used for periodic refresher course, training of the local fire department and for training of new employees.
- C. The training course shall include, in addition to the above, a system overview, and a review of the operation and maintenance manual.
- D. The instructor shall be factory trained and shall be thoroughly familiar with all parts of the installation on which instruction is to be given. The instructor shall be trained in operating theory as well as in practical operation and maintenance work.

END OF SECTION

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SECTION 310000

EARTHWORK

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Excavating, filling, backfilling, grading, and compacting of earth at the site.
- B. Related Sections:
 - 1. Section 003132 - Geotechnical Data
 - 2. Section 014500 - Quality Control
 - 3. Section 312513 - Erosion and Sedimentation Controls
 - 4. Section 311400 - Site Preparation
 - 5. Section 321823 - Trenching and Backfilling
 - 6. Section 314133 - Trench Shielding

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM):

ASTM D 698-78 Tests Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5-lb. Rammer and 12-in. Drop.

1.03 SUBMITTALS

- A. Samples: Submit in accordance with Section 013323 – Shop Drawings, Product Data, and Samples. Submit material analysis results of existing and imported (if required) topsoil from a testing laboratory indicating compliance with these specifications. Any topsoil delivered to the site which does not comply with the approved sample shall be re-tested at the Contractor's expense and replaced.
- B. Test Reports:
 - 1. Submit copies of test reports in accordance with Section 014500 - Quality Control.
 - 2. Submit copies of test reports for select fill material. No select fill material, if required, shall be delivered to the site until after the tests have been made and test reports confirmed.
 - 3. Compaction Tests: Submit copies of compaction test reports.

1.04 QUALITY ASSURANCE

- A. Laboratory Control: Select fill material and imported topsoil, if required, shall be inspected, and tested by an independent testing laboratory.

Testing laboratory shall make tests for the soil from the selected source to determine that it meets the specified requirements for select fill and imported topsoil.

1.05 PROJECT CONDITIONS

- A. Temporary Sheet piling: Shore and sheet excavations to protect utilities and to prevent cave-in.

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Maintain sheeting secure until permanent construction is in place. Remove sheeting as excavations are backfilled.

- B. Drainage: Provide for adequate surface drainage during construction to keep the site free of surface water without creating a nuisance in adjacent areas and in accordance with the erosion control plan.
- C. Pumping: Keep the excavations free of water at all times by pumping or other means. This shall be the responsibility of the Contractor regardless of the cause, source, or nature of the water.
- D. Protection:
 - 1. Property: Protect adjoining property, including improvements outside the limits of the work. Protect walks, curbs, and paving from damage by heavy equipment and trucks.
 - 2. Trees: Protect tops, trunks, and roots of trees on the site which are to remain. Box or fence trees vulnerable to damage during construction. Remove interfering branches with care and cover scars with tree paint. Do not permit fires, storage of materials or excavation within the branch spread of trees to remain.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

- A. Topsoil:
 - 1. Topsoil on the paving site areas shall be stripped, cleaned of grass, roots, and debris to a depth of between 6" and stockpiled for later use. Provide soil amendments to existing topsoil per 2.0.1 A.2.B and C or import topsoil.
 - 2. Import topsoil, as required.
 - a. Contractor shall haul and place imported topsoil obtained from the off-site sources as necessary to construct the topsoil layer and various other details of the construction drawings. All costs related to such imported topsoil fill will be included in the contract price, and no additional or separate payment for imported fill will be due to Contractor.
 - b. Topsoil shall be secured from an approved off-site location. It shall be:
 - 1) Natural, fertile, friable agricultural soil, having characteristics of representative productive soils in the vicinity, and obtained from naturally well-drained areas.
 - 2) Topsoil shall not be excessively acid or alkaline nor contain toxic substances.
 - 3) Topsoil shall be without admixture of subsoil and shall be reasonably free from clay lumps, stone, stumps, roots, live plants, or similar substances one inch or more in diameter, debris, or other objects which might be a hindrance to planting operations.
 - 4) Topsoil shall be free from Johnson grass (*Sorghum halepense*), nut grass (*Cyperus rotundus*), and objectionable weeds.
 - c. The soil texture shall be classified as loam or sandy loam according to the "soil triangle" published by the United States Agriculture Department and the following Criteria:
 - 1) Sand (2.0 to 0.05 mm dia.) (No. 10 sieve): Loam 25-50%; Sandy Loam 45-85%.
 - 2) Silt (0.05 to 0.002 mm dia.) (No. 270 sieve): Loam 30-50%; Sandy Loam less than 50%.
 - 3) Clay (smaller than 0.002 mm dia.) (Hydrometer Analysis): Sandy Loam less than 50%.
 - 4) Natural organic content: Not less than 1.5%.

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- 5) pH of Soil: Not more than 7.6.
 - 6) Soil texture shall be determined by utilizing processes as prescribed in ASTM D 422 using the No. 10 and No. 270 sieves and a hydrometer analysis.
3. Unsuitable Materials: Topsoil or unclassified fill will be declared as "unsuitable" by the Landscape Architect, Geotechnical Engineer or Civil Engineer if, in his opinion, any of the following conditions or matter and articles are present to a degree that is judged detrimental to the proposed use of the material:
- 1) Moisture.
 - 2) Decayed or un-decayed vegetation.
 - 3) Hardpan clay, heavy clay, or clay balls.
 - 4) Rubbish.
 - 5) Construction rubble.
 - 6) Sand or gravel.
 - 7) Rocks, cobbles, or boulders.
 - 8) Cementitious matter.
 - 9) Foreign matter of any kind.
 - 10) Spoils from piers.
4. Unsuitable materials shall be disposed of as "waste" as specified in Section 31 14 00 and 31 11 00.
5. Wet Material: If fill material is unsatisfactory for use as embankment solely because of high moisture content, the Architect may grant the Contractor permission to process the material to reduce the moisture content to a usable optimum condition.
- B. Unselected Earth Fill: Clean, sandy soil free of organic matter and refuse, roots, clay lumps and rocks larger than 2".
- C. Granular Fill: Clean gravel or crushed rock graded to produce a mixture passing 1-3/4" sieve and retained on 1/4" sieve. Granular fill for areas to be covered with membrane waterproofing shall be clean pea gravel graded no larger than 3/4".
- D. Free-Draining Fill: Coarse sand or sand gravel mixture with less than 12% passing a No. 200 sieve, and a Plasticity Index less than 4.
- E. Filter Fabric Protective Membrane: The geomembrane filter fabric shall consist of a minimum 4-mils thick polyethylene (impermeable) film with a layer of nonwoven needle-punched polyester or polypropylene fabric bonded to one side. Fabric-film-fabric laminate being furnished shall consist of fabric fused or heat-sealed or otherwise bonded film so as to form an integral geomembrane. Filter fabric shall be able to withstand normal handling and placement at material temperatures from 20°F. To 145°F. without endangering the serviceability of the material in the intended application. If the filter fabric evidences delamination, such delamination shall serve as grounds for rejection. Filter fabric shall be mildew, abrasion, and puncture resistant and suitable for long term burial in the presence of water or moisture in the intended construction application. Product/manufacturer. Petromat MB: Phillips fibers Corp.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Remove grass, weeds, roots, and other vegetation from areas to be excavated, filled, and graded. Fill stump holes and like small excavations with suitable material placed in lifts and thoroughly tamped.
- B. Scarify the subgrade soil in place to a depth of 6 inches and compact to between 95 and 100 percent of Standard Density, at or above optimum moisture content, in accordance with ASTM D 698.

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- C. Install filter fabric in prepared subgrade soil in strict compliance with manufacturer's instructions and recommendations. Filter fabric joints at the end of each roll and on adjacent rolls shall be overlapped a minimum of 6". Before subsequent rolls of fabric are placed, an application of sealant shall be placed along the edge and end of the in-place roll, which is to be overlapped. Sealant shall be applied at the rate of 35-40 linear feet per gallon to develop an approximately 3-inch wide drool centered about 4" from the edge of the in-place fabric. Then within 5-15 minutes, depending upon the ambient temperature, the next roll of moisture barrier fabric shall be placed overlapping the in-place roll by 6". Immediately after placing the overlapping fabric, the overlap seam area shall be rolled with a heavy roller to force the asphalt into the overlapping fabric.

3.02 EXCAVATION

- A. General: Excavate to the lines, grades and sections shown on the drawings. Allow space for the construction of forms. Excavate as required regardless of the condition or type of material encountered.
1. Cut areas accurately to the indicated cross-sections and grades. Take care to prevent excavation below the grades indicated. Any bottoms and slopes that are undercut shall be backfilled with earth fill and compacted.
 2. Finish the excavating required for graded areas to a tolerance of 0.10 foot above or below the rough grade.
 3. Remove underground obstructions except for piping and conduit which shall be handled as specified in Section 311100.

3.03 WASTING

- A. Surplus excavated material not suitable or required for embankment fill and backfill shall be wasted off site in a legal matter.

3.04 FILL AND BACKFILL

- A. Filling: Construct compacted fills to the lines, grades and sections shown on the drawings.
1. Complete stripping and wasting operations in advance of fill construction.
 2. Deposit and mix fill material in horizontal layers not more than 8" deep, loose measurement. Manipulate each layer until the material is uniformly mixed and pulverized.
 - a. Fill material layers shall be reduced to not more than 4" deep for structure backfill compactors or small self-propelled compactors.
 3. Fill material shall have a moisture content at or slightly above the optimum, to achieve specified compaction. If fill is too wet, dry by aeration to achieve desired moisture content. If fill is too dry, add water and mix in by blading and discing to achieve desired moisture content.
 4. Exercise care to prevent movement or breakage of walls, trenches, and pipe during filling and compaction. Place fill near such items by means of light equipment and tamp with pneumatic or hand tampers.
- B. Backfilling: Construct compacted fill against and around concrete beams below finish grade.
1. Do not backfill until underground construction has been inspected, tested, and approved, forms removed, and the excavations cleaned of trash and debris.
 2. Do not backfill against beams until all of the permanent structural concrete supports and bracing members are in place or until adequate shoring has been erected to prevent displacement and deflection of the beams under horizontal load. Exercise care in the

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placing and compacting of backfill so as not to damage the structure in any way.

3. Bring backfill to required grades by depositing material in horizontal layers not more than 8" deep, loose measurement.
 - a. Fill material layers shall be reduced to not more than 4" deep for structure backfill compactors or small self-propelled compactors.

3.05 COMPACTION

- A. Compact each layer of earth fill and backfill thoroughly and evenly until there is no evidence of further compaction and a solid and uniform density is secured.
 1. Equipment for compacting shall be sheepsfoot and rubber-tired rollers or other compactors capable of obtaining the required density. Compact the fill with power tampers and by hand in areas not accessible to rollers.
 2. Compact each layer of fill to the density listed below as a function of the location. The required density in each case is indicated as a percentage of the maximum dry unit weight determined using the standard compaction test ASTM D 698.
 3. Compact fill to the density listed below at a moisture content per the geotechnical report.
 - a. Material under paving _____ 95 to 100%.
 - b. Material under lawn areas _____ 85 to 90%.
 - c. Material adjacent to retaining walls _____ 93 to 98%.

3.06 FINE GRADING

- A. All fine grading and corresponding construction shall be performed as specified herein, and the complete work shall conform to the required lines, grades, and cross sections of the plans.
 1. The maximum allowable deviation from the required finished grades of a line or plane shall be a slope (gradient) of plus or minus 0.5% in a horizontal dimension of 8' maximum. This shall be field tested by using an 8' long straight edge. If the surface has a deviation of more than 1/4" above or below the midpoint of the straight edge when its ends rest on high or low points, the finished grade will be unsatisfactory and shall be immediately corrected.
- B. Road and Parking Lot Subgrade: Fine grading of the concrete road and parking lot subgrade shall be performed after final mixing and compaction of the lime treated is satisfactorily performed. Fine grading may be executed with a combination of a light roller and road grader. See Specification Section 31 32 00.
- C. Concrete Walks: Fine grading of concrete walk subgrades shall be scarified to a 6" depth and recompact to 95% of ASTM D 698 at a moisture content between - 1% and +4%.
- D. Athletic Fields (if shown on plans): Fine grading of the athletic fields shall be performed as a final step after placing imported topsoil and mixing of the soil amendments.
 1. Topsoil shall first be placed and compacted to normal density, minimum 90% of Tex-113-E Density shall be graded to within 0.02 foot of finished grade.
 2. Contractor shall provide to the Engineer a survey for grade verification at the following intervals:
 - a. Top of native material.
 - b. Top of rough grade.
 - c. Finished grade.Elevations provided shall have an accuracy of 0.01'.
 3. Fine grading shall be executed over all athletic field playing areas by the placement and

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use of final grade stakes or "blue tops" as directed on the grading plan. Final grade stakes shall be placed at intervals not to exceed 50' along the exact contour lines as dimensioned on the grading plan. The stakes will be driven to the exact even foot elevation of the contour and will then be painted a bright color on top or be marked with a brightly colored plastic attachment.

4. Fine grading will then be executed with any or all of the following machinery: road grader, tractor box blade, discing machinery, weighted spike harrow, and weighted drags. Bulldozer blades or front-end loader buckets are not acceptable devices for fine grading operations.
5. The use of a watering truck to moisten dried and hardened areas may be necessary.
6. It is anticipated that some areas will be loosened and pulverized with discing machinery and will then be recompact to normal density before fine grading.
7. Satisfactorily fine graded areas shall be true in plane, even in gradient (slope), uniform in surface texture, free of rocks greater than 1/2" in diameter, and of normal compaction. Areas of loose granular soil pockets interspersed with over-compacted soils are not acceptable. Fine graded areas shall promote complete surface drainage, be ready for turfgrass planting, and assure playability.

E. Timing

1. Fine grading will not begin until all underground utilities are complete, in place, tested to be working properly, and properly backfilled. Fine grading should not be attempted until construction which involves heavy vehicles is complete or nearly complete. Such vehicles cause rutting and over-compaction.
2. After fine grading is accomplished, it shall be the contractor's responsibility to protect all the fine graded areas from vehicular traffic or other disruptive activities. Damages to the fine graded surfaces will be restored to a satisfactory condition as prescribed herein until the job is finished and accepted.

F. Site Grading: Shape and finish earthwork to bring the site to the finish grades and elevations shown on the drawings.

1. Establish grades by means of grade stakes placed at corners of units, at abrupt changes of grade, and elsewhere as may be required.
2. Rough grade for walks, paving, and site improvements to the subgrade elevations required. Soft and unstable material which will not readily compact when rolled or tamped shall be removed and the resulting depressions filled with stable material and re-compacted.
3. Finish grade to the finish contours and spot grades shown. Extend cuts and fills to feather out beyond the last finish contour or spot grade shown. Grade to uniform levels and slopes between points for which elevations are given, round off abrupt changes in elevation, and finish off smoothly. Finish grades shall slope away from the building in all directions to assure proper drainage, minimum of 2%.

G. Grading Around Trees: Where grading is required within the branch spread of trees that are to remain, perform the work as follows:

1. When trenching occurs, the tree roots shall not be cut but the trench shall be tunneled under or around the roots by hand digging.
2. When the existing grade at a tree is below the new finished grade, and fill not exceeding 6" is required, clean washed gravel graded from 1" to 2" size shall be placed directly

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around the tree trunk. The gravel shall extend out from trunk on all sides a minimum of 18" and finish approximately 2" above the finished grade at the tree. Install gravel before earth fill is placed.

3. Trees in areas where the new finished grade is to be lowered shall have regrading work done by hand to elevation as indicated. Existing grades immediately surrounding the trunk shall not be altered except at the direction of the Architect.

3.07 PLACING TOPSOIL

- A. Prior to placing topsoil, scarify subgrade to a depth of 6". Following scarification, topsoil shall be spread in one lift. The in-place depth of the topsoil at the pay field shall be 6". Topsoil shall be compacted to the approximate density of undisturbed soil. Provide topsoil to comply with Section 2.01. If there is insufficient stockpiled topsoil from on-site sources to complete the work, bring in topsoil from off-site sources as needed (topsoil for athletic fields shall be imported). After topsoil has been placed, blade, roll lightly, and rake as required to comply with 3.08, B below.
- B. After placement of topsoil, Contractor shall eliminate all low or hollow places that would allow water to stand or pond during rainfall or during operation of lawn irrigation systems. The area shall be free of all-natural debris and shall also be free of all clods and rocks which are $\frac{3}{4}$ " in size or larger.

3.08 FIELD QUALITY CONTROL

- A. Compaction Tests: Field density testing of the select fill material under the paving and at perimeter grade beam shall be performed by an Independent Testing Laboratory.
 1. Testing laboratory shall make one in place density test for each 5,000 sq. ft. of area per lift, but in no case less than two tests, and one test per 100 linear feet of backfill area adjacent to grade beams, to ensure that the specified density is obtained.
- B. Compaction Tests: Field density testing of fill material shall be performed by an Independent Testing Laboratory.
 1. Testing laboratory shall make one in place density test for each 5,000 sq. ft. of area per lift, but in no case less than two tests, and one test per 100 linear feet of backfill area adjacent to grade beams, to ensure that the specified density is obtained.
- C. Provide "As Built" survey of all areas for verification of grades and acceptance by Engineer. Contractor shall provide a CAD drawing of the survey by a State of Texas Licensed Surveyor. Survey shots shall include point location, description, elevation, and shall be on the same coordinate plane as the original project.

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SECTION 310513

SOILS FOR EARTHWORK

PART 1 -GENERAL

1.01 WORK INCLUDED

This section of the specifications describes the various classes of Earth Fill. All of the classes of Earth Fill contained in this specification may not be used on this project. The classes of Earth Fill used on this project are shown on the drawings or specified in other sections of the specifications. This specification section does not include specifications for placement and compaction of Earth Fill. Specifications for placement and compaction of Earth Fill are included in other sections of the specifications and/or shown on the drawings.

1.02 STANDARDS

Soil materials shall be classified into the appropriate class of Earth Fill shown below according to ASTM D-2487 "Classification of Soils for Engineering Purposes" or other appropriate methods as designated by the Engineer.

PART 2 - PRODUCTS

2.01 MATERIALS; CLASSIFICATIONS

- A. CLASS 1 EARTH FILL: Limited to clays and sandy clays classified as CH material with a liquid limit greater than or equal to 50, a plasticity index greater than or equal to 25, and a minimum of 60% passing the No. 200 sieve, which are free of organic materials.
- B. CLASS 2 EARTH FILL: Limited to clays and sandy clays classified as CH and CL materials with a coefficient of permeability less than or equal to 1.0×10^{-7} cm/sec, a liquid limit greater than or equal to 30, a plasticity index greater than or equal to 15, and more than 50% passing the No. 200 sieve, which are free of organic materials.
- C. CLASS 3 EARTH FILL: Consist of any materials classified as CH, CL, SM, SP, SP-SM, SC, and GC, which have a minimum plasticity index of 4, which are free of organic materials.
- D. CLASS 4 EARTH FILL: Consist of materials which are classified as SP, SM, SC, CL, OR dual classifications thereof, which have a liquid limit less than or equal to 30 and a plasticity index of a minimum of 6 and a maximum of 15, which are free of organic materials and have a maximum particle size of 2 inches.
- E. CLASS 5 EARTH FILL: Consist of materials classified as SP or SP-SM which have a plasticity index less than or equal to 4 and a maximum of 12% passing the No. 200 sieve, which are free of organic materials. (Class 6 through Class 11 reserved)
- F. CLASS 12 EARTH FILL: Consist of soils suitable for topsoil which are relatively free of stones or other objectionable debris, which have sufficient humus content to readily support vegetative growth. The suitability of soils for topsoil shall be subject to the approval of the Engineer.

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SECTION 310516

AGGREGATES FOR EARTHWORK

PART 1 - GENERAL

1.01 WORK INCLUDED

This section of the specifications describes the various classes of Aggregate Fill. All of the classes of Aggregate Fill contained in this specification may not be used on this project. The classes of Aggregate Fill used on this project are shown on the drawings or specified in other sections of the specifications. This specification section does not include installation. Installation of Aggregate Fill is included in other sections of the specifications and/or on the drawings.

1.02 QUALITY ASSURANCE

CLASSIFICATION TESTING

A. CONTRACTOR TESTING

1. Arrange and pay for the services of an independent testing laboratory to sample and test proposed Aggregate Fill materials.
2. Submit the test results to the Engineer and obtain approval prior to providing Aggregate Fill.

B. OWNER TESTING

The Owner shall arrange and pay for additional testing on the Aggregate Fill after delivery to the project site as determined necessary by the Engineer.

C. CONTAMINATION CERTIFICATION

1. Obtain a written, notarized certification from the Supplier of each proposed Aggregate Fill source stating that to the best of the Supplier's knowledge and belief there has never been contamination of the source with hazardous or toxic materials.
2. Submit these certifications to the Engineer prior to proceeding to furnish Aggregate Fill to the site. The lack of such certification on a potential Aggregate Fill source shall be cause for rejection of that source

1.03 STANDARDS

Aggregate Fill shall be classified into the appropriate class listed below according to ASTM testing procedures as specified for the various classes.

American Society for Testing Materials standards:

ASTM C33	Specification for Concrete Aggregates
ASTM C88	Test Method for soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C125	Terminology Relating to Concrete and Concrete Aggregates
ASTM C131	Test Method for Resistance to Degradation of Small-Size coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C535	Test Method for Resistance to Degradation of Large-Size coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM D448	Classification for Standard sizes of Aggregate for Road and Bridge Construction

PART 2 - PRODUCTS

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2.01 MATERIALS; CLASSIFICATIONS

- A. CLASS 1 AGGREGATE FILL: Consist of durable particles of crushed stone free of silt, clay, or other unsuitable materials and have a percentage of wear of not more than 40% when tested in accordance with ASTM C131 or C535. When material is subjected to five (5) cycles of the sodium sulfate soundness test in accordance with ASTM C88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12%. The source of the material shall be approved by the Engineer and meet the following gradation in accordance with ASTM D448, size number 57:

<u>Sieve Size Square Opening</u>	<u>Percent Passing</u>
1-1/2"	100
1"	95 - 100
1/2"	25 - 60
No.4	0 - 10
No. 8	0 - 5

- B. CLASS 2 AGGREGATE FILL: Consist of durable particles of crushed stone free of silt, clay, or other unsuitable materials and have a percentage of wear of not more than 40% when tested in accordance with ASTM Method C131 or C535. When material is subjected to five (5) cycles of the sodium sulfate soundness test in accordance with ASTM C88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12%. The source of the material shall be approved by the Engineer and meet the following gradation in accordance with ASTM D448, size number 67:

<u>Sieve Size Square Opening</u>	<u>Percent Passing</u>
1"	100
3/4"	90 - 100
3/8"	20 - 55
No.4	0 - 10
No.8	0 - 5

- C. CLASS 3 AGGREGATE FILL: Consist of durable particles of crushed stone free of silt clay, or other unsuitable materials and have a percentage of wear of not more than 40% when tested in accordance with ASTM C131 or C535. When material is subjected to five (5) cycles of the sodium sulfate soundness test in accordance with ASTM C88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12%. The source of the material shall be approved by the Engineer and meet the following gradation in accordance with ASTM D448, size number 7:

<u>Sieve Size Square Opening</u>	<u>Percent Passing</u>
3/4"	100
1/2"	90 - 100
3/8"	40 - 70
No.4	0 - 15
No.8	0 - 5

- D. CLASS 4 AGGREGATE FILL: Consist of durable particles of crushed stone free of silt, clay, or other unsuitable materials and have a percentage of wear of not more than 40% when tested in accordance with ASTM C131 or C535. When material is subjected to five (5) cycles of the sodium sulfate soundness test in accordance with ASTM Method C88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12%. The source of the material shall be approved by the Engineer and meet the following gradation in accordance with ASTM D448, size number 467:

<u>Sieve Size Square Opening</u>	<u>Percent Passing</u>
2"	100
1-1/2"	95 - 100
3/4"	35 - 70
3/8"	10 - 30
No. 4	0 - 5

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- E. CLASS 5 AGGREGATE FILL: Consist of durable particles of crushed stone free of silt, clay, or other unsuitable materials and have a percentage of wear of not more than 40% when tested in accordance with ASTM C131 or C535. When material is subjected to five (5) cycles of the sodium sulfate soundness test in accordance with ASTM C88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12%. The source of the material shall be approved by the Engineer and meet the following gradation in accordance with ASTM D448, size number 357:

<u>Sieve Size Square Opening</u>	<u>Percent Passing</u>
2-1/2"	100
2"	95 - 100
1"	35 - 70
1/2"	10 - 30
No. 4	0 - 5

- F. CLASS 6 AGGREGATE FILL: Consist of durable particles of crushed stone free of silt, clay, or other unsuitable materials and have a percentage of wear of not more than 40% when tested in accordance with ASTM C131 or C535. When material is subjected to five (5) cycles of the sodium sulfate soundness test in accordance with ASTM C88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12%. The source of the material shall be approved by the Engineer and meet the following gradation in accordance with ASTM D448, size number 1:

<u>Sieve Size Square Opening</u>	<u>Percent Passing</u>
4"	100
3 - 1/2"	90 - 100
2 - 1/2"	25 - 60
1 - 1/2"	0 - 15
3/4"	0 - 5

- G. CLASS 7 AGGREGATE FILL: Consist of durable particles of crushed stone free of silt, clay, or other unsuitable materials and shall have a percentage of wear of not more than 40% when tested in accordance with ASTM C131 or C535. When material is subjected to five (5) cycles of the sodium sulfate soundness test in accordance with ASTM C88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12%. The source of the material shall be approved by the Engineer and meet the following gradation in accordance with ASTM D448, size number 6:

<u>Sieve Size Square Opening</u>	<u>Percent Passing</u>
1"	100
3/4"	90 - 100
1/2"	20 - 55
3/8"	0 - 15
No.4	0 - 5

- H. CLASS 8 AGGREGATE FILL: Consist of durable particles of crushed stone free of silt, clay, or other unsuitable materials and shall have a percentage of wear of not more than 40% when tested in accordance with ASTM C131 or C535. When material is subjected to five (5) cycles of the sodium sulfate soundness test in accordance with ASTM C88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12%. The source of the material shall be approved by the Engineer and meet the following gradation in accordance with ASTM D448, size number 56:

<u>Sieve Size Square Opening</u>	<u>Percent Passing</u>
1-1/2"	100
1"	90 - 100
3/4"	40 - 85
1/2"	10 - 40
3/8"	0 - 15
No. 4	0 - 5

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- I. CLASS 9 AGGREGATE FILL: Consist of washed and screened gravel and natural sands or sands manufactured by crushing stones complying with the requirements of ASTM C33, "Standard Specifications for Concrete Aggregates", except that the gradation shall be as follows:

<u>Sieve Size Square Opening</u>	<u>Percent Passing</u>
1/2"	100
3/8"	95 - 100
No. 4	80 - 95
No. 8	65 - 85
No. 16	50 - 75
No. 30	25 - 60
No. 50	10 - 30
No. 100	0 - 10

Class 9 Aggregate Fill shall have not more than 45% passing any sieve and retained on the next consecutive sieve of those shown above, and its fineness modulus, as defined in ASTM C125, shall be not less than 2.3 nor more than 3.1.

- J. CLASS 10 AGGREGATE FILL: Consist of washed and screened natural sands or sands manufactured by crushing stones complying with the requirements and tests of "Standard Specifications for Concrete Aggregates", ASTM C33. The gradation as included in ASTM C33 is as follows:

<u>Sieve Size Square Opening</u>	<u>Percent Passing</u>
3/8"	100
No. 4	95-100
No. 8	80-100
No. 16	50-85
No. 30	25-60
No. 50	10-30
No. 100	2-10

Class 10 Aggregate Fill shall have not more than 45% passing any sieve and retained on the next consecutive sieve of those shown above, and its fineness modulus, as defined in ASTM C125, shall be not less than 2.3 nor more than 3.1.

- K. CLASS 11 AGGREGATE FILL: Consist of durable particles of crushed stone free of silt, clay, or other unsuitable material and have a percentage of wear of not more than 40% when tested in accordance with ASTM C131 or C535. When material is subjected to five (5) cycles of the sodium sulfate soundness test in accordance with ASTM C88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12%. The source of the material shall be approved by the Engineer and meet the following gradation:

<u>Sieve Size Square Opening</u>	<u>Percent Passing</u>
1-3/4"	100
7/8"	65 - 90
3/8"	50 - 70
No.4	35 - 55
No.40	15 - 30
No.100	0 - 12 (Wet Sieve Method)

- L. CLASS 12 AGGREGATE FILL: Consist of durable particles of crushed stone free of silt, clay, or other unsuitable material and have a percentage of wear of not more than 40% when tested in accordance with ASTM C131 or C535. When material is subjected to five (5) cycles of the sodium sulfate soundness test in accordance with ASTM C88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12%. The source of the material shall be approved by the Engineer and meet the following gradation:

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<u>Sieve Size Square Opening</u>	<u>Percent Passing</u>
1-1/2"	100
1"	85 - 100
3/4"	60 - 95
3/8"	50 - 80
No.4	40 - 65
No.16	20 - 40
No.100	0 - 12 (Wet Sieve Method)

- M. CLASS 13 AGGREGATE FILL: Consist of durable particles of crushed stone free of silt, clay, or other unsuitable material and have a percentage of wear of not more than 40% when tested in accordance with ASTM C131 or C535. When material is subjected to five (5) cycles of the sodium sulfate soundness test in accordance with ASTM C88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12%. The source of the material shall be approved by the Engineer and shall meet the following gradation:

<u>Sieve Size Square Opening</u>	<u>Percent Passing</u>
1-3/4"	100
7/8"	65 - 90
3/8"	50 - 70
No. 4	35 - 55
No. 40	15 - 30
No. 100	0 - 3 (Wet Sieve Method)

- N. CLASS 14 AGGREGATE FILL. Consist of durable particles of crushed stone free of silt, clay, or other unsuitable material and have a percentage of wear of not more than 40% when tested in accordance with ASTM C131 or C535. When material is subjected to five (5) cycles of the sodium sulfate soundness test in accordance with ASTM C88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12%. The source of the material shall be approved by the Engineer and meet the following gradation:

<u>Sieve Size Square Opening</u>	<u>Percent Passing</u>
1-1/2"	100
1"	85 - 100
3/4"	60 - 95
3/8"	50 - 80
No.4	40 - 65
No. 16	20 - 40
No.100	0 - 3 (Wet Sieve Method)

- O. CLASS 15 AGGREGATE FILL. Consist of durable particles of silica sand, washed clean chemically inert, and packaged by the Supplier. The material shall meet applicable regulatory requirements for monitor well filter pack. The source of the material shall be approved by the Engineer and shall meet the following gradation requirements.

<u>Sieve Size Square Opening</u>	<u>Percent Passing</u>
No.20	98 - 100
No.40	0 - 2

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SECTION 311100

CLEARING AND GRUBBING

PART 1 - GENERAL

1.01 WORK INCLUDED

Furnish labor, materials, equipment, and incidentals necessary to perform operations in connection with clearing, grubbing, and disposal of cleared and grubbed materials.

1.02 QUALITY ASSURANCE; DEFINITIONS

- A. CLEARING: Clearing is defined as the removal of trees, shrubs, bushes, and other organic matter at or above original ground level.
- B. GRUBBING: Grubbing is defined as the removal of stumps, roots, boards, logs, and other organic matter found at or above ground level.

PART 2 - PRODUCTS [Not Used]

PART 3 - EXECUTION

3.01 PREPARATION

- A. Mark areas to be cleared and grubbed prior to commencing clearing operations. Engineer shall approve clearing and grubbing limits prior to commencement of clearing operations.
- B. Trees and shrubs outside of the clearing limits, which are within 10' of the clearing limits, shall be clearly marked to avoid damage during clearing and grubbing operations.
- C. Remove trees and brush outside the clearing limits, but within the immediate vicinity of the work, upon receipt of approval by the Engineer, when the trees or brush interfere with or retard the progress of construction operations.
- D. Clearly mark trees and shrubs within the clearing limits, which are to remain, and protect the trees and shrubs from damage during the clearing and grubbing operations.
- E. The clearing limits shall not extend beyond the project limits.
- F. Establish the clearing limits as follows:
 - 1. Embankments plus 10' beyond the top of the excavation.
 - 2. Excavations plus 5' beyond the top of the excavation.
 - 3. Concrete structures plus 10' beyond the edge of the footing.
 - 4. New roadways and new parking areas plus 5' beyond the edge of pavement.
 - 5. Retaining walls plus 10' beyond the edge of the footing.
 - 6. Underground utility trench top width plus 8'.
- G. Establish the grubbing as follows:
 - 1. Embankments plus 2' beyond the toe of the embankment.
 - 2. Concrete structures plus 2' beyond the edge of the footing.

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3. New roadways and new parking areas plus 1' beyond the edge of pavement.
4. Retaining walls plus 2' beyond the edge of the footing.

3.02 INSTALLATION

A. CLEARING

Clearing shall consist of the felling, cutting up, and the satisfactory disposal of trees and other vegetation, together with the down timber, snags, brush, rubbish, fences, and debris occurring within the area to be cleared.

B. GRUBBING

1. Grubbing shall consist of the removal and disposal of stumps and roots larger than 1" in diameter.
2. Extend grubbing to the depth indicated below: In the case of multiple construction items, the greater depth shall apply.
 - a) Footings - 18" below the bottom of the footing.
 - b) Walks - 12" below the bottom of the walk.
 - c) Roads and Taxiways - 18" below the bottom of the subgrade.
 - d) Parking Areas - 12" below the bottom of the subgrade.
 - e) Runways - 24" below the bottom of the subgrade.
 - f) Embankments - 24" below existing ground.
 - g) Concrete Structures - 18" below the bottom of the concrete.
 - h) Retaining Walls - 18" below the bottom of the footing.

3.03 FIELD QUALITY CONTROL

BURNING NOT PERMITTED

Completely remove timber, logs, roots, brush, rotten wood, and other refuse from the Owner's property. Disposal of materials in streams shall not be permitted and no materials shall be piled in stream channels or in areas where it might be washed away by floods. Timber within the area to be cleared shall become the property of the Contractor, and the Contractor may cut, trim, hew, saw, or otherwise dress felled timber within the limits of the Owner's property, provided timber and waste material is disposed of in a satisfactory manner. Materials shall be removed from the site daily unless permission is granted by the Engineer to store the materials for longer periods.

END OF SECTION

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SECTION 311400

SITE PREPARATION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes: Clearing the site of vegetation, site improvements and obstructions to make way for new work.

1.02 PROJECT CONDITIONS

- A. Existing Conditions: Contractor shall visit the site and verify the nature and extent of clearing work required.
- B. Protection: Contractor shall be responsible for the protection of adjoining property and improvements outside the limits of the work. Protect paving from damage by heavy equipment and trucks. Take precautions to prevent injury to trees which are to remain.

PART 2 - PRODUCTS [Not used]

PART 3 - EXECUTION

3.01 PERFORMANCE

- A. Clearing:
 - 1. Remove trees, shrubs, and other vegetation from within the area of the site where shown on the drawings. Grub out roots to a depth of at least 18 inches below natural grade.
 - 2. Dig out and remove buried obstructions to a depth of 24" below natural grade or 24" below the intended excavation elevation, whichever is lower.
 - 3. Unless otherwise specified on the drawings, trees with calipers greater than 3" shall not be cleared (removed).
- B. Pavement Removal

Bituminous and concrete pavements shall be removed to neatly sawed edges. Saw cuts shall be made full depth. If a saw cut in concrete pavement falls within 3' of an existing score joint, construction joint, saw joint, cold joint, expansion joint, or edge, the concrete shall be removed to that joint or edge. All saw cuts shall be parallel and/or perpendicular to the line of existing pavement. If an edge of a cut is damaged subsequent to saw cutting, the concrete shall again be sawed to a neat, straight line for the purpose of removing the damaged area.
- C. Disposal:
 - 1. Clean up and remove from the site existing stumps, logs, broken paving rubble, and trash.
 - 2. Clean up and remove from the site the stumps, logs, broken paving, rubble, and debris resulting from the clearing and grubbing operations.
 - 3. Material to be wasted shall be legally disposed of off-site.
 - 4. Burning of combustible materials on the site will not be permitted.
 - 5. Remove and dispose of excess soil off site in a legal manner. No extra pay.

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3.02 BACKFILLING

- A. All holes, cavities, and depressions in the ground caused by site preparation operations will be backfilled and tamped to normal compaction and will be graded to prevent ponding of water and to promote drainage. In areas that are to be immediately excavated, the Architect/Engineer may permit holes, etc., to remain open.

3.03 STORM WATER MANAGEMENT PRACTICES

- A. During the progress of the work, the contractor shall maintain existing storm water erosion and silt control measures in place at the site and shall provide additional erosion control barriers, silt fences, and other techniques in accordance with best management practices. Refer to Section 31 23 00 for additional requirements and land disturbance permit requirements.

END OF SECTION

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SECTION 312333

TRENCHING AND BACKFILLING

PART 1 - GENERAL

1.01 WORK INCLUDED

Furnish labor, materials, equipments and incidentals necessary to perform operations in trenching, pipe bedding, backfilling, clearing, grubbing and site preparation, handling, storage, transportation and disposal of excavated material; pumping and dewatering, preparation of subgrades, protection of adjacent property; fills, grading; and other appurtenant work. Trenching, backfilling, and pipe embedment procedures shall be in full compliance with Section 31 41 33, Trench Shielding. Earth removed from excavations and which is not required for backfill shall be removed from the site by the Contractor at his own expense unless arrangements are made with the Owner through his representative to allow disposal on site. If permitted, the Contractor shall dump and spread excess earth in a manner agreed upon by the Contractor and the Owner. Excavation, other than trench excavation and embankment fills are not part of this specification section.

1.02 QUALITY ASSURANCE

CLASSIFICATION

- A. Excavations shall include material of whatever nature encountered, including but not limited to clays, sands, gravels, conglomeritic boulders, weathered clay shales, rock, debris and abandoned existing structures. Excavation and trenching shall include the removal and subsequent handling of materials excavated or otherwise handled in the performance of the work.
- B. Bidders must satisfy themselves as to the actual existing subsurface conditions prior to the submittal of a proposal to complete the proposed work.
- C. Trench excavation shall consist of excavation to the lines and grades indicated, required for installation of the pipe, pipe bedding, backfill, and to accommodate trench safety systems.

1.03 SUBMITTALS

- A. Submittals shall be in accordance with SECTION 013323 – Shop Drawings, Product Data, and Samples and SECTION 012300 – Alternates, Submittals and shall include:
 - 1. Sieve analysis on embedment materials.
 - 2. Test results indicating soil resistivity for embedment material used on metal pipe.

1.04 STANDARDS

The following publications, referred to hereafter by basic designation only, form a part of this specification to the extent indicated by the references thereto:

ASTM D-48	"Standard Classification for Sizes of Aggregate for Road and Bridge Construction"
ASTM D-698	"Moisture-Density Relationship of Soils and Soil Aggregate Mixtures, Using 5.5 -lb Rammer and 12 Inch Drop"
ASTM D-1556	"Density of Soil in Place by the Sand Cone Method"
ASTM D-2487	"Classification of Soils for Engineering Purposes"
ASTM D-2922	"Density of Soil and Soil - Aggregate In-Place by Nuclear Methods"
ASTM D-3017	"Moisture Content of Soil and Soil - Aggregate In-Place by Nuclear Methods"
ASTM D-4253	"Test Methods for Maximum Index Density of Soils Using a Vibratory Table"
ASTM D-4254	"Test Methods for Minimum Index Density of Soils and Calculations of Relative Density"

Any other testing required by these specifications and not specifically referenced to a standard shall be performed under ASTM or other appropriate standards as designated by the Engineer.

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Reference herein or on the drawings to soil classifications shall be understood to be according to ASTM D-2487, "Classification of Soils for Engineering Purposes" unless indicated otherwise.

1.05 DELIVERY AND STORAGE

Excavated materials to be used for backfilling may be deposited in stockpiles at points convenient for re-handling the material during the backfilling process. The location of stockpiles shall be within the limits of construction easements or public right-of-way. The location of stockpiles is subject to the approval of the Owner or the Owner's representative. Keep drainage channels clear of stockpiled materials.

1.06 JOB CONDITIONS

Place no embedment or backfill material during freezing weather or upon frozen subgrades or previously placed frozen embedment or backfill materials.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. CONCRETE FOR BACKFILL, BLOCKING, CRADLING AND ENCASEMENT. Unless other strength requirements are designated, concrete used shall be 3,600 psi as specified in Section 03 30 00, CAST-IN-PLACE CONCRETE.
- B. CLASS 1 EARTH FILL: Limited to clays and sandy clays classified as CH material with a liquid limit greater than or equal to 50, a plasticity index greater than or equal to 25, and a minimum of 60% passing the No. 200 sieve, which are free of organic materials
- C. CLASS 3 EARTH FILL- Consist of any materials classified as CH, CL, SM, SP, SP-SM, SC, and GC, which have a minimum plasticity index of 4, which are free of organic materials.
- D. CLASS 12 EARTH FILL: Consist of soils suitable for topsoil which are relatively free of stones or other objectionable debris, which have sufficient humus content to readily support vegetative growth. The suitability of soils for topsoil shall be subject to the approval of the Engineer.
- E. CLASS 2 AGGREGATE FILL: [For Reinforced Concrete or Concrete Cylinder Pipe] Consist of durable particles of crushed stone free of silt, clay, or other unsuitable materials and have a percentage of wear of not more than 40% when tested in accordance with ASTM Method C-13 1 or C-535. When material is subjected to five (5) cycles of the sodium sulfate soundness test in accordance with ASTM C-88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12%. The source of the material shall be approved by the Engineer and meet the following gradation in accordance with ASTM D-448, size number 67:

<u>Sieve Size Square Opening</u>	<u>Percent Passing</u>
1"	100
3/4"	90 - 100
3/8"	20 - 55
No. 4	0 - 10
No. 8	0 - 5

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- F. CLASS 3 AGGREGATE FILL: [For Iron, Cast Iron, or Corrugated Metal Pipe] Consist of durable particles of crushed stone free of silt, clay, or other unsuitable materials and have a percentage of wear of not more than 40% when tested in accordance with ASTM C-131 or C-535. When material is subjected to five (5) cycles of the sodium sulfate soundness test in accordance with ASTM C-88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12%. The source of the material shall be approved by the Engineer and meet the following gradation in accordance with ASTM D-448, size number 7:

<u>Sieve Size Square Opening</u>	<u>Percent Passing</u>
3/4"	100
1/2"	90 - 100
3/8"	40 - 70
No. 4	0 - 15
No. 8	0 - 5

- G. CLASS 10 AGGREGATE FILL: or Iron-reinforced Concrete, Vitrified Clay, PVC, Fiberglass, or Asbestos Cement Pipe] Consist of washed and screened natural sands or sands manufactured by crushing stones complying with the requirements and tests of "Standard Specifications for Concrete Aggregates", ASTM C-33. The gradation as included in ASTM C-33 is as follows:

<u>Sieve Size Square Opening</u>	<u>Percent Passing</u>
8"	00
No. 4	95 - 100
No. 8	80 - 100
No. 16	50 - 85
No. 30	25 - 60
No. 50	10-30
No. 100	2-10

Class 10 Aggregate Fill shall have not more than 45% passing any sieve and retained on the next consecutive sieve of those shown above, and its fineness modulus, as defined in ASTM C-125, shall be not less than 2.3 nor more than 3.1.

- H. CEMENT: Type I Portland Cement

2.02 MIXES; SAND-CEMENT BACKFILL [OR EMBEDMENT]

- A. A minimum sand and cement mixture of 27 parts sand and 2 parts cement will be required.

Fine Sand	1 Cubic Yard
Cement	1 Bag (Minimum)
Water	Optimum Moisture

- B. Sand shall be free of any cohesive material and shall meet the following gradation and plasticity index requirements:

<u>Sieve Size</u>	<u>Percent Passing</u>
1"	100
1/2"	95 - 100
No. 40	80 - 100
Plasticity Index	10 Maximum
Liquid Limit	25 or less

2.03 FABRICATIONS [Not Used]

2.04 MANUFACTURED PRODUCTS [Not Used]

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PART 3 - EXECUTION

3.01 PREPARATION

A. SITE

1. Clear sites of logs, trees, roots, brush, tree trimmings and other objectionable materials and debris which are to be occupied by pipe trenches, and grub stumps. Designate material not salvaged for reuse as surface material as spoiled and dispose of material in accordance with Paragraph E - DISPOSAL OF SPOIL MATERIAL, of this section.
2. Do not remove trees outside of the required working area unless their removal is authorized in writing by the Engineer and with the approval of the local governing authority. Adequately protect the trees left standing from permanent damage by construction operations. Standing trees may be trimmed where necessary to facilitate construction, but only with written authorization from the Engineer.

B. DEWATERING

1. Provide and maintain adequate dewatering equipment to remove and dispose of surface and ground water entering the excavations, trenches, or other parts of the work. Keep each excavation dry during subgrade preparation and continually thereafter until the proposed pipe is installed. Maintain the proper procedures necessary to protect against damage to the proposed work from hydrostatic pressure, flotation, or other water related causes.
2. Dewater excavations which extend down to or below ground water elevation by lowering and keeping the ground water level a minimum of 2-feet below the bottom of the excavation.
3. Divert surface water or otherwise prevent water from entering excavated areas to the fullest extent possible without causing damage to adjacent property.
4. Provide and maintain any piping or conduit necessary to facilitate drainage. Do not alter area drainage patterns to the extent that adjacent property and landowners become threatened with localized flooding and/or water damage. Should such a situation occur, the Contractor shall be responsible for repairing the damage at no additional cost to the Owner.

C. PROTECTION OF EXISTING STRUCTURES AND UTILITIES

1. Prior to the start of construction, communicate with the local representatives of utilities companies, including but limited to oil, gas, telephone, and communications companies, as well as local water and sewer utilities operating in the location of the proposed construction area. Seek the utility companies' assistance in locating existing facilities to avoid conflicts during construction. The location, number, depth, and owner of utilities indicated are for information purposes only, and all utilities and structures may not be shown or may not be in the location shown.
2. Where construction endangers adjacent structures, utilities, embankments and/or roadways, the Contractor shall, at his own expense, carefully support and protect such structures so that no damage occurs throughout the construction process. In case damage should occur, the Contractor shall be responsible for restoring the damaged structure to a condition acceptable to the Owner of that structure and shall bear all cost of such reparations.
3. Repair or replace damaged street surfaces, driveways, sidewalks, curbs, gutters, fences, drainage structures, or other such facilities to the satisfaction of the Owner. Structures shall be returned to a condition equal to or better than the original condition and of same or better material and quality.

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D. BLASTING

Blasting shall not be allowed in any instance.

E. DISPOSAL OF SPOIL MATERIAL

1. Suitable material from excavations which meets the requirements for pipe backfill material as indicated, except stripping excavation, may be reused. Designate the remaining excavated materials as spoiled material and dispose of material off the site in accordance with all applicable laws, ordinances, and codes. Contractor shall be responsible for the storage, transportation, and deposition of spoiled material and shall be responsible for acquiring the necessary permits, and the payment of fees and duties at no additional cost to the Owner.

2. No burning of materials shall be permitted on the site.

3.02 TRENCH EXCAVATION

A. GENERAL

The trenches shall be excavated to the alignment and depth indicated or as necessary for the proper installation of the pipe and appurtenances. Brace and dewater the trench if necessary, so that the workmen may work therein safely and efficiently. Any specific requirement listed in Part 3 - EXECUTION may be modified as necessary to meet OSHA requirements. However, if trench widths are wider than indicated, the Contractor shall be responsible for determining the proper class of embedment and piping and the installation.

B. TRENCH WIDTH

The trench widths shall be as shown on the drawings.

C. PIPE FOUNDATION SUBGRADE

1. Excavate the trench to an even grade to permit the installation of the pipe so that the full length of the pipe barrel is supported on the proper depth of bedding material. The entire foundation subgrade area in the bottom of the excavations shall be firm, stable material, and the material shall not be disturbed below required grade except as described in this specification. Where the character of the subgrade material is such that proper subgrade cannot be obtained at the elevation indicated, deepen the excavation to a satisfactory subgrade material.

2. Remove the material until a firm, stable, and uniform bearing is reached, and the subgrade brought back to the required grade with the specified bedding material compacted in place or with lean concrete material. The expense of replacing any unsatisfactory subgrade shall be borne by the Contractor.

D. CORRECTING FAULTY GRADE

Should any part of the trench be excavated below required grade, correct the trench with bedding material, thoroughly compacted, or with lean concrete, at no additional compensation to the Contractor.

E. CARE OF SURFACE MATERIAL FOR REUSE

If local conditions permit reuse, keep surface material suitable for reuse separate from the general excavation material.

F. TRENCHING METHODS

The use of any suitable trench digging machinery is permitted except in places where such

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operations may cause damage, above or below ground, in which case, employ hand methods.

G. PIPE CLEARANCE IN ROCK

Remove ledge rock, rock fragments, shale, or other rock to provide proper clearance for bedding materials. Provide adequate clearance for properly jointing pipe laid in rock trenches at bell holes.

3.03 BACKFILL

A. BEDDING WITHIN PIPE ZONE

1. CONCRETE CRADLE, ENCASEMENT OR CONCRETE ARCH

Where indicated, install in the pipe in concrete cradle, encasement, or concrete arch. Take precautions to prevent pipe movement or deflection during construction. Where pipes are placed below structures, completely encase pipes in 1,500 psi concrete, and extend up to bottom of structure.

2. CONCRETE BLOCKING

Place blocking to rest against firm undisturbed trench walls. The supporting area for each block shall be at least as great as that indicated and shall be sufficient to withstand the thrust, including water hammer, which may develop. Each block shall rest on a firm undisturbed foundation of trench sides and bottom.

B. AGGREGATE FILL BEDDING

1. After the trench has been cut to the depths indicated, bring up the bedding layer to a point slightly above grade in maximum 4" lifts and uniformly compact to the density indicated. Form bell holes and scoop out a trough to grade so that the pipe is uniformly supported by the embedment material. Lay and joint the pipe. Bring up the embedment material in maximum 4" lifts on either side of the pipe to the elevation above the pipe shown on the plans. Uniformly compact the pipe as indicated.

2. After moisture is gone from the embedment material, place and compact the remaining backfill by tamping or other appropriate methods. Water jetting shall not be permitted.

C. COMPACTION REQUIREMENTS

1. Compact earth fill and adhesive aggregate fill in maximum 4" lifts with pneumatic rollers or power hand tampers and make a minimum of eight (8) passes.

2. Compact cohesionless aggregate fill in maximum 4" lifts with vibratory rollers or vibratory plate power hand compactors and make a minimum of eight (8) passes.

3. The acceptability of the compaction equipment shall be based upon the results of a test section.

4. Compact earth fill and cohesive aggregate fill to a minimum of 95% of maximum dry density as determined by ASTM D-698, Standard Proctor.

5. Compact earth fill Class 1 and 2 at a moisture content within minus 0 to plus 5 percentage points of the optimum moisture content. Compact the remaining classes of earth fill and cohesive aggregate fill at a moisture content within minus 2 to plus 5 percentage points of optimum moisture content. The moisture ranges listed above are minimum and maximum limits. A tighter moisture range within these limits may be required to consistently achieve the specified density.

6. Compact cohesionless aggregate fill on which it is not practical to control the density by "Proctor" methods to a minimum of 75% of relative density as determined by ASTM D-

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4253 and D-4254, or at the discretion of the Engineer, by a field compaction mold method correlated to ASTM D-4253 and D-4254.

7. Compact cohesionless aggregate fill at moisture content within a range that accommodates consistent placement and compaction to the minimum relative density specified above.
8. The Owner will arrange and pay for density and moisture testing. The testing frequency and methods shall be as requested by the Engineer. The Engineer may waive testing requirements on cohesionless bedding where testing is not practical because of limited space between the pipe and trench walls, however, the minimum number of passes of the compaction equipment specified above shall be achieved.

3.04 FINISHING

- A. Grade and rake areas smooth and even which do not receive any type of paved surface, to allow drainage to drain away from the structures and toward the roads and streets or the natural drainage course. Break up large clods of earth and remove rocks, trash, and debris near the surface.
- B. Finish the top portion of backfill beneath established sodded (lawn) areas with not less than 6" of topsoil corresponding to, or better than, that underlying adjoining sodded areas.

3.05 FIELD QUALITY CONTROL

- A. Compact backfill and appropriate embedment material to a minimum of 95% of maximum density at a moisture content of 0 to + 5% of optimum for backfill and at optimum for sand-cement embedment as determined by ASTM D-698-78 (Standard Proctor),
- B. Make periodic tests of compaction for conformance with this section by an approved testing laboratory selected and paid for by the Owner. Contractor shall pay for re-testing until acceptable test results are obtained.

3.06 CLEAN AND ADJUST

Remove surplus pipeline materials, tools, rubbish, and temporary structures and leave the construction site clean, to the satisfaction of the Engineer.

END OF SECTION

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SECTION 312400

EARTHWORK FOR STRUCTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes earthwork for structures requirements for use in conjunction with the project Geotechnical Report. The section covers excavating, filling, backfilling, and compaction necessary for construction of the earthwork subgrade or building pads supporting the primary building structure, including supplementary Work necessary for completion.
- B. Related Sections:
 - 1. Division 01 Section "Quality Requirements" for independent testing agency procedures and administrative requirements.
 - 2. Division 31 Section "Augered Cast in Place Piles" for foundation element construction information.

1.3 GEOTECHNICAL REPORT

- A. Reference the geotechnical report dated November 12, 2025 prepared by Lantec Engineers. Project No. 1025-3598, as well as Addendum No. 1 report dated December 30, 2025. Project no. 1025-3598-A.
- B. Geotechnical Engineer Contact Information:

Landtec Engineers.
3906 W IH-20 Suit 100
Arlington, Texas 76017
Phone: 817-572-2818
Ramchandra Baral, PE
- C. All earthwork for structures shall be consistent with and inspected per the Project Geotechnical Report requirements. These specifications are intended to supplement and clarify EOR intent for design based on the Geotechnical Report. The Contractor is responsible for adhering to the materials, methods, installation requirements, and inspections indicated in the Owner furnished Geotechnical Report.

1.4 PERFORMANCE REQUIREMENTS

- A. Provide a properly designed Site Retention System to be selected and completed by a specialty foundation contractor designed for all applicable code required forces and safety provisions.
 - 1. Subject to EOR review and approval, General contractor shall select a temporary or permanent retention system as appropriate for construction methodology and site constraints.

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2. Retention system shall be designed using the parameters and capacities provided in the Geotechnical Report.
3. Engineering Responsibility: Contractor's responsibilities include using a qualified Professional Engineer registered in the State of the project to prepare and submit the structural analysis data for installation and performance of the retention system.
4. Provide submittal containing engineer's seal and signature for engineered system. See submittals.

- B. Engineering Responsibility: Contractor's responsibilities include using a qualified Professional Engineer registered in the State of the project to prepare and submit the structural analysis data for installation and performance of the soil improvements.

1.5 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections.

1. Shop drawings shall not be made by using reproductions of Contract Drawings.
2. Shop drawing shall be submitted through General Contractor to Architect. Any fabrication of material before approval of drawings will be at risk of Contractor.
3. Installation of material shall fit within architectural constraints. Installer alone shall be responsible for errors of installation.

- B. Site Retention Systems:

1. Submit product data and retention system type and layout.
2. Provide details indicating installation methods and interface with building structure and waterproofing.
3. Submit Engineer's signed and sealed certification letter of a properly designed retention system meeting all requisite code and safety standards. Retention system Engineer must review all applicable details and products/systems used in the construction of the retention system and indicate such review in submittal.

1.6 QUALITY ASSURANCE

- A. Codes and Standards: Comply with provisions of following, except as otherwise indicated:

1. International Building Code 2021 Edition (IBC). All following code and standard versions shall be as referenced by IBC chapter 35 or, where not referenced in IBC, the most recent published versions.
2. Special Inspection and Quality Control requirements, chapter 17 of the International Building Code and any local or state provisions.

- B. Installer Qualifications:

1.7 PROPOSED SUBSTITUTIONS

- A. Substitutions of sections or modifications of details, if proposed by Contractor, shall be submitted for approval in sketch form prior to submission of shop drawings, and such substitutions shall be made only when approved by Architect, and at no additional cost to Owner. Total amount of credit, if any, shall be stated in writing with submission.

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1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to site at such intervals to ensure uninterrupted progress of work.
- B. Storage of materials: Store materials to permit easy access for inspection and identification.

1.9 COORDINATION

- A. Coordinate preparation of the building pad with all required project discipline drawings, including, but not limited to, structural, civil, architectural, and MEP contract documents.
- B. Coordinate below grade piping, civil structures, and sleeve requirements with final layouts required by MEP and Civil sub-contractors. Verify any changes with Engineer of Record prior to installation.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Specific product, material or manufacturer listed under each item below is "acceptable" only if manufacturer can evidence product compliance with requirements of Contract Documents.
- B. For manufacturers not listed, submit as substitution according to the Conditions of the Contract and Division 01 Specification Sections.

2.2 MATERIALS

- A. Fill Materials:
 - 1. All fill materials shall be as specified in the project geotechnical report.
 - 2. Only materials approved for use by the project Geotechnical Engineer and placed in a manner consistent with the project Geotechnical Report shall be used.
- B. Retention System: As necessary to install new foundation systems adjacent to existing foundations.
- C. Soil Improvements: As presented in the project Geotechnical Report as necessary to provide the bearing pressures indicated in the Contract Documents.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Site Conditions
 - 1. Do not place fill on subgrade which is muddy, frozen or which contains frost.
 - 2. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
 - 3. Provide erosion control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways
- B. Utilities:

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1. Remove abandoned, inactive utilities to a point not less than 3 feet outside building lines. Suitably plug or cap remaining ends.
2. Report encounter of active utilities not indicated by the Contract Documents to the Architect.
3. Disposition shall be as directed, with adjustment in Contract amount.
4. Extra payment will not be authorized for work that could have been foreseen by a careful examination of Site.
5. Notify respective Utility Companies of any damage caused to active utilities.
6. Protect active utilities, pending instruction for disposition.

C. Protection of Adjacent Areas or Surfaces:

1. Protect reference points, bench marks and monuments from damage or dislocation.
2. Replace or repair, immediately, any points damaged, destroyed or dislocated.
3. Sprinkle and dampen dusty material, from the beginning of work to its completion.
4. Protect and maintain conduits, drains, inlets, sewers, pipes and wires that are to remain on the property.
5. Remove temporary wood from concrete, masonry or fill.
6. Cover holes and trenches when work is not in progress.
7. Fence or barricade changes of plane more than 45 degrees with horizontal and more than 3 feet in height.
8. Keep trenches and excavated areas free from water by pumping or draining.
9. Grade to drain surface water away from excavations.
10. Pump or drain water to designated points.
11. Distribute discharge to prevent excessive erosion.

3.2 EARTH EXCAVATION

- A. Excavate for foundations to lines and grades indicated. Allow additional space, as required, for construction operations and inspecting foundations.
- B. Remove obstructions within building lines to a depth of 6" below the depth of excavation indicated on the Drawings.
- C. Remove obstructions in planting and paving areas to 12" below finish grade.
- D. Remove boulders and other deleterious material from the construction area.
- E. Excavation is unclassified and includes excavation to required subgrade elevations regardless of the character of materials and obstructions encountered.
- F. Excavate to indicated elevations and dimensions within a tolerance of plus 0" or minus 4". Extend excavations a sufficient distance from structures for placing and removing concrete forming, installing services and other construction, and for inspections.
- G. Earth excavation includes excavation of pavements and other obstructions visible on surface; underground structures, utilities, and other items indicated to be demolished and removed; together with soil and other materials encountered including rock excavation.
- H. Stockpile excavated materials acceptable for backfill and fill soil materials including acceptable borrow materials.
 1. Stockpile soil materials without intermixing.
 2. Place, grade, and shape stockpiles to drain surface water.
 3. Cover to prevent wind-blown dust.

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4. Stockpile soil materials away from edge of excavations.
5. Do not store within drip line of remaining trees.

3.3 FILLING – GENERAL

A. Preparation Prior to Filling:

1. Clear area of vegetation, topsoil, large rocks, fibrous matter and loose material.
2. Remove existing foundations or subgrade structures encountered.
3. Backfill resulting excavations with specified fill material.
4. Obtain approval for area to be filled, from Geotechnical Engineer before filling is started.
5. Scarify surface and re-compact ground prior to placing fill.

B. Fill in even layers, with layer depths, materials, moisture content, and compaction practices as specified in the project Geotechnical Report. Compact each layer and test as necessary prior to commencing the next layer.

C. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

D. Maintain moisture content as specified by the Geotechnical Engineer. Remove and replace, or scarify and air-dry soil material that is too wet. Stockpile or spread and dry removed wet satisfactory soil material. Properly moisten material that is too dry.

E. Scarify, aerate or moisten soft areas that develop under construction operations as required, and compact to the full depth required to obtain the specified density for each layer.

F. Proof rolling:

1. Perform proof rolling, as required, in areas recommended by the Geotechnical Engineer to the Geotechnical Engineer's standards while under the observation of the Geotechnical Engineer or his authorized representative.
2. Unsuitable materials shall be replaced/compacted as directed by the Geotechnical Engineer.
3. Final proof rolling should be done just prior to placement of the slab-on-grade or foundation systems. Where the subgrade will be finished for more than a few days prior to construction of the slabs-on-grade see protection requirements below.

G. Protect the prepared subgrade as required by the Geotechnical Engineer to maintain moisture content, compaction levels, and prevent disturbing or softening of the soils. Protection must mitigate construction activity and weather events.

1. Where the subgrade cannot be protected during construction, level the surface approximately 1'-0" below final required grade and provide a protective soil layer with drainage slopes to be removed and re-compacted later.
 - a. Once final subgrade preparations can be performed, remove the protective layer, and any disturbed or softened previously compacted layers as required by the Geotechnical Engineer or Testing Agency.
 - b. Place and compact the final layers up to the required elevation.
2. The Geotechnical Engineer or his authorized representative shall review and approve all final subgrade preparations and proof rolls, prior to placing slab-on-grade or foundation systems.
 - a. Such review should occur no more than 5 days prior to placement of concrete.
 - b. In the case of inclement weather that may soften the previously approved subgrade, the Geotechnical Engineer shall review the approved conditions again.

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3.4 FILLING – PLACEMENT SCHEDULES

- A. Reference the Geotechnical report for required properties of each fill type used.
- B. Retaining Walls:
 - 1. Provide drainage fill around the wall drainage piping system and a 12" minimum width vertically against the wall drainage mat system behind the wall.
 - 2. Separate the drainage layer and soil fill layers with filter fabric.

3.5 BACKFILLING

- A. Backfilling is where trenches or other temporary excavations in the completed building pad or the project site are filled in after the work necessitating them has been completed.
 - 1. The contractor is required to maintain safe excavations per OSHA for the type of soils encountered on the site.
 - 2. Contractor must maintain the integrity and moisture conditioning or optimum moisture content of the building pad throughout trenching, excavating, and backfilling operations. Do not allow the exposed subgrade soils to dry out, fill with water, cave-in, loosen, or otherwise compromise the expected bearing capacity of the surrounding subgrade.
 - a. Follow the recommendations of the Geotechnical Engineer or on-site field technicians to appropriately maintain the excavation soil conditions.
 - b. Protection of trenches or excavations prior to backfilling may require various systems or approaches by the contractor depending on the time of year and expected weather conditions. The contractor shall plan for and provide protections such as plastic sheeting, temporary drainage systems, erosion controls, etc.
 - c. Failure to properly protect excavations or place backfills may result in removal and replacement of the excavation backfill AND the impacted subgrade surrounding the excavation as determined by the EOR or Geotechnical Engineer.
 - 3. Excavations and backfilling shall not undermine or negatively affect already placed foundations or building elements.
- B. Backfill excavations promptly, but not before completing the following:
 - 1. Acceptance of construction below finish grade including, where applicable, damp proofing, waterproofing, and perimeter insulation.
 - 2. Surveying locations of underground utilities for record documents.
 - 3. Testing, inspecting, and approval of underground utilities.
 - 4. Concrete forming removal.
 - 5. Removal of trash and debris from excavation.
 - 6. Removal of temporary shoring and bracing, and sheeting.
 - 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.
- C. Place backfill material with layer depths, materials, moisture content, and compaction practices as specified in the project Geotechnical Report. Compact each layer and test as necessary prior to commencing the next layer.
 - 1. Do not damage waterproofing when placing backfill.
 - 2. Thoroughly compact each layer by rolling or pneumatic tamping.
 - 3. Do not flood excavated areas with water before or during backfilling.
 - 4. Bring finished subgrade to elevations indicated.
 - 5. Sloped to drain water away from the building walls.
 - 6. Fill areas where settlement occurs to required elevations.

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3.6 DRAINAGE SYSTEMS

- A. At required locations listed below, provide drainage system, drainage fill, and required accessories to properly collect and limit below grade water build up:
 - 1. Install perforated piping system.
 - 2. Compact drainage fill to required cross sections, thickness, and densities as specified in the Project Geotechnical Report.
 - 3. Provide proper accessories such as drainage mats, filter fabrics, collections assemblies and sump systems.
- B. Required locations:
 - 1. Behind structural retaining walls to prevent hydrostatic pressure, unless noted otherwise.
 - 2. As shown in architectural plans and sections.
 - 3. Where indicated in the project Geotechnical Report.

3.7 SOIL IMPROVEMENTS

- A. Soil improvement installation methods shall follow the protocols established by the soil improvement Geotechnical Engineer as indicated on the submittal approved by the EOR. Where deviation from approved procedures is required by field conditions, proper documentation shall be provided, reviewed and signed by the soil improvement Geotechnical Engineer, and submitted to the EOR.
- B. Soil improvements shall not negatively disturb existing building systems, foundations, or the existing building occupants.
 - 1. Where improvements are to be made immediately adjacent existing foundation systems take appropriate precautions to not undermine or reduce the capacity of those existing systems.
 - 2. Soil improvement contractor is responsible for verifying that all necessary safety procedures, temporary bracing, or temporary retaining systems are in place and undisturbed for the duration of the soil improvement process.
 - 3. Establish if staging or sequencing is required between soil improvement systems and the retention systems and/or bracing for the existing structure. Define a work plan for any steps required.
- C. Retention systems, where required for installation of the soil improvements, shall be identified and coordinated with the retention system engineer. Where retention system engineer and soil improvement engineer are the same firm/contractor all necessary coordination and submittals shall be performed, documented, and submitted for both systems.
- D. Work restrictions may apply to the soil improvement installation and methods.
 - 1. Vibratory installed soil improvements that are known to transmit vibration thru the ground into the existing building may be restricted in proximity to the existing building and/or allowed installation times during the day.
 - 2. Expected impacts and restrictions, if any, shall be discussed with and coordinated by the general contractor. General contractor is responsible for establishing requirements, expectations, and procedures with the building owner and maintaining necessary communication with the owner throughout installation.
 - 3. Reasonable steps shall be taken to minimize the impact to the existing building occupants while accomplishing the installation in a timely and coordinated manner.

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3.8 CLEANING

- A. Keep excavated areas free from debris and stored materials that could damage surfaces or interfere with progress of Work.
- B. Remove excess materials from the Site promptly to prevent large accumulation. Store reusable material neatly in designated locations.
- C. Upon the completion of the Work of this Section, dispose of, away from the Site, debris, trash, containers, residue, remnants and scraps which result from the Work of this Section.

PART 4 - QUALITY CONTROL

4.1 INSPECTION STANDARDS

- A. Quality control, testing, and inspections shall meet the special inspection requirements of the building code and any local or state provisions.
 - 1. Periodic and continuous inspection requirements are indicated below for each earthwork condition.

4.2 TESTING AGENCY

- A. Owner will employ and pay a qualified independent testing agency to perform the quality control indicated in this section, including special inspections required by the building code.
 - 1. Inspection and testing by owner's testing agency is for verification and shall not relieve contractor of his responsibility to furnish materials and workmanship in accordance with Contract Documents.
 - 2. Retesting of materials failing to meet specified requirements shall be done at Contractor's expense.
 - 3. In cases of differences of opinion between owner's testing agency and the contractor's inspector regarding conformance, the issue should be brought to the Engineer of Record and the enforcement agency as part of the resolution process
- B. Subgrades, fills, or backfills:
 - 1. Perform Plasticity Index Test on fill material prior to use to determine compliance with the Project Geotechnical Report. (ASTM D 4318)
 - 2. Perform density tests on fill material as specified in the Project Geotechnical Report for each for each lift in place. (ASTM D 2922)
 - 3. Allow testing agency to inspect and test the subgrade at each fill or backfill layer. Do not proceed until test results for previously completed work verify compliance with requirements.
 - 4. In each compacted backfill layer, perform at least one field in-place density test for each 100 feet or less of wall length, but no fewer than two tests along a wall face or as specified in the Project Geotechnical Report.
 - 5. In each compacted initial and final backfill layer, perform at least one field in-place density test for each 150 feet or less of trench, but no fewer than two tests or as specified in the Project Geotechnical Report.
 - 6. When testing agency reports that subgrades, fills, or backfills are below specified density, scarify and moisten or aerate, or remove and replace soil to the depth required, re-compact and retest until required density is obtained.

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- C. Foundation excavations for footings, piers, grade beams, or other elements bearing direct on subgrades:
 - 1. Soils testing laboratory shall inspect each excavation to determine that proper bearing stratum is obtained and utilized for bearing and that excavations are properly clean and dry before concrete is placed.
 - 2. Do not proceed until the testing agency has authorized each foundation location complies with the project and Geotechnical requirements.
- D. Retention Systems: Provide performance tests of the retention system as specified in the Project Geotechnical Report or retention system design engineer.
- E. Soil Improvements: Visual inspections of the equipment and installation process shall be performed per the requirements of the project Geotechnical Report:
 - 1. Data shall be logged by the inspector indicating that improvements have been made to the proper depth, spacing, and location.
 - 2. Volume of material used, vibration frequency, pressure readings, and other properties related to the installation process shall be monitored.
 - 3. Acceptance testing shall follow the criteria listed in the Geotechnical Report and the program established by the engineer responsible for the soil improvement design.

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SECTION 312500

EROSION AND SEDIMENTATION CONTROL

PART 1 - GENERAL

1.01 WORK INCLUDED

Provide labor, materials, equipment, and incidentals necessary to seed the slopes and other areas as specified. This specification includes seedbed fertilization, watering, mulching, and emulsifying or tacking the mulch and maintenance until final acceptance by the Owner.

1.02 STANDARDS

The seed used on this project will conform to ITEM 164.2 Standard Specifications for Construction of Highways, Streets and Bridges, Texas Department of Transportation.

1.03 DELIVERY AND STORAGE

Deliver seed with each variety separately bagged.

1.04 OPTIONS

- A. If dry mechanical methods are used, the fertilizer may be spread at the same time as the seed. After sowing, straw mulch will be mechanically spread over the seeded area.
- B. When seed and fertilizer are to be distributed as a water slurry, apply the mixture within thirty (30) minutes of mixing.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. SEED: From the previous season's crop, labeled in accordance with the Texas Seed Law.
 - 1. Seed for Fall planting (temporary) shall be one (1) or more of the following small grains as designated by the Engineer: Wheat, oats, cereal rye, or barley.
 - 2. Seed for Spring planting (permanent) shall be Bermuda grass.
- B. FERTILIZER

A uniform application of 10-6-4 (nitrogen-phosphorus-potassium) fertilizer at a rate of 18 pounds per 1,000 square feet (800 pounds per acre).
- C. MULCH
 - 1. Consisting of straw, wood-fiber, mulch nettings, wood chips or other suitable material approved by the Engineer and free of Johnson grass and other noxious weed seeds.
 - 2. Straw mulch shall be oat, wheat or rice straw, prairie hay, Bermuda grass hay, or other hay harvested before seed production and approved by the Engineer. The straw mulch will be kept dry and shall not be rotted or molded. A minimum of 50% by weight of the herbage making up the hay shall be 10" in length or longer.
- D. TOPSOIL: As specified for Class 12 Earth Fill in Section 31 05 13, SOILS FOR EARTHWORK.

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- E. HERBICIDE: Contractor shall be responsible for using herbicides in a manner consistent with label requirements and precautions. Only registered herbicides having a minimal residual effect shall be used. Contractor shall strictly adhere to all Federal, State, and local laws governing herbicide usage.

PART 3 - EXECUTION

3.01 PREPARATION [Not Used]

3.02 TOPSOIL PLACEMENT

Place topsoil as specified for Class 12 Earth Fill.

3.03 FALL PLANTING

Fall planting will be temporary only and will be required if construction is completed between September 15 and April 15. The Fall planting is to be followed by a Spring planting of perennial vegetation.

A. SEEDBED PREPARATION

Use a one-way plow, tandem disk, bedder, or equipment which will accomplish similar results. Break or mix the surface of the soil with the tillage equipment. Additional tillage operations will be necessary if required so planting can be on a clean, firm seedbed. Chiseling will be necessary on areas which have been severely compacted.

B. SEEDING

1. Seeding will be required on disturbed or excavated areas and on new embankments of whatever nature unless requested otherwise by the Engineer.
2. Optimum Fall planting dates are September 1 to November 30. Accomplish the seeding for Fall planting within these dates unless approval to do otherwise is obtained from the Engineer. Planting rates when drilled or broadcast are as follows:

Wheat	120	lbs/acre
Oats	128	lbs/acre
Rye	200	lbs/acre
Barley	114	lbs/acre

3.04 SPRING PLANTING

Follow procedures for Spring planting if construction is completed between April 15 and September 15, or after a temporary Fall planting has been made.

A. SEEDBED PREPARATION

Seedbed preparation for Spring planting is the same as that stated in the Fall planting of temporary cover with one addition. Any temporary cover crop must be top killed using an approved contact herbicide or by mechanically undercutting the growing cover crop, leaving residues on or near the soil surface.

B. MULCHING

1. Spread mulch material on the area to be planted if construction was completed too late for planting a temporary fall crop or if insufficient residues are produced by the Fall planting. Mulch the planting areas to control soil erosion and seed loss by wind and water and to promote grass establishment. Apply Mulch hay at the rate of 2 tons per acre and spread

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- uniformly so that about 25% of the ground surface is uniformly visible through the mulch.
2. Anchor the mulch hay by treading into the soil with a straight disk type mulch tiller. Perform disking across the slope along contours. Other types of mulch such as wood cellulose fiber or cotton bur mulch may be used at recommended rates, if approved by the Engineer. Apply mulch in a manner that will not hinder emergence of seedlings.

C. SEEDING

1. Plant Bermuda grass seed between April 15 and Sept. 15. Sow the seed at the rate of 10 pounds of pure live seed (PLS) per 1,000 SF, or more if required to obtain a complete stand of grass. The PLS content is determined by multiplying the seed package weight by the product of the percent purity, and the percent germination, which are contained on the seed label.
2. Accomplish seeding by mechanical means using either broadcasting or drilling type equipment to provide uniform distribution of the seed in the planting areas. Cover Bermuda grass seed with 1/4 to 1/2" of approved topsoil. If seed is drilled, the distance between drill rows shall not exceed 12". Hydro-seeding may be used to apply seed, fertilizer, and wood-fiber mulch with the approval of the Engineer.

3.05 MAINTENANCE

A. IRRIGATION

Supply the seeded areas with adequate moisture (4" penetration) at ten (10) day intervals, if needed, for seed germination and plant growth until acceptance by the Owner. Water the seed in a manner which will prevent erosion of the soil. Furnish all water to be used.

B. REPAIR

Repair washouts and other bare soil areas in a seeded area either by re-seeding, sprigging, or spot-sodding, and perform maintenance as needed to establish grass in the area.

C. WEED CONTROL

1. Control competitive weed growth during the establishment period by mowing and/or with herbicides. Chemical usage shall be in accordance with the current recommendations of the Texas Agricultural Experiment Station or local Soil Conservation Service Field Office Technical Guides. Strictly adhere to all Federal, State, and local laws governing herbicides.
2. Weed control shall be the Contractor's responsibility whether topsoil is from on-site or off-site sources and also for seeded areas which are specified not to receive topsoil.

3.06 SEEDING OF DISTURBED AREAS

- A. Disturbed areas will require seeding as specified in this section unless requested otherwise by the Engineer or shown otherwise on the drawings or in the specifications.
- B. Any areas which are disturbed by the Contractor which are not shown on the drawings or specified to require disturbance including any approved areas not shown on the drawings, shall be considered as unauthorized disturbed areas. Any such areas shall be seeded as specified in this section at the Contractor's expense and shall not be measured or paid under this section.

3.07 FIELD QUALITY CONTROL; OBSERVATION AND ACCEPTANCE

A. OBSERVATION

Upon completion of the site preparation, mulching, fertilizing, seeding, and maintenance of seeded

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areas, the Engineer will observe the seeded areas periodically to determine the establishment success. The Engineer will consider soil coverage, purity of the grass stand, and maturity of the plants.

B. ESTABLISHMENT OF STAND AND ACCEPTANCE

The Engineer will determine that a grassed area is established upon fulfillment of the following conditions:

1. The permanent grass stand uniformly covers the planting area, with no exposed soil areas more than 6" across in any dimension.
2. The permanent grass stand is free of over-topping weed species which would compete for sunlight, moisture, and nutrients. In addition, no area of pure weed species greater than 6" across in any dimension shall occur within a permanent grass stand.
3. The majority of the grass plants in a stand shall have a well-established root system to survive if irrigation is discontinued. Establish the permanent grass stand before September 15 to preclude having to perform a temporary Fall seeding. In the event a Fall seeding must be performed, follow-up the temporary seeding with a permanent seeding as specified. Upon final acceptance of the work under this contract, the Owner will assume the responsibility of maintaining the grassed areas.

END OF SECTION

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SECTION 313116
TERMITE CONTROL

PART 1 - GENERAL

1.1 SUMMARY

- A. Work required for this Section includes soil treatment for termite control including supplementary Work necessary for its installation.

1.2 DEFINITIONS

- A. EPA: Environmental Protection Agency.
- B. PCO: Pest control operator.

1.3 ACTION SUBMITTALS

- A. Product Data: Treatments and application instructions, including EPA-Registered Label.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: Signed by manufacturers of termite control products certifying that treatments furnished comply with requirements.
- B. Soil Treatment Application Report: After application of termiticide is completed, submit report for Owner's record information, including the following as applicable:
 - 1. Date and time of application.
 - 2. Moisture content of soil before application.
 - 3. Brand name and manufacturer of termiticide.
 - 4. Quantity of undiluted termiticide used.
 - 5. Dilutions, methods, volumes, and rates of application used.
 - 6. Areas of application.
 - 7. Water source for application.
- C. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

- A. Applicator Qualifications: A PCO who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment in jurisdiction where Project is located and who is experienced and has completed termite control treatment similar to that indicated for this Project and whose work has a record of successful in-service performance.
- B. Regulatory Requirements: Formulate and apply termiticides, and label with a Federal registration number, to comply with EPA regulations and authorities having jurisdiction.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: To ensure penetration, do not treat soil that is water saturated or frozen. Do not treat soil while precipitation is occurring. Comply with EPA-Registered Label requirements and requirements of authorities having jurisdiction.

1.7 COORDINATION

- A. Coordinate soil treatment application with excavating, filling, and grading and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs, before construction.

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1.8 WARRANTY

- A. Special Warranty: Written warranty, signed by applicator and Contractor certifying that termite control work, consisting of applied soil termiticide treatment, will prevent infestation of subterranean termites. If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.
- B. Warranty Period: Five years from date of Substantial Completion.

1.9 MAINTENANCE SERVICE

- A. Continuing Service: Provide a proposal for continuing service, including monitoring, inspection, and retreatment for occurrences of termite activity, from applicator to Owner, in the form of a standard yearly (or other period) continuing service agreement, starting on the date of Substantial Completion. State services, obligations, conditions, and terms for agreement period and for future renewal options.

PART 2 - PRODUCTS

2.1 SOIL TREATMENT

- A. Termiticide: Provide an EPA-registered termiticide complying with requirements of authorities having jurisdiction, in a soluble or emulsible, concentrated formulation that dilutes with water or foaming agent, and formulated to prevent termite infestation. Use only soil treatment solutions that are not harmful to plants. Provide quantity required for application at the label volume and rate for the maximum termiticide concentration allowed for each specific use, according to the product's EPA-Registered Label.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of the soil, interfaces with earth moving, slab and foundation work, landscaping, and other conditions affecting performance of termite control.
- B. Proceed with application only after unsatisfactory conditions have been corrected. Starting of Work will be construed as installers acceptance of installation conditions.

3.2 PREPARATION

- A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's written instructions for preparing substrate. Remove all extraneous sources of wood cellulose and other edible materials such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil and around foundations.
- B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated, except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended by termiticide manufacturer.
- C. Fit filling hose connected to water source at the site with a backflow preventer, complying with requirements of authorities having jurisdiction.

3.3 APPLYING SOIL TREATMENT

- A. General: Apply soil treatment under all enclosed structures. Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's EPA-Registered Label for products.

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- B. Application: Mix soil treatment termiticide solution to a uniform consistency. Provide quantity required for application at the label volume and rate for the maximum specified concentration of termiticide, according to manufacturer's EPA-Registered Label, to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction. Distribute the treatment evenly.
- C. Slabs-on-Grade and Basement Slabs: Under ground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.
- D. Foundations: Adjacent soil including soil along entire inside perimeter of foundation walls, along both sides of interior partition walls, around plumbing pipes and electric conduit penetrating slab, and around interior column footers, piers, and chimney bases; and along entire outside perimeter, from grade to bottom of footing. Avoid soil washout around footings.
- E. Crawlspace: Soil under and adjacent to foundations as previously indicated.
- F. Adjacent Areas: Around entrance platform, porches, and equipment bases. Apply overall treatment only where attached concrete platform and porches are on fill or ground.
- G. Penetrations: At expansion joints, control joints, and area where slabs will be penetrated.
- H. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.
- I. Protect termiticide solution, dispersed in treated soils and fills, from being diluted until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.
- J. Post warning signs in areas of application.
- K. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

END OF SECTION

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SECTION 31 41 33

TRENCH SHIELDING

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. This specification consists of the basic requirements which the Contractor must comply with in order to provide for the safety and health of workers in a trench. This specification is for the purpose of providing minimum performance specifications, and the Contractor shall develop, design, and implement the trench safety system. The Contractor shall bear the sole responsibility for the adequacy of the trench safety system and providing "a safe place to work" for the workman.
- B. Should the trench safety protection system require wider trenches than specified elsewhere, the Contractor shall be responsible for the costs associated with determining adequacy of pipe bedding and class, as well as purchase and installation of alternate materials.

1.02 STANDARDS

- A. The following standard shall be the minimum governing requirement of this specification and is hereby made a part of this specification as if written in its entirety.

Occupational Safety and Health Standards - Excavations (29CFR Part 1926), U.S. Department of Labor, latest edition.
- B. Comply with the applicable Federal, State, and local rules, regulations, and ordinances.

END OF SECTION

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SECTION 314133

TRENCH SHIELDING

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. This specification consists of the basic requirements which the Contractor must comply with in order to provide for the safety and health of workers in a trench. This specification is for the purpose of providing minimum performance specifications, and the Contractor shall develop, design, and implement the trench safety system. The Contractor shall bear the sole responsibility for the adequacy of the trench safety system and providing "a safe place to work" for the workman.
- B. Should the trench safety protection system require wider trenches than specified elsewhere, the Contractor shall be responsible for the costs associated with determining adequacy of pipe bedding and class, as well as purchase and installation of alternate materials.

1.02 STANDARDS

- A. The following standard shall be the minimum governing requirement of this specification and is hereby made a part of this specification as if written in its entirety.

Occupational Safety and Health Standards - Excavations (29CFR Part 1926), U.S. Department of Labor, latest edition.
- B. Comply with the applicable Federal, State, and local rules, regulations, and ordinances.

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SECTION 316316

AUGERED CAST-IN-PLACE PILES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes all work required to complete, as indicated by the Contract Documents, and furnish all supplementary items necessary for the proper installation of Augered Cast-In-Place Piles.
- B. Related Requirements:
 - 1. Division 01 Section "Quality Requirements" for independent testing agency procedures and administrative requirements.
 - 2. Division 03 Section "Concrete Accessories".
 - 3. Division 03 Section "Concrete Reinforcing".
 - 4. Division 03 Section "Cast In Place Concrete".
 - 5. Division 31 Section "Building Excavation".

1.2 DEFINITIONS

- A. Augered Cast-In-Place Piles (ACP): A deep foundation system installed via auger and grouting, rather than driving of prefabricated elements. Typically slender elements that are narrow in diameter and installed in groups to achieve required foundation capacities.

1.3 GEOTECHNICAL REPORT

- A. Reference the geotechnical report information provided by Landtec Engineers. Original project report dated November 11, 2025, Project No. 1025-3598. Geotechnical information includes additional addendum letter Dated December 30, 2025..
- B. Geotechnical Engineer Contact Information:

Landtec Engineers
3906 W IH-20 Suite 100
Arlington, Tx 76017
817-572-2812
Ann M. Long
- C. All ACP foundations shall be installed and inspected per the Project Geotechnical Report requirements. These specifications are intended to supplement and clarify EOR intent for design based on the Geotechnical Report. The Contractor is responsible for adhering to the materials, methods, installation requirements, and inspections indicated in the Owner furnished Geotechnical Report:

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1.4 SYSTEM DESCRIPTION SUMMARY

- A. General Description: Work to be performed under this section consists of providing labor, materials, and equipment necessary or required to install piles as shown and specified on drawings, including the following items:
 - 1. Production Piles: Installation of production piles, including drilling, casing (if required), pumping water, cleaning pile holes, placing reinforcing steel, placing grout, and removing spoil.
- B. Specialty Contractor: Work to be performed under this section is considered to be a foundation system which will require a Specialty Contractor experienced with the type piles shown and specified to be installed.

1.5 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections.
 - 1. Shop drawings shall not be made by using reproductions of Contract Drawings.
 - 2. Shop drawing shall be submitted through General Contractor to Architect. Any fabrication of material before approval of drawings will be at risk of Contractor.
 - 3. Fabricator alone shall be responsible for errors of detailing and fabrication.
- B. Written documentation of Specialty Contractor's experience and qualifications. Submit fourteen (14) days minimum prior to Pre-Job Conference specified herein.
- C. Certificates:
 - 1. Reinforcing Steel: Submit two (2) copies of manufacturer's certificates of mill test reports for reinforcing steel.
 - 2. Submit test reports on as used basis for each type and brand of cementitious material used.
 - 3. Submit grout design mix in similar format as required for concrete design mixes specified in Division 3 Section "Cast-In-Place Concrete".
 - 4. Written certification that all piles installed on the project have been installed in compliance with the project specifications and recognized industry standards and have a minimum load carrying capacity as indicated on the drawings.
- D. Written description of equipment, procedures, and techniques for production pile installation.
- E. Shop Drawings: Layout drawings showing location and individual identification number of each pile. Show reinforcement placement details. Final approved layout drawings with individual pile identification numbers shall be filed with Building Official prior to installation of production piles.
- F. Record Drawings: Submit drawing of as-built location and deviation of piles from those shown on contract drawings and layout drawings.
- G. Source and field quality-control documentation.
 - 1. Submit test reports as required for indicating compliance with the Quality Control sections below.
- H. Contractor shall submit to the Engineer and the enforcing agency, for acceptance, a quality control or inspection plan that addresses all inspection issues.

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1.6 QUALITY ASSURANCE

A. Codes and Standards: Comply with provisions of following, except as otherwise indicated:

1. International Building Code (IBC). All following code and standard versions shall be as referenced by IBC chapter 35 or, where not referenced in IBC, the most recent published versions.
2. Special Inspection and Quality Control requirements, chapter 17 of the International Building Code and any local or state provisions.
3. Design and Construction of Continuous Flight Auger Piles (FHWA 2007) and Static Testing of Deep Foundations (FHWA, 1991)

B. Installer Qualifications:

1. Products covered under this section shall be furnished by single Specialty Contractor unless otherwise specified.
2. Only firm which has had minimum of 5 years successful experience in installation of piles similar to the piles required for this project will be acceptable. Specialty Contractor must have sufficient production capacity to produce required piles without causing delay in the work.
3. Cooperate with testing/inspection personnel as required for recording purposes of load tested piles and production piles.

C. Survey Work:

1. Contractor shall engage surveyor acceptable to Architect to perform surveys, layouts, and measurements for pile work. Surveyor shall conduct layout work for each pile to lines and levels required. Surveyor shall identify each installed pile's top location by coordinates, size, tip and top elevation, deviations from specified tolerances, and other data as required.
2. Surveyor shall record and maintain information pertinent to each pile, including rejected and added piles, and cooperate with other testing and inspection personnel to provide data for required reports.

1.7 UNIT PRICES

A. Quote unit prices for the following:

1. Installation of Production Piles including re-drilling and re-grouting as required: Price per Lineal Foot
 - a. Unit price for additional footage over the base amount of footage indicated by drawings, for each pile size.
 - b. Unit price (credit) for less footage than base amount of footage indicated by drawings, for each pile size.

1.8 MEASUREMENT AND PAYMENT

A. Basis for Bids:

1. Bids for installation of production piles shall be a lump sum price based on meeting the indicated performance requirements with the required number of piles indicated with length of piles as determined by the specialty installer. Lengths shall include not less than one (1) foot of overlength for cutting piles at required cut-off elevations.
2. It is not the intent of this specification section to dictate the type of contract implemented with the Specialty Installer by the General Contractor.

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B. Basis for Payment:

1. Contract for installation of production piles shall be per General Contractor requirements and client/owner specifications. Installation shall include labor, materials, tools, equipment, and incidentals, and for performing work for furnishing, drilling, grouting, re-drilling and re-grouting (if required), cutting-off of piles, site clean-up, and disposal of waste.
2. At the discretion of the General Contractor, with approval from the owner, contract adjustments based on actual pile installed lengths may be part of the Specialty Installers bid/payment process given the variability of foundation systems and installation conditions.
 - a. Where the contract is based on such adjustments, measurements will be based on effective length of piles in place with fractional lengths measured to nearest foot.
 - b. All measurements shall be made and documented by the owner's inspection agency, GEOR, or GEOR representative.
 - c. Payment for linear footage in excess of that indicated as the basis of performance design, and credit for linear footage less than basis of performance design, shall be made at unit prices stated in contract, based on net addition or deduction.
 - d. Specialty Installer must include in design lengths differences from site conditions at time of GEOR borings to required bearing stratas, and the expected building pad elevation for actual construction.
3. No payment will be made for rejected piles, including piles installed out of place, imperfect piles, or otherwise faulty piles.

1.9 PROPOSED SUBSTITUTIONS

- A. Substitutions of sections or modifications of details, if proposed by Contractor, shall be submitted for approval in sketch form prior to submission of shop drawings, and such substitutions shall be made only when approved by Architect, and at no additional cost to Owner. Total amount of credit, if any, shall be stated in writing with submission.
- B. Corrections for inaccuracies that result in change from Structural Drawings or final approved shop drawing details shall be submitted in sketch form for approval. Such substitutions or corrections shall be made only when approved by Architect.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to site at such intervals to ensure uninterrupted progress of work.
- B. Storage of materials: Store materials to permit easy access for inspection and identification.

1.11 COORDINATION

- A. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation
- B. Coordinate pile locations for equipment pads and equipment supports with final equipment selections and locations by MEP sub-contractors. Coordinate locations with underground utilities, sleeves, and other systems shown by other disciplines. Verify any changes with Engineer of Record prior to fabrication.

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1.12 SITE CONDITIONS

- A. Examine site, drawings, records of existing utilities and other existing subsurface structures, subsurface exploration reports prepared by Geotechnical Engineer, and soil samples made available by Owner to determine pile installation conditions.
- B. Data on indicated subsurface conditions is not intended as representations of continuity of subsurface conditions. It is expressly understood that Owner will not be responsible for interpretations or conclusions drawn therefrom by Contractor or Specialty Contractor. Data are made available for convenience of Contractor and Specialty Contractor.
- C. Additional test borings and other exploratory operations may be made by Contractor or Specialty Contractor at no additional cost to Owner.
- D. Protection: Protect structures, underground utilities and other construction from damage caused by pile installation operations. Damaged material shall be replaced or repaired to the satisfaction of Owner at no additional cost to Owner.
- E. Existing Utilities:
 - 1. Verify location of existing underground utilities by excavation before starting excavation and pile drilling operations. If utility lines are to remain in place, provide protection from damage during pile installation operations.
 - 2. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation execution of the work, consult Architect immediately for directions as to procedure. Cooperate with Owner and public or private utility companies in keeping their respective service and facilities in operation. Repair damaged utilities to satisfaction of utility Owner at no additional cost to Owner.
 - 3. Do not interrupt existing utilities serving facilities occupied by Owner or others, except when permitted in writing by Architect and then only after temporary utility services have been provided.

1.13 PRE-JOB CONFERENCE

- A. Pre-job conference is required among Architect-Engineer, Contractor, Specialty Contractor, and Geotechnical Engineer to review special requirements for work. Conference shall be arranged by Contractor and shall be planned sufficiently in advance of work to allow required attendees adequate notice (one week minimum) to make arrangements to attend.
- B. Notify Architect/Engineer 72 hours minimum prior to commencement of Indicator pile installations and prior to commencement of initial production pile excavation

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Reinforcing Steel: ASTM A615 GR. 60 deformed bars, specified in Division 03 – Concrete Reinforcing. No lap splices allowed. If splicing is required, use mechanical sleeve type coupler, capable of developing 125% of bar yield strength.

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- B. Grout: Flowable grout consisting of a mixture of Portland Cement, sand, water, fluidifier, and admixtures to produce a suitable grout for pumping under pressure. Capable of maintaining the solids in suspension without appreciable water gain. Grout must be able to penetrate and fill augered hole and shall comply with following requirements:
1. Compressive Strength: 5000 psi minimum at 28 days, unless specified as higher on Drawings.
 2. Portland Cement: Type II ASTM C150 – Soils on site are considered to have high corrosion potential for subgrade concrete.
 3. Fly Ash: ASTM C618, Class C or F. 20 percent maximum (by weight) of total cementitious materials in mix.
 4. Minimum Cement Content: 893 lbs per cu. yd. of grout, unless otherwise approved.
 5. Fluidifier: Fluidifier shall be a compound possessing characteristics which will increase fluidity of mixture, reduce bleeding, assist in dispersal of cement grains, and neutralize setting shrinkage of high-strength cement grout. Fluidifier shall meet requirements of ASTM Designation C494 and shall be approved prior to use on project.
 6. Water: ASTM C94, paragraph 4.1.3.
 7. Fine Aggregate: ASTM C33, natural sand, manufactured sand, or a combination thereof. Sand shall be washed and screened consisting of hard, dense, durable, uncoated rock particles free of silt, loam, lumps, soft or flaky particles, shale, alkali, organic material, mica, or other deleterious substances. If washed, washing method shall be such as will not remove desirable fines, and sand shall subsequently be permitted to drain until residual-free moisture is reasonable uniform and stable. Sand shall be well graded from fine to coarse with a fineness modulus between 1.80 and 3.40.
 8. Mineral Filler: Mineral filler, if used, shall be finely powdered siliceous material which possesses property of combining with lime liberated during process of hydration of Portland Cement, and shall conform to ASTM Designation C618. Mineral filler shall not exceed 15 percent (by weight) of total Portland Cement content.
- C. Accessories: Support and alignment accessories to facilitate alignment and spacing of steel reinforcing in pile. Specific type of centralizer(s) provided by Specialty Contractor. Subject to review/approval by Architect/Engineer. Submit for approval in accordance with paragraph 1.5.F above. Maximum spacing between centralizers shall be 10'-0".

PART 3 - EXECUTION

3.1 EXCAVATION FOR PILE INSTALLATION

- A. Piles may be installed when earthwork in area which piles are to occupy has been partially completed, as follows:
1. Excavations: Earth excavation will be stopped at an elevation of 6" to 12" above top of pile caps before piles are installed. Final excavation of required elevation of pile caps bottoms will be done as part of earthwork for buildings, after piles have been drilled, grouted, and have reached design strength.
 2. Fills: Fills will be constructed and compacted to elevation of grade indicated.

3.2 PILE AND PILE CAP ORIENTATION

- A. Orient piles, pile groups, and pile caps as shown on drawings unless altered orientation is unavoidable due to existing conditions, rejected pile, etc.

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- B. If reorientation is unavoidable, submit proposed change in orientation to Architect for approval prior to work.

3.3 INSTALLATION

A. General:

1. Piles shall be installed under observation of Owner's Geotechnical Engineer to elevations shown on drawings.
2. Report any unusual occurrences observed during pile drilling and installation to Geotechnical Engineer and Architect.
3. Installation on same working day, including drilling, of adjacent piles within six (6) pile diameters center-to-center of freshly grouted pile shall not be permitted while fresh grout is plastic and not hardened sufficiently to prevent damage by installation of additional piles. Minimum period to elapse between placement of adjacent piles as described above is 12 hours, but shall not operate to relieve Contractor of Specialty Contractor from responsibility for maintaining integrity of completed piles.
4. Fit augers with cutting teeth as required to penetrate anticipated subsurface elements.
5. Plumb leads and casing before drilling.

B. Drilling Piles:

1. Piles shall be placed by rotating a continuous flight hollow shaft auger into the foundation soil to a predetermined depth or "auger refusal" into the more competent material as defined by the Geotechnical Engineer.
2. Drill into below grade rock/soil/sand stratum to specified pile tip elevation.
3. Should a pile meet refusal at a tip elevation significantly above the tip elevation shown on drawings, Architect/Engineer may require an additional pile be installed which may require revisions to pile cap size and reinforcing steel. Do not proceed with pile cap construction until notified in writing by Architect.
4. Drilling Tolerances: Drill piles within following maximum tolerances:
 - a. Location: Within 3" of location indicated for center of gravity of each single pile of pile groups; 1" for single/isolated piles.
 - b. Plumbness: Vertical shafts shall not be allowed to deviate more than two percent (2%) out of plumb for entire depth, not to exceed 6 in (150 mm).

C. Casing:

1. Provide casing or bentonite slurry, or other means at drilled holes as necessary for drilling and to prevent water intrusion and/or caving of sidewalls of hole.
2. Casing, if required, shall be slowly withdrawn in vertical direction (no rotation permitted) as pressure is applied to grout. Rate of extraction will be determined by field conditions.

- D. Install reinforcing steel in pile(s) as required by drawings. Center reinforcing steel and maintain required spacing by use of approved centralizers. Refer to paragraph 2.2.C above.

- E. Check grout level periodically to insure grout level does not fall below bottom of casing. Grout pressure shall be lowered or eliminated as required near surface to prevent damage to existing structures.

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3.4 DRILLING EQUIPMENT

- A. Equipment used by Specialty Contractor to drill holes for required piles shall be as required for specified pile sizes and anticipated subsurface conditions. Prior to actual installation of production piles, Contractor shall demonstrate that materials and equipment proposed for use are capable of installing production piles.
- B. Anticipated equipment required utilizes a hollow-stem continuous flight auger rotated into the ground, until planned tip depth or termination criterion is achieved. Hole through which high strength grout is discharged during pumping of grout into pile shall be located at bottom of auger head below cutting teeth.
- C. Augers over 40 ft (12 m) (if any) in length shall contain a middle guide.
- D. Auger-cast piling leads should be prevented from rotating by use of a stabilizing arm.
- E. Intent of this specification is to not specify specific equipment to be used by Specialty Contractor. Equipment shall have sufficient production capacity to not cause delay in the work.

3.5 MIXING/PUMPING GROUT

- A. Use only approved continuous mixing, pumping, and agitating equipment in preparation and handling of grout mix. Remove all oil or other rust inhibitors from mixing drums, stirring mechanism and other portions of equipment in contact with grout before mixers are used.
- B. Use screen no larger than 1/4 of an inch between mixer and pump or between mixer and agitator.
- C. Materials shall be accurately measured by volume or weight as they are fed into mixer. Order of placing materials into mixer shall be as follows:
 - 1. Water
 - 2. Admixture
 - 3. Other solids in order of increasing particle size.
- D. Quantity of water used shall be such as to produce grout having a consistency in accordance with ASTM C91.
- E. Time of mixing shall be not less than one minute. If agitated continuously, mortar may be held in mixer or agitator for a period not exceeding three (3) hours at temperatures below 70 degrees F. and for a period not exceeding two and one-half (2-1/2) hours at temperatures below 90 degrees F. Maximum grout temperature not to exceed 90 degrees F.
- F. Grout pump, pressure gage, and other equipment for pumping of grout shall be as required by Specialty Contractor to insure sufficient grout pressure and assist in determining volume of grout pumped into each pile. Following criteria shall be complied with:
 - 1. Pressure gauge shall be installed on grout pump close to pile rig and shall be positioned to permit easy observation by Geotechnical Engineer.
 - 2. A properly functioning mechanical counter shall be provided on grout pump to record number of pump strokes during installation of each pile.
 - 3. Grout pump shall be calibrated prior to initiation of production pile installation by pumping grout into container of known volume. Pump shall then be calibrated as often as deemed necessary by Geotechnical Engineer.

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- G. Anticipated grout volume required per pile is 1.2 to 1.5 times the calculated theoretical pile volume for proper pile installation, and shall be satisfactorily pre-planned by Contractor.
1. Grout factor for each pile should be determined during the Indicator Pile Program.
 2. Grout factor obtained from successful Test Piles will serve as the minimum criterion for grout volume of production piles. Production piles not meeting this requirement may be rejected, and if rejected, shall be re-drilled and re-grouted immediately. Re-drilling of an individual pile may be required or waived by Geotechnical Engineer during installation of the production piles based on subsurface conditions at a specific location.
- H. Grouting
1. Grout shall not be pumped into piles after period of 2 hours from time of batching. If grout temperature exceeds 90 degrees F., reduce period to 1 ½ hours.
 2. Positive grout pressure shall be observed prior to initiating auger withdrawal. Maintain positive grout pressure of 100 psi minimum during auger withdrawal.
 - a. Withdraw auger slowly and smoothly to maintain positive grout pressure at all times.
 - b. The rate of extraction and rotation of auger during grouting process will be determined and monitored by Geotechnical Engineer, until grout is observed flowing out top of hole.
 3. High strength grout shall be injected through the auger shaft as the auger is being withdrawn. The grout shall be pumped with sufficient pressure as auger is slowly withdrawn to fill augered hole, preventing hole collapse and to cause lateral penetration of grout into any soft or porous zones of surrounding soils.
- I. If installation process of pile is interrupted or a loss of grouting pressure occurs, pile shall be rejected, and re-drilled to original depth and re-grouted, unless otherwise approved by Geotechnical Engineer.
- J. Subsidence of fresh grout of up to 2 feet may occur at top of piles as result of weight of grout column pushing laterally into pores of soil layers.
1. Subsidence, if occurs, is anticipated within period of 2 hours following grouting operation.
 2. If subsidence occurs while pile grout is in fluid state (generally within 2 hours), the pile shall be topped immediately with fresh grout to proper cut-off elevation.
 3. Contractor and pile installation personnel shall closely monitor pile grout levels to address subsidence within 2 hour period. Piles subsiding more than 2 feet after 2 hour period or overnight shall be evaluated by Geotechnical Engineer and Architect on individual basis.
- K. Where reinforcing steel is required, reinforcement shall be installed while the grout is fluid, but no longer than 20 minutes from completion of grouting.

3.6 PILE TOPS

- A. Contractor should consider placement of temporary metal sleeves of proper diameter thru existing fill zones placed around top of the pile to prevent contamination by foreign material and loss of grout. Length as required to seal off possible contaminants and to control grout volume.
- B. When pile cutoff elevation is below existing ground surface, metal casing of proper diameter shall be placed around pile tops and extend above existing ground surface. Casing shall prohibit loose material from falling onto pile top.

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- C. Vertical reinforcement shall extend above top of pile, (into cap, column, or wall above), as shown by drawings.

3.7 FIELD QUALITY CONTROL

- A. Owner will employ a qualified independent testing agency to perform the following testing, including special inspections required by local building code. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.
- B. Grout Mix Designs (review and comment).
- C. Pile Installation:
 - 1. Geotechnical Engineer will make continuous on-site inspections during installation of each pile. Full-time inspection shall be as follows:
 - a. Monitor installed diameter, length and location as shown on drawings.
 - b. Monitor depth of drilling and determine that proper pile tip elevation is achieved to obtain full pile capacity.
 - c. Confirm that pile has been drilled plumb within specified tolerances along total length.
 - d. Verify size, number, length, projection length, location, and cover of reinforcing steel in pile.
 - e. Verify use of centralizers for reinforcing steel in pile.
 - f. Monitor and record amount of grout pumped, volume factor (ratio of actual volume grout pumped to nominal calculated volume) and rate of casing withdrawal.
 - g. Additional integrity testing shall be performed on quantity of piles as required by the GEOR. Locations shall either be chosen at random, piles with questionable installations or depths, or where required by the GEOR. Confirm procedure with GEOR.
- D. Grout Testing:
 - 1. Grout in piles shall be tested as follows:
 - a. Secure sample(s) of batched grout. Each sample shall be obtained from different batch of grout on random basis, avoiding selection of test batch other than by number selected at random before commencement of grout placement.
 - b. Mold and cure six (6) 2 in (50 mm) cube specimens in accordance with ASTM Standard Designation C 109. The frequency shall be a minimum of two (2) sets per day for each grouting rig initially, and then one (1) set per day for each grouting rig after Geotechnical Engineer determines the grout mix is consistent and adequate. These six specimens represent one (1) strength test.
 - c. Two (2) cube specimens shall be tested at seven (7) days for information and two (2) cube specimens shall be tested at 28 days for strength acceptance. Acceptance test results shall be average of strengths of two specimens tested at 28 days.
 - d. Remaining two (2) cube specimens shall be held for testing at a later time, if required, as determined by Engineer.
 - e. Make at least one strength test for each day of pile installation, but, not less than one strength test for every fifty (50) cu. yd. of grout batched or fraction thereof.
 - f. Inspect visually each batch of grout to assure consistency batch to batch and make additional strength test(s) whenever consistency appears to vary by visual observation.
- E. Furnish complete Auger cast Pile Foundation Log showing following information:
 - 1. Project name and number.

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2. Name of Specialty Contractor.
3. Pile location tied into project grid line designations and a unique identification number.
4. Date that pile was installed.
5. Dimensions of pile, including diameter of auger, and drilled hole size.
6. Elevation of grade.
7. Elevation of pile tip (bottom).
8. Elevation of top of pile immediately after grouting.
9. Length of pile.
10. Start time, completion time, and interruptions for drilling and grouting operations (if any).
11. Stroke count of grout pump and stroke volume.
12. Volume factor (actual grout volume divided by nominal calculated grout volume).
13. Range of grouting pressure.
14. Grout temperature.
15. Grout ticket number or batch number.
16. Grout dispatch time and time of grout arrival on site.
17. Start time of grouting.
18. Finish time of grouting.
19. Reinforcing steel, including size, quantity, and confirmation of spacing and extension above top of pile.
20. Any other pertinent information or unusual occurrences during pile installation.

3.8 SURVEY OF AUGERCAST PILES

- A. After installation of piles is completed and before any concrete for caps is poured, Contractor shall provide Architect and Geotechnical Engineer with a survey showing actual location of each pile. Contractor shall not proceed until Architect and Geotechnical Engineer has reviewed survey.

3.9 CLEAN-UP

- A. Upon satisfactory completion of installation, all equipment, frames, loading platforms, reaction piles, Test Pile cut-off segments and other material related to work specified here- in shall be removed from the Owner's property. Salvaged materials shall be property of Contractor.

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SECTION 321313

CONCRETE PAVING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Provisions established within the General and Supplementary General Conditions of the Contract, Division 1 - General Requirements, and the Drawings are collectively applicable to this Section.

1.02 SUMMARY

- A. Section Includes: New concrete walks, curbs and gutters, paving, approaches, and other concrete flatwork outside the building.
- B. Related Sections:
 - 1. Section 310000 - Earthwork
 - 2. Section 033000 - Cast-in-place Concrete
 - 3. Section 321373 - Sealants and Caulkings

1.03 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. ACI 301 - Specifications for Structural Concrete for Buildings.
 - 2. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete.
 - 3. ACI 305 - Recommended Practices for Hot Weather Concreting.
 - 4. ACI 306 - Recommended Practices for Cold Weather Concreting.
- B. American National Standards Institute/American Society for Testing and Materials (ANSI/ASTM):
 - 1. ANSI/ASTM D1752-84 - Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
- C. NCTOG - Standard Specifications for Public Works Construction.

1.04 QUALITY ASSURANCE

- A. Codes and Standards: Comply with the applicable provisions of the following codes, specifications, and standards:
 - ACI 301 "Specifications for Structural Concrete for Buildings."
 - ACI 304 "Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete."
 - ACI 311 "Recommended Practice for Concrete Inspection."
 - ACI 318 "Building Code Requirements for Reinforced Concrete."
 - ACI 347 "Recommended Practice for Concrete Formwork."
 - Concrete Reinforcing Steel Institute, "Manual for Standard Practice."
- B. Workmanship: Contractor is responsible for correction of concrete work which does not conform to the specified requirements, including strength, tolerance, and finishes. Correct deficient unsatisfactory concrete as directed by the Engineer. All pavement replacement shall be a minimum of ½ panel.
- C. Perform work in accordance with ACI 301.
- D. Obtain materials from same source throughout.
- E. City Standards: Street sidewalks, curbs and gutters, and approaches shall be constructed to meet

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or exceed the requirements of the city standard specifications (or NCTCOG) where the city standards are applicable.

1.05 SUBMITTALS

- A. Submit product data under provisions of SECTION 013323 – Shop Drawings, Product Data, and Samples. And SECTION 012300 – Alternates.
- B. Include data on joint filler, admixtures and curing compounds.
- C. Submit manufacturer's instructions under provisions of SECTION 013323 – Shop Drawings, Product Data, and Samples and SECTION 012300 - Alternates
- D. Provide field samples of surface textures specified for Engineer approval prior to beginning work.

1.06 ENVIRONMENTAL REQUIREMENTS

- A. Do not place pavement when base surface or ambient temperature is less than 40°F, or if base surface is wet or frozen.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Formwork shall meet the requirements specified in SECTION 031100 - CONCRETE FORMING.
- B. Reinforcement shall meet the requirements specified in SECTION 032000 - CONCRETE REINFORCING. ASTM A 615, Grade 60.
- C. Concrete shall meet the requirements specified in SECTION 033000 - CAST-IN-PLACE CONCRETE. Portland Cement: ASTM C 150 Type I Domestic manufacturer. Use only one brand of cement throughout the project. Minimum compressive strength shall be 3,600 psi at 28 days. Provide entrained air of 5% (±1%) ASTM C260 with a maximum water cement ratio of 0.50.
- D. Expansion Joints:
 - 1. Redwood expansion for joints to be caulked with sealant and joints in architectural concrete flatwork.
- E. Normal Weight Aggregates: ASTM C 33
 - 1. Fine Aggregate: Clean, sharp, natural sand free from loam, clay, lumps, or other deleterious substances.
 - 2. Coarse Aggregate: Clean, uncoated, processed aggregate containing no clay, mud, loam, or foreign matter, as follows:
 - a. Crushed stone processed from natural rock or stone.
 - b. Washed gravel, either natural or crushed. Use of pit or bankrun gravel is not permitted.
 - c. Maximum Aggregate Size: 1½".
- F. Water: Clean, fresh, free from oil, acid, organic matter, or other deleterious substances.
- G. Air-Entraining Admixture: ASTM C 260.
- H. Fly ash and calcium chloride or admixture containing more than 0.1% chloride ions are not permitted.
- I. Supports for reinforcement: Provide supports for reinforcement-plastic chairs and fastening reinforcing in place. Wood, brick, and other devices will not be acceptable.

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2.02 RELATED MATERIAL

- A. Membrane-Forming Curing Compound: ASTM C309, Type I.
- B. Bonding Compound: Polyvinyl acetate or acrylic base, rewettable type.
Product/manufacturer; one of the following:
Weldcrete; Larsen Products
EucoWeld; Euclid Chemical Co.
Sonocrete; Sonneborn-Contech
Acrylic Bondcrete; The Burke Co.

2.03 PROPORTIONING AND DESIGN OF MIXES

- A. Prepare design mix for concrete, to produce a minimum 28-day compressive strength of 3,600 psi, as indicated on Contract Documents. Use an independent testing facility acceptable to the Architect for preparing and reporting proposed mix designs.
- B. Proportion mixes by laboratory trial batch, using materials to be employed on the project for each class of concrete required, complying with ACI 211.1.
- C. Submit written reports to the Architect of each proposed mix for each class concrete at least 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed by the Architect/Engineer.
- D. Admixtures:
 - 1. Use air-entraining admixture in exterior exposed concrete. Add air-entraining admixture at the manufacturer's prescribed rate to result in concrete at the point of placement having air content of 5% ($\pm 1\%$) with a maximum water cement ratio of 0.50.
- E. Slump Limits: Proportion and design mixes to result in concrete slump at the point of placement of not less than 3" and not more than 5".

2.04 CONCRETE MIXING

- A. Ready-Mix Concrete: Comply with the requirements of ASTM C94, and as herein specified. No additional water to be added to the batch for material with insufficient slump with approval of Architect/Engineer.
 - 1. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C 94 may be required. When the air temperature is between 85° F and 90° F, reduce the mixing and delivery time from 1-2 hours to 75 minutes, and when the air temperature is above 90° F, reduce the mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Verify compacted subgrade is ready to support paving and imposed loads, free of frost, smooth and properly compacted.
- B. Verify gradients and elevations of base are correct, and proper drainage has been provided so that water does not stand in the area to receive paving.
- C. Beginning of installation means acceptance of existing conditions.

3.02 PREPARATION

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- A. Verify subgrade meets specified moisture, density and composition specified no longer than two days before concrete placement.
- B. Moisten base to minimize absorption of water from fresh concrete.
- C. Notify Architect, Owner, and testing laboratory, minimum 24 hours prior to commencement of concreting operations.
- D. Grade Control: Establish and maintain the lines and grades for concrete site work items by means of lines and grade stakes. Complete any fine grading required to prepare the subgrade. Maintain the finished subgrade cushions in a satisfactory condition.
- E. Ensure all irrigation and electrical sleeves are installed prior to concrete placement.

3.03 INSERTS AND ACCESSORIES

- A. Make provisions for installation of inserts, accessories, anchors, and sleeves.

3.04 INSTALLATION

- A. Forming: Set forms to lines and grades, and brace and secure to withstand wet concrete without deflection or leakage. Stake forms securely in position with joints keyed to prevent relative displacement. Clean and oil forms each time they are used. Refer to SECTION 03 11 00 - CONCRETE FORMING for additional installation requirements. Place concrete in thicknesses scheduled below:
 - 1. Walks: As shown on paving plan; as detailed.
 - 2. Curbs and Gutters: As detailed.
 - 3. Drive Approaches and Drive Pavement as detailed.
 - 4. Miscellaneous: Catch basins and other miscellaneous items of concrete shall be constructed to detail.
- B. Reinforcing: Install reinforcing to meet the requirements of SECTION 032000 - CONCRETE REINFORCING. Where reinforcement is not specifically detailed, reinforce paving and walks with #4 rebar at 12" o.c. each way.
 - 1. Comply with the specified codes and standards, and Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars," for details and methods of reinforcement placement and supports.
 - 2. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials which reduce or destroy bond with concrete.
 - 3. Accurately position, support, and secure reinforcement against displacement by formwork, construction, or concrete-placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers.
 - 4. Place reinforcement to obtain the minimum coverage for concrete protection. Arrange, space and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.
- C. Concrete: Place concrete to meet the requirements of SECTION 033000 - CAST-IN-PLACE CONCRETE.
 - 1. Place concrete in accordance with ACI 301 and 304. Deposit concrete so that specified slab thickness will be obtained after vibrating and finishing operations. Minimize handling to prevent honeycombs. Exercise care to prevent disturbance of forms and reinforcing and damage to vapor retarder. Place concrete to lines and levels shown, properly sloped to drain into adjacent yard areas or drainage structures.
 - 2. Hot Weather Placement: ACI 305.

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3. Cold Weather Placement: ACI 306.
 4. Ensure reinforcement, inserts, embedded parts, and formed joints are not disturbed during concrete placement.
 5. Place concrete continuously between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.
- D. Expansion Joints: Locate expansion joints around fixed objects within or abutting concrete, and at intervals of not more than 30 ft. o.c. along walks and curbs and max of 90 ft. o.c. along all other paving.
1. Install preformed filler with the top edge approximately 1/4" below the finished concrete surface to leave a neat, straight joint.
 2. Joint edges shall be rounded with an edging tool.
 3. There shall be no connection by reinforcement or keyway across expansion joints. Joints shall be held in alignment with sleeved, smooth dowels.
 4. Install expansion joints at all point of curvatures, point of tangency, structuring and point of inflections.
- E. Scoring: Provide all tooled joints on all sidewalks and flatwork.
1. Saw cut, approaches, and paving using an abrasive or diamond blade. Cut joint width shall be 1/8" and depth shall be 1/4" deep at walks and 1/4 slab thickness at approaches and paving. Cutting of joints must be done as soon as concrete surface is firm enough not to be torn or damaged by the blade (within 4 to 12 hours), and before random shrinkage cracks can form in the concrete slab.
 - a. Tool joint walks at max 5-foot intervals each way.
 - b. Score curbs and gutters at approximately 5-foot intervals.
 - c. Score approaches and paving at max 12-foot intervals each way or as shown.
- F. Standard Finishing: Strike slabs off true by double screeding to the required level at or below the elevations and grades shown on the drawings. Set edge forms and screed strips accurately to produce the designated elevations and contours.
1. Standard Walks: Float with wood floats to true planes with no coarse aggregate visible. Hand trowel to produce smooth surfaces. Brush surfaces with a soft fiber brush to produce a uniformly striated finish. Edge concrete surfaces with a rounded edging tool.
 2. Curbs and gutters: Finish the curb and flow lines of gutters with a steel "S" shaped trowel to the contour of the curb and gutter and then cross brush surfaces with a soft fiber brush to produce a fine brush finish.
 3. Approaches: Screed and float to a monolithic medium float finish and belt with a canvas belt to produce a herringbone texture finish.
 4. Non-Slip Broom Finish: Apply non-slip broom finish to exterior concrete platforms, steps, and ramps. Immediately after trowel finishing, slightly roughen surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.
- G. Curing:
1. Cure concrete 7 days as specified in SECTION 033000 - CAST-IN-PLACE CONCRETE. Coat exposed surfaces with curing compound and protect surfaces from pedestrian and vehicular traffic during the curing period. Damaged areas shall be re-sprayed.
 2. Concrete surfaces designated to receive chemical stain must be free of curing compound. Accordingly, finished concrete shall be "water-cured" or shall be completely sandblasted if cured with a curing compound membrane.
 3. Concrete surfaces shall be cured by application of curing compound. Provide membrane curing by applying membrane-forming curing compound to damp concrete surfaces as soon as water film has disappeared. Apply uniformly in 2-coat continuous operation by power-spray equipment in accordance with manufacturer's directions. Apply second coat

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at right angle to first coat.

- H. Removing Forms: Forms shall remain in place for a least 12 hours after concrete has been placed and finished. Remove forms without damaging the concrete. Bars and heavy tools shall not be used to pry against the concrete in removing the forms.

3.05 FIELD QUALITY CONTROL

A. Grade and Smoothness Tests:

1. Plan Grade: Finished surface of the flatwork shall not vary more than 0.02 ft. above or below the plan grade or elevation. Finished surfaces of abutting pavement and walks shall coincide at their juncture. Where a new pavement or walk abuts an existing surface, transition pavement or walk strip shall be installed.
2. Surface Smoothness: Finished surface of the flatwork shall have no abrupt changes or more than 1/8" and shall not deviate from the testing edge of a 12 ft. straight edge more than 1/4" plus or minus tolerance. Flow line of gutters shall not deviate from the testing edge of a 10 ft. straight edge more than 1/8" plus or minus tolerance.
3. Concrete shall be sampled and tested for quality control during the placement of concrete, as follows:
 - a. Slump: ASTM C 143: One test for each concrete load at point of discharge; and one for each set of compressive strength test specimens.
 - b. Compression Test Specimens: ASTM C 31; one set of 4 standard cylinders for each compressive strength test. Mold and store cylinders for laboratory cured test specimens.
 - c. Compressive Strength Tests: ASTM C 39; one set for each 100 cu. Yds. or fraction thereof, of each concrete class placed in any day or for each 5,000 sq. Ft. of surface area placed; 1 specimen tested at 7 days, 2 specimens tested at 28 days and the remaining specimen held for future testing, if required. Report test results in writing to the Architect and the Contractor on the same day that tests are made. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of contractor, name of concrete type and class, location of concrete batch in the structure, design compressive strength at 28 days, concrete mix proportions and materials; compressive breaking strength and type of break for both 7-day test and 28-day tests.

- B. Additional Tests: The testing service will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained. Test to determine adequacy of concrete will be by cored cylinders complying with ASTM C 42. Contractor shall pay for such test conducted, and any other additional testing as may be required, when unacceptable concrete is verified.

- C. Concrete shall meet the compressive strength as shown on the plans and specifications regardless of ACI 318. ACI 318 shall have no bearing on pass/fail of all site concrete.

3.06 CLEANING

- A. Remove debris, scraps, surplus materials, tools, and equipment from the premises upon completion of the work. Clean concrete droppings from walks and curbs. Leave the graded areas free of debris and rubble.

3.07 PROTECTION

- A. Immediately after placement, protect concrete under provisions of SECTION 01 50 00 – TEMPORARY FACILITIES AND CONTROLS from premature drying, excessive hot or cold temperatures, and mechanical injury.

3.08 CONCRETE SURFACE REPAIRS

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- A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removal of forms, but only when acceptable to the Architect/Engineer. Remove and replace damaged concrete as directed by Engineer.
- B. Cut out honeycomb, rock pockets, voids over 1/2" diameter, and holes left by tie rods and bolts, down to solid concrete, but in no case to a depth of less than 1". Make edge of cuts perpendicular to the concrete surface. Before placing cement mortar, thoroughly clean, dampen with water and brush-coat the area to be patched with neat cement grout. Proprietary patching compounds may be used when acceptable to the Architect/Engineer.

END OF SECTION

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SECTION 321373

SEALANTS AND CAULKINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Provisions established within the General and Supplementary General Conditions of the Contract, Division 1 - General Requirements, and the Drawings are collectively applicable to this Section.

1.02 SUMMARY

- A. Section Includes: Sealing and caulking of joints.
- B. Related Sections:
 - 1. Section 321313 - Concrete Paving
 - 2. Section 033000 - Cast-In-Place Concrete

1.03 REFERENCES

- A. American National Standards Institute/American Society for Testing and Materials (ANSI/ASTM):
 - 1. ANSI/ASTM D1056 - Flexible Cellular Materials - Sponge or Expanded Rubber.
 - 2. ANSI/ASTM D1565 - Flexible Cellular Materials - Vinyl Chloride Polymers and Copolymers (Open-Cell Foam).
 - 3. ASTM C790 - Use of Latex Sealing Compounds.
 - 4. ASTM C804 - Use of Solvent - Release Type Sealants.
 - 5. ASTM C834 - Latex Sealing compounds.
 - 6. ASTM C920 - Elastomeric Joint Sealants.
 - 7. ASTM C962 - Use of Elastomeric Joint Sealers.
- B. Federal Specification (FS):
 - 1. FS TT-C-00598 - Caulking Compound, Oil and Resin Base Type.
 - 2. FS TT-S-001657 - Sealing Compound, Single Component, Butyl Rubber Based, solvent Release Type.
 - 3. FS TT-S-00227 - Sealing Compound: Elastomeric Type, Multi-Component.
 - 4. FS TT-S-00230 - Sealing Compound: Elastomeric Type, Single Component.
 - 5. FS TT-S-001543 - Sealing Compound, Silicone Rubber Base.
- C. Sealant, Waterproofing and Restoration Institute (SWR) - Sealant and Caulking Guide Specification.

1.04 SUBMITTALS

- A. Submit under provisions of Section 012300 Alternates and 013323 Shop Drawings, Product Data, and Samples.
- B. Submit product data indicating sealant chemical characteristics, performance criteria, limitations, color availability and application instructions.
- C. Submit two samples 1/4-inch diameter x 4 inches in size illustrating color selections available.
- D. Submit manufacturer's certificate under provisions of Section 012300 Alternates and 013323 Shop Drawings, Product Data, and Samples that products meet or exceed specified requirements.

1.05 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum 3 years documented experience.

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- B. Applicator: Company specializing in applying the work of this Section with minimum 3 years documented experience and approved by sealant manufacturer.
- C. Conform to SWR requirements for materials and installation.

1.06 FIELD SAMPLES

- A. Provide samples under provisions of Section 012300 Alternates and 013323 Shop Drawings, Product Data, and Samples.
- B. Construct one field sample joint, 5 feet long, illustrating sealant type, color, and tooled surface.
- C. Locate where directed.
- D. Accepted sample may remain as part of the Work.

1.07 PROJECT CONDITIONS

- A. Environmental Requirements: No caulking shall be done at temperatures below 40°F.

1.08 WARRANTY

- A. Furnish to the Owner a written warranty that the caulking shall remain watertight for a period of 2 years from the date of acceptance of the project. Joints which prove defective by leaking, cracking, melting or shrinking of the sealant shall be re-sealed without additional expense to the Owner.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Polyurethane (Type 2 Sealant):
 - 1. Two-part conforming to FS TT-S-00227E, Class A, Type I (self-leveling) and ASTM-920.
 - 2. Color: Custom color as selected by Architect.
 - 3. Acceptable products
 - a. Urexpan NR-00, Pecora Corp.
 - b. MasterSeal Paving Joint Sealant, Sonneborn-Contech.
 - c. THC 900 (Self leveling) or 901 (low sag), Tremco.
- NO SUBSTITUTIONS

2.02 ACCESSORIES

- A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.
- B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
- C. Joint Backing: Refer to Section 321313 Concrete Paving for expansion joint filler.
- D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces and joint openings are ready to receive work and field measurements are as shown on Drawings and recommended by the manufacturer.

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- B. Beginning of installation means installer accepts existing substrate.

3.02 PREPARATION

- A. Joint surfaces shall be clean and dry. Remove loose mortar and other material completely with compressed air or by brushing.
1. Joints to be caulked shall be at least 1/4" wide. At any point where the width of the joint is appreciably less, cut or grind out the joint to that width to assure an adequate volume of sealant along the length of the joint.
 2. Pack with backing material the voids and recesses around metal frames which are deeper than the depth required for caulking. Leave the proper depth for the sealant.
 3. Particular attention shall be paid to the preparation of horizontal joints in wall surfaces to be filled with sealant. Adjust joint depth to comply with sealant manufacturer's recommendations by malleting down the joint filler or filling in with rod stock as may be required.
 4. Perform preparation in accordance with ASTM C804 for solvent release sealants, C790 for latex base sealants, and C962 for elastomeric sealants

3.03 APPLICATION

- A. Priming: prime porous joint surfaces, particularly concrete. Test the primer to make sure it causes no staining of the material on which it is applied.
- B. Depth of sealant: Seal joints to a depth of approximately 2" the joint width, but never less than 1/4" deep. Follow the sealant manufacturer's recommendations where possible.
- C. Apply the sealant in accordance with the manufacturer's instructions.
1. Force the sealant into joints with enough pressure to expel all air and provide a solid filling. Correct any flowing or sagging before final inspection is made.
 2. Where adjacent surfaces permit, use masking tape to obtain straight, even lines. Remove tape immediately after the joints have been sealed.
 3. Fill joints flush with adjacent surfaces except where a recessed joint is specifically detailed. Tool beads with a sled runner or similar tool to insure full contact with joint faces.
 4. For caulking horizontal joints in wall surfaces, use a gun with a narrow nozzle. Apply the flow type sealant with the nozzle riding along the bottoms so that the sealant is forced up to completely fill the slot without cavities. Provide and use a portable vacuum cleaner to remove loose dirt from the joints just ahead of the caulking gun.
- D. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- E. Tool joints concave. Sealant shall achieve a firm skin before surface coating is applied.

3.04 CLEANING/REPAIRING

- A. Clean adjacent surfaces of soiling due to caulking operations. This applicator shall be responsible for and shall bear the cost of replacing any material damaged or discolored due to caulking operations.
- B. Repair or replace defaced or disfigured finishes caused by work of this Section.

3.05 SEALANT SCHEDULE

- A. Locations specified below for sealant required under this section are general and shall not be considered as affecting the required use of sealing compounds specified under other sections of the specifications.

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3.06 SEALANT TYPE APPLICATION

- A. Horizontal control and expansion joints in concrete paving and at junctures between this material and other adjacent materials.

END OF SECTION

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SECTION 321715
PARKING ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Work required for this section includes parking accessories and supplementary items necessary to complete their installation for the following:
 - 1. Pavement markings.
 - 2. Concrete wheel stops
 - 3. Speed bumps.
 - 4. Overhead clearance bars.
 - 5. Traffic control and safety signs.
 - 6. Convex surveillance mirrors.
- B. Related Section: Division 11 Section "Parking Control Equipment" for parking gates and control equipment.

1.2 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
 - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
 - 2. Pavement Markings: Include technical data and tested physical and performance properties.
- B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components and attachments to other work. Distinguish between shop and field-assembled work.
 - 1. Pavement Markings:
 - a. Indicate pavement markings, colors, lane separations, defined parking spaces, and dimensions to adjacent work.
 - b. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.
- C. Samples for Pavement Markings: For each exposed product and for each color and texture specified; on rigid backing, 8 inches (200 mm) square.

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer with experience with successful production of products and systems similar to scope of this Project, with a record of successful in-service performance and with sufficient production capability, facilities, and personnel to produce required Work.
- B. MPI Standards for Pavement Markings:
 - 1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
 - 2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" and "MPI Maintenance Repainting Manual" for products and paint systems indicated.

1.4 PRE-INSTALLATION CONFERENCE

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.

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1. Pavement Markings: Review methods and procedures related to marking pavement including, but not limited to, the following:
 - a. Pavement aging period before application of pavement markings.
 - b. Review requirements for protecting pavement markings, including restriction of traffic during installation period.

1.5 FIELD CONDITIONS

- A. Environmental Limitations for Waterborne Pavement Markings: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of **55 deg F (12.8 deg C)** for water-based materials, and not exceeding **95 deg F (35 deg C)**.
- B. Environmental Limitations for Alkyd Pavement Markings: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of **40 deg F (4.4 deg C)** for alkyd materials, and not exceeding **95 deg F (35 deg C)**.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND PRODUCTS

- A. Available Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, manufacturers offering products that may be incorporated into the Work include, but are not limited to, those listed.

2.2 PAVEMENT MARKINGS

- A. Waterborne Pavement Marking Paint:
 1. Asphalt Substrates: Comply with MPI System EXT 2.1A, MPI #97, latex traffic-marking paint.
 2. Concrete Substrates: Comply with MPI System EXT 3.2E, MPI #97, latex traffic-marking paint.
 3. Colors:
 - a. White: Parking stalls and direction markings.
 - b. Yellow: Pedestrian cross walks.
 - c. Red: Fire lanes.
 - d. Blue and White: Handicapped parking symbols.
 - e. Locations: As indicated on drawings.
- B. Alkyd Pavement Marking Paint:
 1. Asphalt Substrates: Comply with MPI System EXT 2.1B, MPI #32, alkyd traffic-marking paint.
 2. Concrete Substrates: Comply with MPI System EXT 3.2F, MPI #32, alkyd traffic-marking paint.
 3. Colors:
 - a. White: Parking stalls and direction markings.
 - b. Yellow: Pedestrian cross walks.
 - c. Red: Fire lanes.
 - d. Blue and White: Handicapped parking symbols.
 - e. Locations: As indicated on drawings.

2.3 CONCRETE WHEEL STOPS

- A. Concrete Wheel Stops: Precast, steel-reinforced, air-entrained concrete, **4000 psi (27.6 MPa)** minimum compressive strength, **4-1/2 inches (112 mm)** high by **9 inches (225 mm)** wide by **72 inches (1800 mm)** long. Provide chamfered corners, transverse drainage slots on underside,

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and a minimum of three factory-formed or -drilled vertical holes through wheel stop for anchoring to substrate.

1. Surface Appearance: Free of pockets, sand streaks, honeycombs, and other obvious defects. Corners shall be uniform, straight, and sharp.

B. Mounting Hardware:

1. Asphalt Substrates: Galvanized-steel spike or dowel, 1/2 inch (12 mm) diameter, 10 inch (250 mm) minimum length.
2. Concrete Substrates: Galvanized-steel lag screw, shield, and washers; 1/2 inch (12 mm) diameter, 8 inch (200 mm) minimum length.

- C. Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class and grade to suit requirements.

2.4 SPEED BUMPS

- A. Speed Bumps: Solid, integrally colored, 96 percent postconsumer or commingled postconsumer and preconsumer recycled rubber or plastic; UV stabilized. Provide factory-formed or -drilled vertical holes for anchoring to substrate.

1. Size: 2 inches (50 mm) high by 10 inches (250 mm) wide by 72 inches (1800 mm) long; with tapered, square, or rounded ends.
2. Color: Black.
3. Embedded Markings: Molded-in, yellow reflective markings, permanently inset in exposed surface.

B. Mounting Hardware:

1. Asphalt Substrates: Galvanized-steel spike or dowel, 1/2 inch (12 mm) diameter, 10 inch (250 mm) minimum length.
2. Concrete Substrates: Galvanized-steel lag screw, shield, and washers; 1/2 inch (12 mm) diameter, 8 inch (200 mm) minimum length.

- C. Adhesive: As recommended by device manufacturer for adhesion to pavement.

2.5 OVERHEAD CLEARANCE BARS

- A. Refer to Sign Graphic Consultant Documents.

- B. Pipe: Provide 4 inch (100 mm) diameter piping of one the following materials:

1. PVC: ASTM D 3034, PVC sewer pipe, painted.
2. Aluminum: ASTM B 429 (ASTM B 429M), Alloy 6063-T6; mill finish.

- C. Chain: ASTM A 413, Grade 30 Carbon steel chain, 1/4 inch (6 mm) nominal size.

- D. Supports: 1/4 inch (6 mm) galvanized steel eye bolt and expansion anchors for concrete.

2.6 TRAFFIC CONTROL AND SAFETY SIGNS

- A. Compliance Standard: Provide traffic control and safety signage compliant with Manual on Uniform Control Devices (MUTCD) and with state highway standards of Project location where applicable.

- B. Traffic Control and Safety Signage: Provide message signs (STOP, YIELD, DO NOT ENTER, SPEED LIMIT, ETC) as indicated on drawings.

- C. Parking for the Disabled Signage: Provide signage design as indicated on the drawings.

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2.7 CONVEX SURVEILLANCE MIRRORS

- A. Convex Surveillance Mirrors: Plexiglas, 26 inch (650 mm) diameter, outdoor round convex mirror, ABS backing.
- B. Manufacturer and Product: Meek Mirrors LLC; Model M1924.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

3.2 INSTALLATION, GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
 - 1. Respective manufacturer/fabricator's written installation instructions.
 - 2. Accepted submittals.
 - 3. Contract Documents.

3.3 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.

3.4 INSTALLATION OF PAVEMENT MARKINGS

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.
- B. Allow paving to age for a minimum of 30 days before starting pavement marking
- C. Sweep and clean surface to eliminate loose material and dust.
- D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils (0.4 mm).
 - 1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to pavement. Mask an extended area beyond edges of each stencil to prevent paint application beyond the stencil. Apply paint so that it cannot run beneath the stencil.

3.5 INSTALLATION OF CONCRETE WHEEL STOPS

- A. Install devices in bed of adhesive before anchoring.
- B. Securely anchor wheel stops to pavement with hardware in each preformed vertical hole in wheel stop as recommended in writing by manufacturer. Recess head of hardware beneath top of wheel stop.

3.6 INSTALLATION OF SPEED BUMPS

- A. Install devices in bed of adhesive before anchoring.

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- B. Securely anchor devices to pavement with hardware spaced as recommended in writing by manufacturer for heavy traffic. Recess head of hardware beneath top surface of device.

3.7 INSTALLATION OF OVERHEAD CLEARANCE BAR

- A. Mounting Height: Set horizontal pipe at maximum clearance as indicated on drawings.
- B. Support Mechanism: Support with steel chain of length required for clearance.
- C. Lettering: Paint with stencil, **2 inch (50 mm)** high lettering indicating maximum clearance as follows:
 - 1. Imperial Units: CLEARANCE X-FT X-IN
 - 2. Metric Units: CLEARANCE X-M
- D. Lettering: Stenciled; **2 inch (50 mm)** high; limiting height as indicated on drawings.

3.8 INSTALLATION OF TRAFFIC CONTROL AND SAFETY SIGNS

- A. Mounting Method: Set steel posts in **8 inch (200 mm)** diameter concrete footing **12 inches (300 mm)** deep unless indicated to be surface mounted.
- B. Mounting Height of Signage: As indicated on drawings.

3.9 INSTALLATION OF CONVEX SURVEILLANCE MIRRORS

- A. Mounting: Installation shall be fully adjustable for proper observation.

3.10 PROTECTING AND CLEANING FOR PAVEMENT MARKINGS

- A. Protect pavement markings from damage and wear during remainder of construction period.
- B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

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SECTION 321723

PAVEMENT MARKINGS

PART 1 - GENERAL

1.01 SCOPE

Provide all labor, materials, and equipment necessary to paint all parking stripes as indicated on the Drawings and as specified herein on concrete or asphalt paving.

1.02 PROTECTION

The Contractor shall protect his own work and adjacent surfaces from damage or splatters with suitable coverings. Take every precaution to avoid danger of fire. Remove oily rags, waste, and empty cans from site every night.

1.03 DELIVERY AND STORAGE

- A. Deliver materials in original containers with seals unbroken and labels intact.
- B. Store materials and equipment in an approved area. Store rags, paint, and solvents in closed metal containers located in designated area. Use adequate means and precautions to prevent fire, explosions and other damage caused by paint materials.

1.04 RELATED DOCUMENTS

- A. Provisions established within the General and Supplementary General Conditions of the Contract, Division 1 - General Requirements, and the Drawings are collectively applicable to this Section.

1.05 SUMMARY

- A. Section Includes: Pavement marking on concrete paving.

1.06 REFERENCES

- A. Aexcel Gorilla High-performance Acrylic Zone Marking Paint 22W-E008 (WHITE), 22Y-E006 (YELLOW), 22L-E004 (BLUE), 22A-E001 (BLACK), 22R-E007 (RED) and per City requirements, color for fire lanes.

1.07 PROJECT CONDITIONS

- A. Environmental Requirements: Apply paint per manufacture recommendations and when ambient temperature is 50°F or above, and relative humidity is below 85%.

1.08 QUALITY ASSURANCE

- A. Installer: Shall have a minimum of 2 years experience in the layout and striping of parking lots.
- B. Job Conditions: Do not apply marking paint when weather is foggy or rainy, or ambient or pavement temperatures are below 40°F, nor when such conditions are anticipated during eight hours after application.

1.09 SUBMITTALS

- A. Submit manufacturer's product data and installation instructions.
- B. Substitutions: Submit in accordance with of Section 01 23 00 Alternates and 01 33 23 Shop Drawings, Product Data, and Samples.

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PART 2 - PRODUCTS

2.01 MATERIALS

- A. Traffic Paint: Aexcel Gorilla high performance acrylic zone marking paint. Fire lane stripes shall be per City requirements. Provide Gorilla high performance acrylic zone marking paint as manufactured by Aexcel: Phone (800) 854-0782.
- B. Paint Schedule is as follows, see plans for locations and if required:

Parking Stall Stripes:	22W-E008 (White)
Handicap Parking Stripes	22W-E008 (White) & 22L-E004 (BLUE)
Crosswalks	22W-E008 (White)
Fire Lane Striping	22R-E007 (Red)
Lettering on yellow or white stripes	22A-E001 (Black)
Lettering on red or blue	22W-E008 (White)
- C. Cleaning Solvent: VM & P Naphtha.
- D. When striping must be removed from existing concrete paving (see Site Plan for possible locations), striping shall be water or sandblasted to expose the concrete beneath.

2.02 EQUIPMENT

- A. Applicators: Hand-operated push type marking machine or conventional airless spray equipment with guide lines and templates.

2.03 WORKMANSHIP

- A. All work shall be done by experienced, skilled craftsmen. All finishes shall be applied in accordance with manufacturer's printed directions. All finishes shall be applied evenly and be free from runs, skips or other defects.
- B. Do not apply paint during extremely hot weather or when air and/or surface temperature is below 50 degrees Fahrenheit or if rain is imminent.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Surface Conditions: Clean and dry free from dirt, loose paint, oil, grease, wax, and other contaminants.
- B. Concrete Surfaces: Allow concrete to cure a minimum of 90 days prior to application of marking paint.
- C. Existing Concrete and Asphalt Surfaces: Shall be swept clean of all debris, including grease.
- D. Equipment Condition: Clean previously used paint and solvent from application equipment, using VM & P Naphtha.
- E. Paint: Stir contents thoroughly from bottom of container. Do not thin paint.
- F. Locate markings as indicated on Drawings. Provide qualified technician to supervise equipment and application of markings. Lay out markings using guide lines, templates, and forms.
- G. Allow paving to cure before painting as required by manufacturer of traffic paint.
- H. Apply primer for all locations to receive paint.

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3.02 APPLICATION

- A. Two (2) coats minimum at the rate of 8.0 mils dry film thickness.
- B. Fire Lane Striping: Stripe fire lanes as shown on the plans and as required to meet City requirements.
- C. Directional Striping and Painting: Stripe and paint all directional stripes pavement markings.
- D. Stripes shall be 4" wide unless shown otherwise.
- E. Apply striping as shown on the drawings by power spray or other approved method.

3.03 CLEANING

- A. Upon completion of the work, remove all splatterings, spots and blemishes caused by this work. Remove all extra materials from the job site and leave buildings and grounds in neat, clean, and finished condition.

END OF SECTION

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SECTION 323113

CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.01 WORK INCLUDED

Furnish labor, materials, equipment, and incidentals necessary to install chain link fencing as indicated on the drawings and specified herein.

1.02 QUALITY ASSURANCE

Fence components shall be the standard products of the Cyclone Fence Division of U.S. Steel Company or approved equal. Manufacturer shall be a member of the Chain Link Fence Manufacturer's Institute. (CLFMI)

1.03 SUBMITTALS

A. Product Data: Submit in accordance with SECTION 013323 – Shop Drawings, Product Data, and Samples and SECTION 012300 – Alternates. Include manufacturer's Installation instructions.

1.04 STANDARDS

The applicable provisions of the following references and standards shall apply to this section as if written in their entirety.

A. AMERICAN SOCIETY OF TESTING AND MATERIALS (ASTM) STANDARDS:

- A 90 Tests for Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles
- A 120 Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Ordinary Use
- A 121 Zinc-Coated (Galvanized) Steel Barbed Wire
- A 569 Steel, Carbon Hot Rolled Sheet and Strip, Commercial Quality
- A 570 Hot Rolled Sheet and Strip, Structural Quality
- F 626 Fence Fittings
- F 900 Industrial and Commercial Swing Gates

1.05 DELIVERY AND STORAGE

A. Store products on platform raised above grade and cover with weather resistant coverings until erected.

1.06 JOB CONDITIONS

A. Visit the site and ascertain the conditions under which the fencing must be installed. Determine the soil conditions and provide drilling apparatus suitable for the existing conditions.

1.07 OPTIONS [Not Used]

1.08 GUARANTEE

A. Fence materials, workmanship and serviceability shall be guaranteed by the manufacture and the Contractor for one year.

PART 2 - PRODUCTS

2.01 MATERIALS

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- A. CHAIN LINK FABRIC: height per plan, 9-gauge, steel chain link wire, woven in a 2" mesh. Top and bottom salvages shall be knuckled. Aluminum coating shall be not less than 0.40 oz per sq. ft.
- B. TOP RAIL: 1-5/8" O.D. galvanized pipe, weight 2.27 pounds per foot, with outside sleeve-type couplings at least 7" long. Fabric shall be tied to the top rail at 24" centers with 9-gauge black PVC coated aluminum wire.
- C. LINE POSTS: 2-3/8" O.D. galvanized pipe, weight 3.65 pounds per foot, or Schedule 40 galvanized pipe. Fabric shall be tied to line posts with 6-gauge black PVC coated galvanized clips on 14" centers.
- D. TERMINAL POSTS: At ends and corners pull posts shall be 4" O.D. galvanized pipe, weight 9.12 pounds per foot. Posts shall be equipped with 1/4" x 3/4" tension bars, 11-gauge x 1" wide tension bands, and 3/8" carriage bolts, bands on approximately 14" centers.
- E. GATE POSTS: For the 4'-0" gates, posts shall be 4" Schedule 40 galvanized pipe.
- F. BOTTOM TENSION WIRE: No.7 galvanized spring coil or tension wire which shall hold fabric in proper alignment and be resilient so as to restore alignment when fabric is deflected.
- G. GATES: Having posts as specified above, with a frame of 2" O.D. galvanized pipe. Corner fittings shall be heavy malleable cast fittings. Hinges shall allow gates to swing 90 degrees outward. Gates shall be complete with a padlocking device, catches, and stops.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. The fence shall be installed by skilled and experienced fence erectors and on lines and grades established by the Engineer. Set posts in concrete a minimum of 9" in diameter and 36" deep. The complete fence shall discourage tampering with connections, and ends shall be secured to prevent easy removal or disconnecting.
- B. POST BRACES: Shall be provided for each gate, corner and end post for use when top rail is omitted consisting of a round tubular brace extending to each adjacent line post at approximately mid height of the fabric, and a truss consisting of a rod not less than 5/16 inch nominal diameter from the line post back to the gate, corner, pull, or end post, with a turnbuckle or other equivalent provision for adjustment.
- C. POST TOPS: Shall consist of ornamental top. When a top rail is to be provided, the top shall be provided with a hole suitable for the through passage of the top rail. The post tops shall fit over the outside of posts and shall exclude moisture from posts.
- D. TOP RAILS: Shall be in lengths not less than 18-feet and shall be fitted with couplings or wedged for connecting the lengths into a continuous run. The couplings shall be not less than 6 inches long, with .070 minimum wall thickness.

3.03 GATES

- A. Gates shall be swing type, complete with latches, stops, keepers, hinges. Swing gates shall conform to ASTM F-90.
- B. Gate Frames shall be constructed of tubular of members welded at all corners or assembled with fittings. Steel welds shall be painted with zinc-based paint. Where corner fittings are used, gates shall have truss rods of 5/16 inch minimum nominal diameter to prevent sag or twist.
- C. Gate Fabric shall be the same type as used in the fence construction. The fabric shall be attached securely to the edge frame at intervals not exceeding 15 inches.

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- D. Gate hardware shall include hinges, latches, stops and keepers. Hinges shall be heavy duty cast metal, clamped into position. Latches shall have plunger bar arranged to engage center stop and shall have arrangements for a padlock. Keeper shall consist of a mechanical device for securing the free end of gate in full open position.

END OF SECTION

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SECTION 323115
TUBULAR STEEL FENCING

PART 1 - GENERAL

1.1 SUMMARY

- A. Work of this Section includes tubular steel fencing and supplementary items necessary to complete the work required for their installation.

1.2 SYSTEM DESCRIPTION SUMMARY

- A. Fencing shall include necessary posts, fittings, fastenings and gates required for a complete and proper installation.

1.3 ACTION SUBMITTALS

- A. Product Data: Submit manufacturer's specifications to evidence compliance with these specifications.
- B. Shop Drawings: Submit fabrication details and erection drawings.
- C. Samples:
 - 1. Submit finished 12" long sections of posts, pickets and rails to indicate compliance with these specifications.
 - 2. Submit samples of post caps and other required accessories.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer with not less than 10 years of experience in the successful production and in-service performance of products and systems similar to scope of this Project.
- B. Installer Qualifications:
 - 1. Experience: Installer's personnel with not less than 5 years of experience in the successful performance of Work similar to scope of this Project.
 - 2. Supervision: Installer shall maintain a competent supervisor at Project while the Work is in progress, and who has not less than 5 years of experience installing products and systems similar to scope of this Project.
 - 3. Manufacturer Acceptance: Installer shall be certified, approved, licensed, or acceptable to manufacturer to install products.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND PRODUCTS

- A. **Acceptable Manufacturers and Products:** Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".
 - 1. Ameristar
 - 2. Monumental Iron Works
 - 3. Builders Fence Company, Inc.
 - 4. Delgard Aluminum Ornamental Fence
 - 5. Specrail

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- B. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other manufacturers offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.

1. Manufacturer and Series/Model Name: Monumental Iron Works "Estate" with flat top pickets, stile "L".

2.2 MATERIALS

- A. Pickets, Rails and Posts:

1. Not less than 16 gage metal, pregalvanized mild steel, formed into square or rectangular tubing with welded seams.
2. After welding, weld zone shall be zinc metalized.
3. Size(s) of pickets, rails and posts shall be as required for fence height.

- B. Gates:

1. Gates shall be pre-assembled.
2. Frame of gate shall be welded construction with neat full weld.
3. Hinges and locking device shall be of substantial and practical construction.

2.3 FABRICATION

- A. Pickets shall be fastened to rails with stainless steel rivets.
- B. Posts shall pre-drilled to accept rails.
- C. Rails shall be connected to posts with flat head aluminum drive rivets.
- D. Fence components shall be pre-assembled in standard 6'-0" sections.
- E. Finish:
1. The fence and components shall be factory finished with a thermosetting polyester powder applied by electrostatic spray and baked at 450 -500 deg. F.
 2. Finish color shall be as selected from manufacturers standard colors.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrate surfaces to receive fencing system and associated work and conditions under which work will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to installer. Starting work within a particular area will be construed as applicator's acceptance of surface conditions.

3.2 PREPARATION

- A. Prepare concrete curb to insure proper and adequate structural support for the fencing.
- B. Prepare substrate surfaces to insure proper and adequate installation, in accordance with the Contract Documents and approved Shop Drawings, or manufacturer's requirements.
- C. Field measure and verify dimensions as required.
- D. Protect adjacent areas or surfaces from damage as a result of the Work of this Section.

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3.3 INSTALLATION

- A. Install in accordance with manufacturer's latest published requirements, specifications, details and approved shop drawings.
- B. Posts and pickets shall be installed truly vertical and rails shall be parallel to finished grade.
- C. Posts shall be set in footings or sleeves as indicated.

3.4 ADJUSTING

- A. Adjust and leave Tubular Steel gate in perfect working order.

3.5 PROTECTION

- A. After installation, and until Owner acceptance the complete fence shall be retouched wherever paint has been scratched, abraded or otherwise damaged or removed. Retouching paint shall be polyester paint of the same formulation and color as that used for the original painting of the fence.

END OF SECTION

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SECTION 32 3115

ORNAMENTAL STEEL FENCING AND GATES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Decorative metallic-coated tubular ornamental steel fencing, gates, motorized operators, and supplementary items necessary for installation.

1.2 SYSTEM DESCRIPTION SUMMARY

- A. Fencing system shall include posts, rails, pickets, fittings, fastenings, gates, and motorized operators and activation system as necessary and required for a complete installation.

1.3 SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
 - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
- B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components and attachments to other work. Distinguish between shop and field-assembled work. Include gate swing and other required installation and operational clearances, hardware, and accessories. Indicate materials, dimensions, sizes, weights, finishes of components, and details of post anchorage and attachment and bracing.
- C. Installer Qualifications:
 - 1. Experience: Installer with not less than 5 years experience in performing specified Work similar to scope of this Project, with a record of successful in-service performance and completion of projects for a period of not less than 5 years, and with sufficient production capability, facilities, and personnel to produce required Work.
 - 2. Supervision: Installer shall maintain a competent supervisor who is at Project during times specified Work is in progress, and, who is experienced in installing systems similar to type and scope required for Project.
 - 3. Manufacturer Acceptance: Installer shall be certified, approved, licensed, or acceptable to manufacturer to install products.

1.4 PROJECT CONDITIONS

- A. Field Measurements: Verify layout information for ornamental steel fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

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1.5 COORDINATION

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND PRODUCTS

- A. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".
 - 1. Ameristar Fence Products, Montage Invincible Style.

2.2 MATERIALS, GENERAL

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

2.3 PERFORMANCE REQUIREMENTS

- A. General Performance: Products and systems shall be engineered to withstand loads within limits of allowable working stresses of the materials involved under conditions indicated and without permanent deformation or failure of materials.

2.4 MATERIALS

- A. Plates, Shapes, and Bars: ASTM A 36 / A 36M.
- B. Bars (Pickets): Hot-rolled, carbon steel complying with ASTM A 29 / A 29M, Grade 1010.
- C. Tubing: ASTM A 500, cold formed steel tubing.
- D. Bar Grating: NAAMM MBG 531.
 - 1. Bars: Hot-rolled steel strip, ASTM A 1011 / A 1011M, Commercial Steel, Type B.
 - 2. Wire Rods: ASTM A 510 / A 510M.
- E. Galvanized-Steel Sheet: ASTM A 653 / A 653M, structural quality, Grade 50 (Grade 340), with G90 (Z275) coating.
- F. Castings: Either gray or malleable iron unless otherwise indicated.
 - 1. Gray Iron: ASTM A 48 / A 48M, Class 30.
 - 2. Malleable Iron: ASTM A 47 / A 47M.

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2.5 DECORATIVE METALLIC-COATED TUBULAR ORNAMENTAL STEEL FENCING

- A. Product Standard: Comply with ASTM F 2408, for light industrial (commercial) application (class) unless otherwise indicated.
- B. Pickets, Rails and Posts:
 - 1. Formed from 0.108 in (2.74 mm) nominal thickness, metallic-coated steel sheet, formed into square or rectangular tubing with welded seams.
 - 2. After welding, weld zone shall be zinc metalized.
 - 3. Size(s) of pickets, rails, and posts shall be as required for fence height.
- C. Swing Gates: Gates shall be pre-assembled fully-welded construction.
 - 1. Hardware: Latches permitting operation from both sides of gate, hinges, and keepers for each gate leaf more than 5 ft (1.52 m) wide. Provide center gate stops and cane bolts for pairs of gates. Fabricate latches with integral eye openings for padlocking; padlock accessible from both sides of gate.
 - 2. Hinges: BHMA A156.1, Grade 1, suitable for exterior use.
 - a. Function: 39 - Full surface, triple weight, antifriction bearing.
 - b. Material: Wrought steel, forged steel, cast steel, or malleable iron.
 - 3. Cane Bolts: Provide for inactive leaf of pairs of gates. Fabricated from 1/2 in (12.7 mm) diameter, round steel bars, hot-dip galvanized after fabrication. Finish to match gates. Provide galvanized-steel pipe strikes to receive cane bolts in both open and closed positions.
 - 4. Finish exposed welds to comply with NOMMA Guideline 1, Finish #2 - completely sanded joint, some undercutting and pinholes okay.
- D. Post Caps: Formed from steel sheet and hot-dip galvanized after forming.
- E. Fasteners: Manufacturer's standard tamperproof, corrosion-resistant, color-coated fasteners matching fence components with resilient polymer washers.
- F. Galvanizing: For components indicated to be galvanized and for which galvanized coating is not specified in ASTM F 2408, hot-dip galvanize to comply with ASTM A 123 / A 123M. For hardware items, hot-dip galvanize to comply with ASTM A 153 / A 153M.

2.6 FABRICATION

- A. Pickets shall be fastened to rails with manufacturer's standard tamperproof, corrosion-resistant, color-coated fasteners.
- B. Posts shall pre-drilled to accept rails.
- C. Rails shall be connected to posts with manufacturer's standard tamperproof, corrosion-resistant, color-coated fasteners.
- D. Fence components shall be pre-assembled in standard 8 ft (2.4 m) sections.

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2.7 METALLIC-COATED STEEL FINISHES

- A. Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a zinc-phosphate conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas and repair galvanizing to comply with ASTM A 780.
- B. Powder Coating: Immediately after cleaning and pretreating, apply 2-coat finish consisting of zinc-rich epoxy prime coat and TGIC polyester topcoat, with a minimum dry film thickness of 2 mils (0.05 mm) for topcoat. Comply with coating manufacturer's written instructions to achieve a minimum total dry film thickness of 4 mils (0.10 mm).
 - 1. Color and Gloss: Black.
 - 2. Comply with surface finish testing requirements in ASTM F 2408 except change corrosion-resistance requirement to 3000 hours without failure.

2.8 CAST-IN-PLACE CONCRETE

- A. General: Comply with ACI 301 for cast-in-place concrete.
- B. Materials: Portland cement complying with ASTM C 150, aggregates complying with ASTM C 33, and potable water for ready-mixed concrete complying with ASTM C 94.
 - 1. Concrete Mixes: Normal-weight concrete with not less than 3000-psi compressive strength (28 days), 3-in slump, and 1-inch maximum size aggregate.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

3.2 INSTALLATION, GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
 - 1. Respective manufacturer's written installation instructions.
 - 2. Accepted submittals.
 - 3. Contract Documents.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by isolating metals and other materials from direct contact with incompatible materials.

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3.3 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.
- B. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 ft (152.5 m) or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.
- C. Protect adjacent areas or surfaces from damage as a result of the Work of this Section.

3.4 INSTALLATION OF TUBULAR STEEL FENCING

- A. Install fencing in accordance with manufacturer's latest published requirements, specifications, details, and accepted shop drawings.
- B. Posts and pickets shall be installed vertically and rails shall be parallel to finished grade.
- C. Posts shall be set in footings or sleeves as indicated. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting.
- D. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

3.5 ADJUSTING

- A. Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.
- B. Lubricate hardware, and other moving parts.

3.6 PROTECTION

- A. After installation and until Owner acceptance the complete fence shall be retouched wherever paint has been scratched, abraded, or otherwise damaged or removed. Retouching paint shall be paint of the same formulation and color as that used for the original painting of the fence.

END OF SECTION

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SECTION 323117
GATE OPERATORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes work required to complete, as indicated by the Contract Documents, and furnish supplementary items necessary for the proper installation of Gate Operators.

1.2 ACTION SUBMITTALS

- A. Design Data: Submit complete and specific design data for products specified.
- B. Product Data: Submit manufacturer's specifications to evidence compliance with these specifications.
- C. Shop Drawings:
 - 1. Submit complete fabrication details and erection drawings.
 - 2. Submit drawings showing connections to adjacent construction, range of travel, and electrical and mechanical connections to the operator.
 - 3. Drawings shall also show the size and location of the concrete mounting pad.
 - 4. Underground runs of hose and electrical shall be shown on shop drawings.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Test Reports:
 - 1. Submit affidavits from the manufacturer demonstrating that the gate mechanism has been tested to 200,000 cycles without breakdown.
 - 2. Each operator shall bear a label indication that the operator mechanism has been tested for full power and pressure of hydraulics, full stress tests of mechanical components and electrical tests of overload devices.
- B. Field Quality Control Reports: Written report of testing and inspection required by "Field Quality Control".

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer with not less than 10 years of experience in the successful production and in-service performance of products and systems similar to scope of this Project.
- B. Installer Qualifications:
 - 1. Experience: Installer's personnel with not less than 5 years of experience in the successful performance of Work similar to scope of this Project.
 - 2. Supervision: Installer shall maintain a competent supervisor at Project while the Work is in progress, and who has not less than 5 years of experience installing products and systems similar to scope of this Project.
 - 3. Manufacturer Acceptance: Installer shall be certified, approved, licensed, or acceptable to manufacturer to install products.

1.5 CODES AND REGULATORY REQUIREMENTS

- A. Complete electrical work according to local codes and National Electrical Code.
- B. Operators shall be built to standards of the Underwriters Laboratories or bear the U.L. label. Field work shall be done to journeyman electrician standards.

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1.6 PROJECT/SITE CONDITIONS

- A. Environmental Requirements: Per manufacturer's latest published specifications.

1.7 WARRANTY

- A. Refer to and conform to requirements in Section 01740 - Warranties and Bonds.
- B. Extended Warranty (Beyond any warranties specified in the Conditions of the Contract):
1. Provide a five year warranty against defects in materials or workmanship.
 2. Defective materials shall be replaced with new materials furnished by the manufacturer, at no cost to the owner.
 3. Labor and other incidental costs are not covered under the factory warranty.
- C. Certificate: Provide Certificates of Warranty to Owner.

1.8 MAINTENANCE

- A. Train Owner's personnel in general maintenance of the gate operator and accessories and provide two copies of "Operations and maintenance" manuals for the Owner's use. Manuals will identify parts of the equipment for future procurement.
- B. Provide a video tape, in VHS format, showing the components of the gate operator. Identify parts and systems and show in detail how parts are installed and how they are serviced in the field. The purpose of this video tape is to train operations and maintenance personnel for their continued contact with this equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND PRODUCTS

- A. **Acceptable Manufacturers and Products:** Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".
1. Hy-Security Gate Operators.
 2. Customline, Inc.
 3. Crusader, McKinney Electronics Division.
 4. Division of Overhead Door.
 5. Stanley.
- B. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other manufacturers offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.
1. Manufacturer: Hy-Security.
 2. Series/Model Number: [#222 SS] [#333 MS] Hydraulic Slide Gate Operator.

2.2 MATERIALS

- A. Operator shall be modular in design allowing remote location of the control panel and pump package, away from the gate opening.
- B. The drive unit and the power unit are complete in themselves and can be located up to 100 feet from each other.
- C. Power unit shall be housed in an NEMA 3R enclosure.

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- D. Drive unit may be mounted at ground level or at the head of an overhead mounted gate.
- E. Hydraulic hoses and electrical wires for limit switches. shall be run from overhead to the ground in a 6" x 6" x 1/8" square steel tube.
- F. Connection will be tamper resistant.

2.3 OPERATION

- A. Operation shall be by means of a metal rail passing between a pair of solid aluminum wheels with polyurethane treads.
- B. Operator motors shall be hydraulic and system shall not include belts, gears, pulleys, roller chains or sprockets to transfer power from operator to gate panel.
- C. The grip of the drive wheels on the metal rail shall withstand a minimum horizontal pull of 300 pounds without slipping and without distortion of strut arms.
- D. Gate panel velocity shall not be less than one foot per second and shall be stopped gradually to prevent shock loads to the gate and operator assembly.

2.4 STANDARD COMPONENTS SHALL INCLUDE AS A MINIMUM:

- A. Strut Arms: 6" x 3/8" steel flat bar.
- B. Pivots: 3/4" diameter, grade 5 bolts in hinge configuration with flat bars.
- C. Tension Spring: 2-1/2" heavy duty, 800 pound capacity.
- D. Tension Adjustment: Finger tightened nut, without the use of tools.
- E. Drive Release: Must instantly release both motors from contact with rail, for emergency operation.
- F. Pushbutton Operation: 3 button station mounted permanently on exterior of electric panel.
- G. Limit Switches: Fully adjustable, toggle type, NEMA 4.
- H. Electrical Enclosure: NEMA 12/13, sealed to provide protection from spraying of dust, oil, coolants or water.
- I. Chassis: 1/4" steel plate, welded and ground edges, smooth to the touch.
- J. Cover: Joints welded, filled and ground smooth. Finished corners square and true with no visible joints.
- K. Finish: Powder paint finish coat with high gloss, withstanding 1000 hour salt spray test.
- L. Drive Wheels: Aluminum hub with polyurethane tread and a durometer hardness not less than 90.
- M. Drive Rail: Shall be extruded 6061-T-6, not less than 1/8" thick. Drive rail shall incorporate alignment pins for ease of replacement, splicing and for break-away design. Pins shall provide a perfect butt splice.
- N. Hydraulic Hose: Shall be 1/4" synthetic, rated to 2750 P.S.I.
- O. Hose Fittings: At manifold shall be quick disconnect type, other locations shall be swivel type.
- P. High performance, multiple viscosity, hydraulic oil.

2.5 MINIMUM STANDARD ELECTRICAL COMPONENTS:

- A. Industrial Grade, Meeting U.L. or C.S.A. Requirements

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- B. Pump Motor: 1 HP minimum
- C. Components shall have overload protection.
- D. Electrical panel enclosures shall be NEMA 12/13.
- E. Controls: Industrial grade relays.
- F. Transformer: 100 VA non-jumpered taps, for common voltages.
- G. Maximum run timer.
- 2.6 CONTROL DEVICES:
- 2.7 SAFETY DEVICES (for stopping or reversing the gate travel):
- 2.8 SAFETY ALARM DEVICES:
- 2.9 ACCESSORIES:
 - A. Special locks for operator cover and gate panel.
 - B. Special features to withstand physical attack, (add "CF").
 - C. Master/slave control package.
 - D. Heater with thermostat for cold or damp climates.
 - E. Insulated and weatherstripped operator covers.
 - F. Remote gate release devices.
 - G. Special controls for extra duty or gates weighing more than 1000 pounds.
 - H. High speed options for more than one foot per second (speeds up to six feet per second are available).
- 2.10 SOURCE QUALITY CONTROL (MANUFACTURER/FABRICATOR)
 - A. Inspections and Testing:
 - 1. Fully assemble and test, at the factory, each gate operator to assure smooth operation, sequencing and electrical connection integrity. Apply physical loads to operator to simulate field conditions. Tests shall simulate physical and electrical loads equal to the full rated capacity of the operator components.
 - 2. Check mechanical connections for tightness and alignment. Check welds for completeness and continuity. Check welded corners and edges for square and straightness.
 - 3. Inspect painted finishes for completeness and gloss. Touch up any imperfections prior to shipment.
 - 4. Check hydraulic hoses and electrical wires to assure that chafing cannot occur during shipping or operational vibrations.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine and verify that receiving substrate surfaces of the structure have no defects or errors which would result in poor or potentially defective application or cause latent defects in workmanship.
 - 1. Locate concrete mounting pad in accordance with approved shop drawings.

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2. Make sure that gate is operating smoothly under manual conditions before installation of gate operators. Do not proceed if gate is binding or not aligned properly.

- B. Report any unsatisfactory conditions to the Architect.
- C. Starting installation shall imply acceptance of surfaces.

3.2 PREPARATION

- A. Structural Adequacy: Prepare the structure to insure proper and adequate structural support for the materials specified.
- B. Substrate Surface: Prepare substrate surfaces to insure proper and adequate installation, in accordance with the Contract Documents and approved Shop Drawings, or manufacturer's requirements.
- C. Field Measurements/Verifications: Field measure and verify dimensions as required.
- D. Protection of Adjacent Areas or Surfaces: Protect adjacent areas or surfaces from damage as a result of the Work of this Section.

3.3 INSTALLATION

- A. Install gate operator in accordance with manufacturer's latest published requirements, instructions, specifications, details and approved shop drawings.
 1. Anchor bolts shall be fully concealed in the finished installation.
- B. Interface with Other Products: Coordinate and cooperate with supporting, contiguous, adjacent or otherwise related materials trades to ensure a proper, operating installation.

3.4 FIELD QUALITY CONTROL

- A. Contractor Testing: Test gate operator through ten full cycles and adjust for operation without binding, scraping or uneven motion. Test limit switches for proper gate position.

3.5 DEMONSTRATION AND TRAINING

- A. Instructions: Instruct Owner's personnel in proper operation.
- B. Demonstrations: Demonstrate operation to Owner's personnel.

3.6 PROTECTION

- A. After installation and until Owner acceptance, protect the operators from damage.
- B. Remove damaged materials and replace with new, undamaged materials, at no cost to the Owner.

END OF SECTION

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LANDSCAPE IRRIGATION SYSTEM

PART 1 - GENERAL

1.1 SCOPE

- A. Furnish all work and materials, appliances, tools, equipment, facilities, transportation, and services necessary for and incidental to performing all operations in connection with the installation of underground sprinkler irrigation system complete, as shown on drawings and/or specified herein. When the term "Contractor" is used in this section, it shall refer to the irrigation Subcontractor.

1.2 QUALITY ASSURANCE

- A. The Contractor shall warranty material and workmanship for one (1) year after final acceptance including repair and replacement of defective materials, workmanship, and repair of backfill settlement.

1.3 WARRANTY AND MAINTENANCE

- A. Maintenance during warranty shall include, but not necessarily be limited to, the following:
 - 1. Adjustment of sprinkler height and plumb to compensate for settlement and/or plant growth.
 - 2. Backfilling of all trenches.
 - 3. Adjustment of head coverage (arc of spray) as necessary.
 - 4. Unstopping heads plugged by foreign material.
 - 5. Adjustment of controller as necessary to ensure proper sequence and watering time.
 - 6. All maintenance necessary to keep the system in good operating order. Repair of damage caused by vandals, other contractors or weather conditions shall be considered extra to these specifications.
- B. Warranty and maintenance after final acceptance does not include alterations as necessitated by re-landscaping, re-grading, addition of trees or the addition and/or changes in sidewalks, walls, driveways, etc.
- C. Maintenance shall continue for one (1) month after final acceptance to allow for adjustments, repair and scheduling.

1.4 SUBMITTALS

- A. The Contractor shall submit shop drawings or manufacturer's "cut sheet" for each type of sprinkler head, pipe, controller, valves, check valve assemblies, valve boxes, wire, conduit, fittings, and all other types of fixtures and equipment proposed to install on the job. The submittal shall include the manufacturer's name, model number, equipment capacity, and manufacturer's installation recommendation, if applicable, for each proposed item.
- B. No partial submittal will be accepted, and submittals shall be neatly bound into a brochure and logically organized. After the submittal has been approved, substitutions will not be allowed except by written consent of the Owner's Authorized Representative.
- C. Shop drawings shall be provided, upon request, for any special custom fabrication or coordination with other trades.

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1.5 "APPROVED EQUAL" SUBSTITUTIONS

- A. Where items on the plans are specified by a manufacturer's brand name and catalog number, followed by the phrase "or approved equal". This is not intended to unduly restrict competitive procurements or bidding but is done to assure a minimum standard of quality which is believed to be best for the item specified and to match existing equipment.

1.6 CODES/PERMITS

- A. All work under this section shall comply with the provisions of these Specifications, as illustrated on the accompanying drawings, or as directed by the Owner and shall satisfy all applicable local codes, ordinances, or regulations of the governing bodies and all authorities having jurisdiction over this Project.
- B. Installation of equipment and materials shall be done in accordance with requirements of the National Electrical Code, City Plumbing Code, and standard plumbing procedures. The drawings and these Specifications are intended to comply with all the necessary rules and regulations; however, some discrepancies may occur, the Contractor shall immediately notify the Owner's Authorized Representative in writing of the discrepancies and apply for an interpretation. Should the discovery and notification occur after the execution of a contract, any additional work required for compliance with the regulations shall be paid for as covered by these Contract documents.
- C. The Contractor shall give all necessary notices, obtain all permits, and pay all costs in connection with his work; file with all governmental departments having jurisdiction; obtain all required certificates of inspection for his work and deliver to the Owner.
- D. The Contractor shall include in the work any labor, materials, services, apparatus, or drawings in order to comply with all applicable laws, ordinances, rules, and regulations whether or not shown on the drawings and/or specified.
- E. The installation of the irrigation system shall be made by an individual or firm duly licensed under Article No. 8751 VTCS, Titled "Licensed Irrigators Act", S.B. No. 259 as passed by the 66th Texas Legislature.

1.7 EXISTING UTILITIES

- A. Locations and elevations of various utilities included with the scope of this work have been obtained from the most reliable sources available and should serve as a general guide without guarantee to accuracy. The Contractor shall examine the Site and verify to his own satisfaction the locations and elevation of all utilities and availability of utilities and services required. The Contractor shall inform himself as to their relation to the work and the submission of bids shall be deemed as evidence thereof. The Contractor shall repair at his own expense, and to the satisfaction of the Owner, for damage to any utility shown or not shown on the plans.
- B. Should utilities not shown on the plans be found during excavations, Contractor shall promptly notify the Owner for instructions as to further action.
- C. Contractor shall make necessary adjustments in the layout as may be required to connect to existing stub-outs, should such stub-outs not be located exactly as shown and as may be required to work around existing work, at no increase in cost to the Owner. All such work will be recorded on record drawings and turned over to the Owner prior to final acceptance.

1.8 RECORD DRAWINGS

- A. Record dimensioned locations and depths for each of the following:
 - 1. Point of connection.
 - 2. Sprinkler pressure line routing (provide dimensions for each 100 lineal feet (maximum) along each routing, and for each change in directions).

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3. Gate valves.
 4. Sprinkler control valves (buried only).
 5. Control wire routing.
 6. Other related items as may be directed by the Owner's Authorized Representative.
- B. Locate all dimensions from two (2) permanent points (buildings, monuments, sidewalks, curbs, or pavements).
- C. Record all changes which are made from the Contract drawings, including changes in the pressure and non-pressure lines.
- D. Record all required information on a set of reproducible drawing files.
- E. Maintain information daily. Keep Contract drawings at the Worksite at all times and available for review by the Owner's representative.

1.9 CONTROLLER CHARTS

- A. Do not prepare charts until record drawings have been approved by the Owner's representative.
- B. Provide one (1) controller chart for each automatic controller installed.
1. Chart may be a reproduction of the record drawing, if the scale permits fitting within the controller door. If photo reduction prints are required, keep reduction to maximum size possible to retain full legibility.
 2. Chart shall be blackline print of the actual system, showing the area covered by that controller.
- C. Identify the area of coverage of each remote control valve, using a distinctly different pastel color, drawn over the entire area of coverage.
- D. Following approval of charts by the Owner's representative, they shall be hermetically sealed between two (2) layers of 20 mil. thick plastic sheet (laminated).
- E. Charts must be completed and approved prior to final acceptance of the irrigation system.

1.10 OPERATING AND MAINTENANCE MANUALS

- A. Provide individual bound manuals detailing operating and maintenance requirements for irrigation systems.
- B. Manuals shall be delivered to the Owner's representative for review and approval no later than ten (10) days prior to completion of work. Revise manual as required.
- C. Provide descriptions of all installed materials and systems in sufficient detail to permit maintenance personnel to understand, operate, and maintain the equipment.
- D. Provide the following in each manual:
1. Index sheet, stating Irrigation Contractor's name, address, telephone number, and name of person to contact.
 2. Duration of guarantee period.
 3. Equipment list providing the following for each item:
 - a. Manufacturer's name.
 - b. Make and model number.
 - c. Name and address of local manufacturer's representative.
 - d. Spare parts list in detail.
 - e. Detailed operating and maintenance instructions of major equipment.
 4. Recommended programs for watering by season.

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1.11 CHECKLIST

- A. Provide a signed and dated checklist and deliver to the Owner's representative prior to final acceptance of the work.
- B. Use the following format:
 - 1. Plumbing permits: if none required, so note.
 - 2. Material approvals: approved by and date.
 - 3. Pressure line tests: by whom and date.
 - 4. Record Drawings: received by and date.
 - 5. Controller charts: received by and date.
 - 6. Materials furnished: received by and date.
 - 7. Operation and maintenance manuals: received by and date.
 - 8. System and equipment operation instructions: received by and date.
 - 9. Manufacturer's warranties if required: received by and date.
 - 10. Written guarantee: received by and date.
 - 11. Lowering of heads in lawn areas: if incomplete, so state.

1.12 ELECTRICAL POWER

- A. Electric power shall be provided within five feet of each controller location by the G.C. The irrigation contractor shall provide final hardwire connection.

1.13 WATER FOR TESTING

- A. Unless noted otherwise on the plans or elsewhere, furnish all water necessary for testing, flushing, and jetting.

1.14 BORINGS, SLEEVES AND ELECTRICAL CONDUITS

- A. Sleeves and electrical conduits are the responsibility of the Irrigation Contractor to install prior to paving or related construction and should be installed as noted on the drawings and specifications. Contractors shall be responsible for locating all sleeves and conduits at no additional cost to the Authority. Borings under existing paving will be required where noted on the drawings and shall be provided at no additional cost to the Owner. Borings shall be a minimum of eighteen (18) inch depth and new pipes shall be incased in PVC sleeves as noted on the plans.

1.15 SPARE PARTS

- A. The Contractor shall supply the Owner with five (5) spray heads, one (1) for each head designated on the plan. The Contractor shall supply one (1) additional key and hose swivel for every six (6) quick couplers (one (1) minimum).

PART 2 - PRODUCTS

2.1 GENERAL

- A. Unless otherwise noted on the plans, all materials shall be new and unused. The irrigation equipment catalog numbers used for reference in these Specifications are to establish minimum quality standards and may be substituted with an "approved equal" as outlined in Paragraph 1.5 of this section.

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2.2 POLYVINYL CHLORIDE PIPE (PVC PIPE)

PVC pipe manufactured in accordance with ASTM Standards noted herein.

- A. Marking and Identification: PVC pipe shall be continuously and permanently marked with following information: Manufacturer's name, size, type of pipe, and material, SDR number, Product Standard number, and the NSF (National Sanitation Foundation) Seal.
- B. PVC pipe fittings: Shall be of the same material as the PVC pipe specified and compatible with PVC pipe furnished. Solvent weld type fittings shall be Schedule 40.
- C. PVC Pipe: Shall be as noted on the plans. Sizes up to three (3) inch diameter shall be solvent weld type. Pipe sizes of four (4) inch diameter and larger shall be o-ring gasket type with ductile iron gasket fittings.
- D. Pipe sleeves: Shall be as noted on the plans.

2.3 SWING JOINTS

- A. Swing joints shall be O-ring seal type, Lasco or approved equal.

2.4 WIRE AND SPLICES

- A. Valve wire shall be as noted on the plans, minimum 14 gauge with type UF insulation which is Underwriters Laboratory approved for direct underground burial when used in a National Electrical Code Class II Circuit (30 volts AC or less) as per Articles 725 and 300. Voltage drop shall be taken into consideration.
- B. All connectors shall be UL listed, rated 600 volt, for PVC insulated wire. No wire splices shall be buried.

2.5 QUICK COUPLING VALVES

- A. Quick coupling valves shall be composed of a bronze cast body with a purple, (NP) cover.
- B. The valve shall accept a single lug three-quarter (3/4) inch bronze valve key for operation unless noted otherwise.

2.6 MANUAL VALVES

- A. Unless noted otherwise, manual valves two and one-half (2-1/2) inches and smaller shall be all brass, globe type with composition disc rated at 150 pounds W.O.G. Manual valve size four (4) inches and larger shall be Kennedy cast iron type.
- B. All valves shall have wheel handles unless cross handles are called for on the plan.

2.7 VALVE BOXES

- A. A box shall be provided for all valves.
- B. Valve boxes shall be made of high-strength plastic suitable for turf irrigation purposes.
- C. Boxes shall be suitable in size and configuration for the operability and adjustment of the valve.
- D. Extension sections will be used as appropriate to the depth of piping.
- E. All valve box covers shall bolt down or have locking mechanisms and shall be colored green or black as selected by the Contracting Officer, or purple where required, as noted.

2.8 POP-UP SPRAY, BUBBLERS AND ROTARY HEADS

- A. Sprinkler heads are specified on the drawings. Spray heads shall have a minimum four (4) inch pop-up.
- B. The sprinkler body and all related parts shall be plastic cycloc or polycarbonate. They shall have a spring retraction for positive return action of the pop-up nozzle.

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- C. The spring for retraction and the adjustable nozzle screw shall be made of corrosion resistant materials.

2.9 DRIP TUBE WITH PRESSURE COMPENSATING EMITTERS

Drip tube shall be of the manufacturer and model as noted on the plans. Pressure compensating emitters with internal check valves are required unless noted otherwise.

A. Barbed Insert Fittings:

1. All barbed insert fittings shall be constructed of molded, ultra-violet-resistant plastic having nominal inside dimension (I.D.) of 0.24 inch.
2. Each fitting shall have a minimum of two (2) ridges or barbs per outlet with a raised barb nearest the fitting outlet. All fittings shall be of one (1) manufacturer and shall be available in one (1) of the following end configurations:
 - a. Barbed insert fittings, or
 - b. Male pipe threads (MPT) with barbed insert fittings, or
 - c. Female pipe threads (FPT) with barbed insert fittings.

2.10 ELECTRICAL CONTROLLER

- A. The electric irrigation controller shall be as noted on the plans. The system may be designed to operate multiple section valves at a time, per controller unless otherwise noted.
- B. Power source shall be 110v A.C. Output for operation of companion solenoid actuated valves shall be 24 volts 60 Cycle AC.

2.11 ELECTRIC REMOTE CONTROL VALVES

- A. Electric remote control valves shall have plastic bodies and covers and shall be globe-type diaphragm valves of normally closed design. The valves are specified on the drawings.
- B. Operation shall be accomplished by means of integrally mounted heavy-duty 24-V solenoid complying with National Electrical Code, Class II Circuit. Solenoid coil shall be potted in epoxy resin within a plastic coated stainless steel housing. Solenoids shall be completely waterproof, suitable for direct underground burial.
- C. A flow stem adjustment shall be included in each valve.

2.12 BACKFLOW PREVENTER

- A. An approved backflow prevention device is required, as noted on the plans. The device shall include all materials as required by the local municipality and shall be inspected accordingly.

2.13 TEMPERATURE SENSORS AND RAIN SENSORS

- A. Rain and freeze sensors shall be provided and installed as noted on the plans.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Design Pressure: This irrigation system has been designed to operate with a minimum static inlet water pressure as indicated on the drawings. The Contractor shall take a pressure reading prior to beginning construction. If the pressure reading is 5% less than above, the Contractor shall notify the Owner's Representative.

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- B. Contractor Responsibility: The Contractor shall not willfully install the irrigation system as shown on the drawings when it is obvious in the field that obstructions, grade differences or discrepancies in equipment usage, area dimensions or water pressure exist that might not have been considered in the engineering. Such obstructions or differences shall be brought to the attention of the Owner's Representative in writing. In the event this notification is not performed, the Contractor shall assume full responsibility for any revision necessary.
- C. Staking: Before installation is started, place a stake or flag where each sprinkler and valve box is to be located, in accordance with drawing. Staking shall be approved by the Owner's Authorized Representative before proceeding.
- D. Piping Layout: Piping layout is diagrammatic. Route piping around existing trees and root zones in such a manner as to avoid damage to plantings. Do not dig within the ball of newly planted trees or shrubs.
- E. In areas where trees are present, trenches will be adjusted on site to provide a minimum clearance of four (4) times the trunk diameter of the tree (at its base) between any tree and any trench.
- F. All material and equipment shall be delivered to the Worksite in unbroken reels, cartons or other packaging to demonstrate that such material is new and of a quality and grade in keeping with the intent of these Specifications.

3.2 EXCAVATION AND TRENCHING

- A. The Contractor shall perform all excavation to the depth indicated in these Specifications and Contract drawings. The banks of trenches shall be kept as nearly vertical as practicable. Trenches shall be wide enough to allow a minimum of four (4) inches between parallel pipelines or electrical wiring. Where rock excavation is required, or where stones are encountered in the bottom of the trench that would create a concentrated pressure on the pipe, the rock or stones shall be removed to a depth of six (6) inches minimum below the trench depth indicated. The over depth rock excavation and all excess trench excavation shall be backfilled with loose, moist earth or sand, thoroughly tamped. Whenever wet or otherwise unstable soil that is incapable of properly supporting the pipe is encountered in the trench bottom, such shall be removed to a depth and length required, and the trench backfilled to trench bottom grade as hereinafter specified, with coarse sand, fine gravel or other suitable material.
- B. Bottom of trench grade shall be continued past ground surface deviations to avoid air pockets and low collection points in the line. The minimum cover specifications shall govern regardless of variations in ground surface profile and the occasional deeper excavation required at banks and other field conditions. Excavation shall be such that a uniform trench grade variation will occur in all cases where variations are necessary.
- C. Trench excavation shall comprise the satisfactory removal and disposition of all materials and shall include all shoring and sheeting required to protect the excavation and to safeguard employees.
- D. During excavation, material suitable for backfilling shall be stockpiled in an orderly manner a sufficient distance back from edge of trenches to avoid overloading and prevent slides or cave-ins. Material unsuitable for backfilling shall be wasted as directed by the Owner's Authorized Representative. When excavated material is of a rocky nature and the topsoil or any other layer of excavated material is suitable for pipe bedding and backfill in the vicinity of the pipe, such material shall be separately stockpiled for use in such bedding and pipe backfill operations, unless satisfactory imported material is used.
- E. All excavations and backfill shall be unclassified and covered in the basic bid. No additional compensation will be allowed for rock encountered.

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- F. Restore all surfaces, existing underground installations, etc., damaged or cut as a result of the excavations to their original conditions in a manner acceptable to the Owner's Authorized Representative.

3.3 PIPE INSTALLATION

- A. Sprinkler Mains: Sprinkler mains are that portion of piping from water source to electric valves. This portion of piping is subject to surges since it is a closed portion of the sprinkler system. Sprinkler mains shall be installed in a trench with a minimum of eighteen (18) inches of cover.
- B. Lateral Piping: Lateral piping is that portion of piping from electrical valve to sprinkler heads. This portion of piping is not subject to surges since it is an "open end" portion of the sprinkler system. Lateral piping shall be installed in a trench with a minimum of twelve (12) inches of cover.

3.4 PVC PIPE AND FITTING ASSEMBLY

- A. Solvent: Use only solvent recommended by manufacturer to make solvent-welded joints following standards noted herein. Thoroughly clean pipe and fittings of dirt, dust, and moisture with an approved PVC primer before applying solvent.
- B. PVC to Metal Connection: Work metal connections first. Use a non-hardening pipe dope such as Permatex No. 2 or "Teflon" tape on threaded PVC to metal joints. Use only light wrench pressure.
- C. Threaded PVC Connections: Where required, use threaded PVC adapters into which pipe may be welded.
- D. Remove lumber, rubbish, and rocks from trenches. Provide firm, uniform bearing for entire length of each pipeline to prevent uneven settlement. Wedging or blocking of pipe will not be permitted. Remove foreign matter or dirt from inside of pipe before welding and keep piping clean during and after laying pipe.
- E. PVC pipe shall not be installed where there is water in the trench, nor shall PVC pipe be laid when temperature is 40 deg. F or below or when rain is imminent. PVC pipe will expand and contract as the temperature changes. Therefore, pipe shall be snaked from side to side of trench bottom to allow for expansion and contraction.

3.5 HYDROSTATIC TESTS

- A. Pressure Test: After the pipe is laid, the joints completed, and the trench partially backfilled, leaving the joints exposed for examination, the newly laid mainline pipe or any valved section of main pressure line piping shall, unless otherwise specified, be subjected for four (4) hours to a hydrostatic pressure test of normal city water pressure. Each valve shall be opened and closed during the test. Enclosed pipe, joints, fittings, and valves shall be carefully examined during the partially open trench test. Joints showing visible leakage shall be replaced or remade, as necessary. Cracked or defective pipe, joints, fittings, or valves discovered in consequence of this pressure test shall be repeated until the test results are satisfactory. All replacement and repair shall be at contractor's cost. Notify the Owner's Authorized Representative at least three (3) days before tests are scheduled to be conducted.

3.6 CONTROL WIRE INSTALLATION

- A. All control wire less than five hundred (500) feet in length shall be continuous without splices or joints from the controller to the valves. Connections to the electric valves shall be made within eighteen (18) inches of the valve using connectors specified in Paragraph 2.4 of this section, unless otherwise approved by the Owner's Authorized Representative in writing.

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- B. All control wires shall be installed at least eighteen (18) inches deep. Contractor shall obtain the Owner's Representative's approval for wire routing when installed in a separate ditch. Control wires may be installed in a common ditch with piping, however wires must be installed a minimum of four (4) inches below or to one (1) side of piping.
- C. All wire passing under existing or future paving, sidewalk, construction, etc., shall be encased in PVC conduit extending at least two (2) feet beyond edges of paving, sidewalks, or construction.

3.7 POP-UP SPRAY BUBBLER HEADS

- A. Provide heads and nozzles as specified and install in locations as shown on the Contract Drawings.
- B. Pop-up spray heads shall be installed with connections to rigid PVC pipe as detailed on the Contract drawings. Rotary heads shall be installed on a double swing joint connected to the lateral pipe as detailed on the drawings.
- C. Heads shall be installed with underside of flange flush with the finished grade.
- D. Contractor will be required to adjust heads as necessary after establishment of grass or other plant material.

3.8 DRIP EQUIPMENT

- A. Drip tube can be installed in one (1) of the following methods:
 - 1. Over-excavation: Over-excavate the entire area to a depth of two (2) inches to four (4) inches below finish grade. Plant all specimen trees and shrubs fifteen (15) gallon size and larger, then place drip tube at the row spacing interval indicated on the plans.
 - 2. Pipe Pulling: Where ground disruption is to be minimized, pneumatic tire, pipe-pulling machinery shall be used. Potholes shall be used at the ends of each run for making connection to supply and exhaust headers of rigid PVC pipe or polyethylene pipe.
 - 3. Trenching: Hand or mechanically trench to the pipe depth indicated on the plans or in these specifications and backfill flush with finish grade. Avoid mechanically trenching within the dripline of existing trees. Hand-trench around existing tree roots when roots of two (2) inches and larger are encountered. Remove all rock one and one-half (1½) inch and larger when excavating and remove from site. Do not backfill trenches with rock that will come in direct contact with tubing or rigid PVC piping.
- B. Placement of Rigid PVC Piping: Install pipe in a serpentine (snaked) manner to allow for expansion and contraction in trench before backfilling. Install pipes at temperatures over 40°F. Pipe markings shall face upward out of the trench whenever possible.
- C. Drip tube: Drip tube can be installed with the water outlets facing up, down, or sideways. In irregular areas, some water outlets could end up too close to fixed improvements and may have to be capped off with a dripper plug ring.
- D. Cover: Install underground piping horizontally and as evenly as possible to a maximum depth of 4 inches, unless otherwise specified. (Typical pipe depth is two (2) inches in shrub beds, four (4) inches in turf unless periodic aeration is anticipated, and then pipe depth should be lowered to six (6) inches.)
- E. Barbed Insert Fittings: Connect drip tube to barbed insert fittings by pushing the tubing on and over both barbs of the fitting until the tubing has seated against another piece of tubing or has butted against another portion of the barbed fitting. For water pressures in excess of the 30 psi, or the maximum stated system pressure for the drip tube, whichever is less, use stainless steel clamps.

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- F. Clamping: When design-operating pressure exceeds 30 psi, or maximum stated system pressure for the drip tube, whichever is less, stainless steel pipe clamps shall be used. Slip clamps over tubing before slipping tubing over barbed insert fitting. Place clamp between the first and second ridge of the barbed fittings and crimp the "ear" of the clamp tightly. Crimp the "ear" twice to ensure proper seating.

3.9 QUICK COUPLING VALVES

- A. Quick coupling valves shall be installed with the underside of flange flush with the finished grade.
- B. Quick coupling valves shall be installed on a swing joint assembly as detailed on the drawings.
- C. Under the warranty, the Contractor shall return after grass is established and adjust valves and valve boxes to proper grade.

3.10 MANUAL VALVES

- A. Manual valves shall be sized and located where shown on the Contract drawings.
- B. Valve boxes shall be adjusted to be flush with finished grade. The Contractor will be required to adjust after establishment of grass.
- C. Valve boxes shall be properly supported and of sufficient construction that tractors and mowers crossing over the boxes will not push boxes down and crush the pipe, valve, or box.

3.11 VALVE AND VALVE BOX PLACEMENT

- A. All manual, electric, and quick coupling valves shall be in boxes as specified in Paragraph 2.7 of this section and shall be set with a minimum of six (6) inches of space between their top surface and the bottom of the valve box. The base of the box shall be filled with pea gravel as shown on plan.
- B. Valves shall be fully opened and fully closed to ensure that all parts are in operating condition.
- C. Valve boxes shall be set plumb, vertical, and concentric with the valve stem.
- D. Any valve box which has moved from this required position so as to prevent the use of the operating wheel of the valve shall be reset by the Contractor at his own expense.

3.12 ELECTRIC CONTROLLER

- A. Electric controller location shall be confirmed with the L.A. before installation, as shown on the plans.

3.13 ELECTRIC REMOTE CONTROL VALVES

- A. Remote control valves shall be located and sized as shown on the plans. All electrical connections shall be made when the weather is dry with connection kits as specified in Paragraph 2.4 of this section in strict accordance with manufacturer's recommended procedures. All remote control valves shall be installed in a horizontal position, in accordance to the manufacturer's published installation instructions.
- B. It shall be the responsibility of the Contractor to furnish and install the proper size wire on each of the low voltage circuits from the master control center to the various electric remote control valves.
- C. Consideration shall be given to each circuit for allowance of voltage drop and economy consistent with accepted practices of electrical installation. Under no circumstances shall the voltage of any branch circuit be reduced more than proper due to length of run exceeding the maximum allowable for the wire size used.

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3.14 BACKFILL AND COMPACTION

- A. After system is operating and required tests and inspections have been made, the trenches shall be carefully backfilled with the excavated materials approved for backfilling, consisting of earth, loam, sandy clay, sand, gravel, soft shale, or other approved materials, free from large clods of earth or stone. Rock, broken concrete, or pavement, and large boulders shall not be used as backfill material. The backfill shall be thoroughly compacted and evened with the adjacent soil level.
- B. Compact trenches in areas to be planted by thoroughly flooding the backfill. Compact all other areas by flooding or hand tamping. The jetting process may be used in areas when flooding.
- C. Backfill for all trenches, regardless of the type of pipe covered, shall be compacted to a minimum of 90% density.
- D. Any trenches improperly backfilled, or where settlement occurs, shall be reopened to the depth required for compaction, then refilled and compacted with the surface restored to the required grade and left in a completed surface condition as described above.
- E. Specifically tamp backfill under heads and around the flange of heads for one (1) foot by a suitable means after trench backfill has dried from flooding to prevent heads loosening in the ground.

3.15 FINAL ADJUSTMENT

- A. After installation has been completed, make final adjustment of sprinkler system prior to Owner's Authorized Representative's final inspection.
- B. Completely flush system to remove debris from lines by removing nozzle from heads on ends of lines and turning on system.
- C. Check sprinklers for proper operation and proper alignment for direction of throw.
- D. Check each section for operating pressure and balance to other sections by use of flow adjustment on top of each valve.
- E. Check nozzles for proper coverage. Prevailing wind conditions may indicate that arc or angle of spray should be other than as shown on drawings. In this case, change nozzles to provide correct coverage and furnish record data to Owner's Authorized Representative with each change.
- F. After system is thoroughly flushed and ready for operation, each section of sprinklers shall be adjusted to control pressure at heads. Use the following method, one (1) section at a time:
 - 1. Remove last head on section and install a temporary riser above grade. Install tee with pressure gauge attached on top of riser and re-install head with nipple onto tee.
 - 2. Correct operating pressure at last head of each section as follows: Spray and rotor heads - 30-35 psi.
 - 3. After replacing head, at grade, tamp thoroughly around head.
 - 4. Drip zone valve pressure regulating devices shall be set at not to exceed 40 psi.

3.16 CLEAN-UP

- A. The Worksite shall be thoroughly cleaned of all waste materials and all unused or salvaged materials, equipment, tools, etc.
- B. After completion of the work, areas disturbed shall be leveled and the Worksite shall be raked clean and left in an orderly condition.

END OF SECTION

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SECTION 32 9200

TURF AND GRASSES

PART 1 – GENERAL

1.1 SCOPE

- A. Furnish all work and materials, appliances, tools, equipment, facilities, transportation, and services necessary for and incidental to performing all operations in connection with the installation of the sod.
- B. Conform to the requirements of the general conditions of the contract.

1.2 SUMMARY

- A. Work Includes:
 - 1. Soils Test/Analysis Report of existing site soils.
 - 2. Providing and installing manufactured topsoil.
 - 3. Providing and installing organic fully mature compost.
 - 4. Providing and installing organic fertilizer.
 - 5. Initial removal of weeds on site.
 - 6. Spike harrowing/ripping/breaking-up/shattering of compacted site soils.
 - 7. Soil preparation and tilling topsoil and compost into existing rough graded subbase soils.
 - 8. Hand or deep-tine aerifier mixing organic compost into existing soil at root zone of existing trees to remain.
 - 9. Fine grading and removal of debris.
 - 10. Germinating weeds for second eradication prior to sodding.
 - 11. Hand removal or raking away of dead weeds.
 - 12. Sodding of grass as designated on landscape plans.
 - 13. Installing temporary grass if sod installation schedule is not met.
 - 14. Providing permanent irrigation.
 - 15. Establishment of grass.

1.3 REFERENCES

- A. Codes and regulations of the jurisdictional authorities.
- B. Reference Codes and Standards (current standards):
 - 1. AASHTO: M140.
 - 2. ASTM: C33/C33M, C51.
 - 3. ASTM: D6459, D6566, D6567, D7322, D7367.
 - 4. U.S. Department of Agriculture and Texas Department of Agriculture
 - 5. Federal Seed Act.

1.4 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Manufacturer: Company specializing in manufacturing Products specified with minimum seven (7) years documented experience.
 - 2. Installer: Company specializing in performing the Work of this Section with minimum seven (7) years documented experience.

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- B. Inspections:
 - 1. Make written request for inspection after sodding operations have been completed. Such inspection is for the purpose of establishing the Maintenance Period.
 - 2. Submit written requests for inspections to the Owner's Authorized Representative at least seven (7) days prior to anticipated inspection date.

1.5 SUBMITTALS

- A. Submit the following for approval in accordance with contract related submittals in a single package to the Owner's Authorized Representative no less than sixty (60) days prior to installation.
- B. All delivery receipts and copies of invoices for materials used for this work shall be subject to checking by the Owner's Authorized Representative. The Contractor shall offer proof of materials' compliance to the specifications to the Owner's Authorized Representative prior to installation. Various samples, certificates, and specifications of seed, and other materials shall be submitted for approval as required by subsequent sections of this specification and Section 32 9300. The Contractor should submit the following certification to the Owner's Authorized Representative prior to installation.
 - 1. Sodds: Certified, each delivery bearing a certification tag and label as required by law.
 - 2. Seed: Submit source of grass seed with analysis and guarantee of seed purity.
 - 3. Sources: No less than sixty (60) days prior to installation, notify Owner and Owner's Authorized Representative in writing of source of seed required for the project.
 - 4. Soil as used for Manufactured Topsoil: Submit a one (1) gallon sample along with documentation for Soil Test/ Analysis Report.
 - 5. Manufactured Topsoil: Submit a one (1) gallon sample for spreading along with manufacturer's product data and laboratory analysis report with Solvita® Compost Maturity Test results for compost components of this manufacturer's mix.
 - 6. Mature Organic Compost: Submit a one (1) gallon sample for spreading as specified in Section 2.6 along with Solvita® Compost Maturity Test results.
 - 7. Organic Fertilizer: Copy of product information labeled with manufacturer's name and address and chemical analysis.
 - 8. Organic Herbicide: Copy of product information labeled with manufacturer's name and address and chemical analysis. Submit manufacturer's information or cut sheets on products.
 - 9. Organic Fungicide: Copy of product information labeled with manufacturer's name and address and chemical analysis. Submit manufacturer's information or cut sheets on products.
 - 10. Organic Insecticide(s): Copy of product information labeled with manufacturer's name and address and chemical analysis. Submit manufacturer's information or cut sheets on products.
- C. Work Schedule: The sodding of grass must occur at stipulated times. Also, time periods are specified to achieve an acceptable stand. Therefore, the Contractor must submit a schedule for the work of this section so that the grass can achieve full coverage as specified by the contract completion date. The schedule must be submitted no less than sixty (60) days prior to installation for review and approval of the Owner's Authorized Representative, Architect and Owner's Authorized Representative. Refer to Subsection 1.11.
- D. Submit Maintenance Instructions upon final acceptance. Refer to Subsection 3.10, Paragraph K.
- E. Special Warranty: Submit written special warranty registered with manufacturer as specified in this Section.

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- F. Provide documentation and testing of existing site soils and screened soil as used in the manufactured topsoil by means of a Chemical Soil Test/Analysis Report with recommendations for organic amendments (not chemical based) to soils for landscape turf grasses, aesthetic planting with ornamentals and native plants (not agricultural crops) for determination or adjustment of required amendments. Provide testing at two (2) predetermined/approved locations on site per approval by Owner's Authorized Representative and Landscape Architect. Provide testing at least sixty (60) days prior to soil preparation.
1. Approved Chemical Testing Laboratories:
- a. Perry Agricultural Laboratory, mailing address: P.O. Box 418, or shipping address: 15241 Pike 138, Bowling Green, MO 63334, phone: (573-324-2931), www.perryaglab.com. (Equivalent tests as noted above – minimum – Standard Albrecht Test.)
- b. Approved equivalent laboratory to match parameters and report recommendations as approved by Owner's Authorized Representative.
- G. Provide documentation and testing of compost materials as specified in Parts 2 and 3 of this section.

1.6 SELECTION AND ORDERING OF PLANTING MATERIALS

- A. Documentation: Submit documentation no less than sixty (60) days prior to installation that all materials have been ordered.
- B. Unavailable Materials: If proof is submitted that any of the materials specified is not obtainable, a proposal will be considered for use of the nearest equivalent variety with corresponding adjustment of Contract price. Substantiate such proof in writing no less than sixty (60) days prior to installation.
- C. Special Conditions: The above provisions shall not relieve Contractor of the responsibility for obtaining specified materials in advance if special growing conditions or other arrangements must be made in order to supply specified materials.

1.7 JOB CONDITIONS AND PROVISIONS

- A. Carefully maintain all site benchmarks, layout points and other points established by other contractors. If destroyed, replacement will be by this Contractor.
- B. Coordinate all work of this Section with other on-site contractors and the Owner. Give advance notice on sequencing of this work so not to affect the operations of other contractors.
- C. All turf grass work shall be performed under the direct supervision of a superintendent and laborers thoroughly experienced with the work of this Section and who shall be at the project site for the duration of the work.
- D. No turf grass work shall take place during inclement weather or when the ground conditions are, in the opinion of the Owner's Authorized Representative, not in a condition to be properly worked. No turf grass operations shall occur earlier than April 15th nor later than August 30th. If sod is to be installed from October 15th to March 15th, then provide temporary installation of cereal rye grass for winter establishment. Remove cereal rye grass prior to April 15th and install sod.
- E. Erect barricades, snow fencing, hire temporary watchmen or whatever is deemed necessary by the Contractor to totally protect all turf grasses until one hundred (100%) percent established.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Materials and supplies are subject to inspection and sampling for testing. Allow no seed, fertilizer, straw, or other agronomic materials or supplies on Work site other than those for the Project.
1. Sod:
- a. Deliver sod to job within twelve (12) hours after being cut; place sod within twenty (20) hours after being cut. Allow sod only eight (8) hours maximum on site.

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- b. Prior to and after delivery during wet weather, allow sod to dry to the extent that will prevent tearing during handling and laying. During dry weather, water sod to ensure its vitality and prevent dropping of the soil in handling.
 - c. Analysis of purity and germination tag.
 - d. Certification tag.
 - B. Bonded Fiber Matrix: Labeled with manufacturer's name and address, and guaranteed analysis. Store and handle in strict compliance with manufacturer's instructions and recommendations. Protect from damage from weather, excessive temperatures, and construction operations.
 - C. Organic Biological Fertilizer: Labeled with manufacturer's name and address, guaranteed analysis, including nutrient and its derived source, listing of potential acidity, and any toxic materials.
 - D. Organic Biological Fungicide: Labeled with manufacturer's name and address and analysis, warnings, safety instructions, and application requirements.
 - E. Organic Herbicide: Labeled with manufacturer's name and address and analysis, warnings, safety instructions, and application requirements.
 - F. Organic Insecticide: Labeled with manufacturer's name and address and analysis, warnings, safety instructions, and application requirements.
- 1.9 PROJECT CONDITIONS OR SITE CONDITIONS
- A. Verify and examine site conditions with the Owner's Authorized Representative. Proceed when official notice is given to the Contractor that the work site is ready. Proceed with tree protection prior to any site work, demolition or grading.
- 1.10 SEQUENCING
- A. Coordinate grading, soil preparation and other related units of Work specified in other Sections to ensure that grass sod can be supported and installed as indicated.
 - B. Coordinate with General Contractor for construction sequencing.
- 1.11 SCHEDULING
- A. Submit a proposed work schedule to the Owner for approval no less than sixty (60) days prior to start of installation. After approval, no modification shall be made to this schedule without written authorization by the Owner. List anticipated start and stop dates for each segment of work up to and including final acceptance.
 - B. In general, the work shall proceed as rapidly as the site becomes available, consistent with normal seasonal limitations for turf grass work.
 - C. Note: The grass must be fully, one hundred (100%) percent established by the contract completion date. The Contractor should allow for a minimum of one hundred (100) days to establish the grasses.

PART 2 – PRODUCTS

2.1 SOD FOR TURF

- A. Well-rooted certified sod, at least eighteen (18) months old.
 - 1. 'Tifway 419' Bermudagrass (Cynodon dactylon)
Cultivar to be approved by Landscape Architect based on availability per submittal by Contractor.
- B. Sod and attached soil free from any noxious weeds such as quack grass, garlic, Johnson grass, dallisgrass, nutsedge, Canada thistle, and other turf weeds.

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- C. Mowed in production field to height of not more than two and one-half (2-1/2) inches within five (5) days prior to lifting.
 - D. DO NOT use any sod grown with mesh netting due to tripper issues with children. Sod with netting will be rejected.
 - E. Machine cut in sections not less than two and one-half (2-1/2) feet in length nor less than twelve (12) inches in width and to a depth equal to growth of fibrous roots, uniform soil thickness of three-quarter (3/4) inch, plus or minus one-quarter (1/4) inch. Measurement for thickness to exclude top growth and thatch.
 - F. Cut in sections or strips for pallets strong enough to support its' own weight and retain size and shape when suspended vertically from firm grasp on upper ten (10) percent of section. Small, irregular or broken pieces of sod are prohibited.
- 2.2 ORGANIC BIOLOGICAL FERTILIZER: to build soil structure within urban environment. Synthetic fertilizers will not be used due to runoff issues and per iSWM (Integrated Storm Water Management) best practices.
- A. Homogenous, granulated all organic biological fertilizer containing soil microbes, endo & ecto mycorrhizal fungi, vitamins, minerals, plant hormones, stimulators, essential carbon and protein: MicroLife Multi-Purpose 6-2-4 All Organic Biological Fertilizer.
 - B. Manufacturer/Supplier: San Jacinto Environmental Supplies, (713) 957-0909, local representative: Lanse Fullinwider, cell: (214-534-2317), or equivalent product as approved by the Owner's Authorized Representative or Landscape Architect.
 - C. See 3.4 for application rates of product to amended soils.
- 2.3 MANUFACTURED TOPSOIL
- A. Containing approximately twenty-five (25) percent organic matter as determined by the topsoil composition tests.
 - B. Compost will meet requirements of 2.6 D. for Solvita® Compost Maturity value of 7 or higher.
 - C. Soil shall be very fine native silt screened to be free of sticks, stones, roots, and other debris and objectionable materials. Soil may be as from screened lake dredging. Screened soil shall be subject to the approval of the Owner's Authorized Representative based on visual and tactile inspection.
 - D. Sand shall be a deep sand excavated from below fifteen (15) feet to ensure it is free of nutsedge, and screened or screened cushion (sharp) sand from sands available in this region.
 - E. Manufactured topsoil as blended from soil, deep sand (screened cushion sand) and organic compost. Manufactured topsoil handled too wet or soggy is not acceptable. Soils supporting growth of noxious weeds, as defined by the Kansas Seed Law, or undesirable weeds, are not acceptable. Manufactured topsoil containing dallisgrass and nutgrass (nutsedge) will be rejected.
 - F. Physical properties as follows:
 - 1. Clay: between 0 and 10 percent
 - 2. Screened Soil: between 13 to 17 percent
 - 3. Sand: between 55 to 65 percent
 - 4. Mature Compost (Organic matter): approximately 25 percent of total dry weight
 - 5. pH: 7.2 to 8.7
 - G. Acceptable Manufactured Topsoil Mix: Enriched Top Soil™ – a precisely measured mixture of Professional Compost, screened native soil and screened sharp sand, pH from 7.5 to 8.7, as supplied by Soil Building Systems, 2101 Walnut Hill Lane, Dallas, Texas 75229, (972-831-8181), attention: Baron Ablon, or equivalent meeting all composition and compost maturity as determined by the Owner's Authorized Representative.

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2.4 COMPOST - Professional Compost or Mature Organic Compost – 100% plant based

- A. Compost: shall be compost for mix above that is fully finished compost that has been produced by aerobic (biological) decomposition of organic matter and meets or exceeds the requirements set forth by the United States Department of Agriculture, the United States Composting Council (USCC), and State composting requirements.
- B. Compost feedstock shall include fully composted cotton burrs, local grass trimmings, leaves, brush and processed wood fiber and shall add an average of 1.1 lbs. N¹, 0.13 lbs. P¹, and 0.8 lbs. K¹ of pure consumable organic nutrients per one (100) square feet for each inch depth added plus minerals and trace elements. Compost shall not include food waste, stable waste, treated lumber, pallets, pine bark, raw manure or mushroom compost waste. Compost shall not include any man-made materials or chemicals. Do not use mixed municipal solid waste compost since it varies from season to season. Ensure compost does not contain any visible inorganic refuse, other physical contaminants, or any substance considered to be harmful to plant growth.
- C. The compost must be turned a minimum of five (5) times and not achieve a temperature greater than 160 degrees Fahrenheit. Each turning cycle should not be shorter than fourteen (14) days minimum. Compost shall be completely composted for a minimum of six to twelve (6 - 12) months. Particle Sizes 97% will pass through a one-half (1/2) inch screen, 99%+ will pass through a three-quarter (3/4) inch screen.
- D. Compost material shall have no pungent smell, but rather an earthy smell. Supporting documentation should be made available upon request. The contractor is obligated to provide testing of the compost at the supplier's yard and at the job site for quality assurance.

Acceptable Professional compost is as supplied by Soil Building Systems, 2101 Walnut Hill Lane, Dallas, Texas 75229, (972-831-8181), attention: Baron Ablon, or equivalent as determined by the Owner's Authorized Representative.

Table 1
Physical Requirements for Compost

pH: 7.9 – 8.9
Maturity: germination and vigor greater than 90% in accordance with TMECC 05.05-A, "Germination and Vigor"
Solvita® Compost Maturity Index: value of 7 or higher

- E. The contractor is obligated to provide testing of the compost at the supplier's yard and at the job site for quality assurance.
- F. TESTING OF THE COMPOST AT THE JOB SITE

NOTE: Contractor is advised to test the designated compost stockpile at the supplier's yard prior to loading to ensure the designated pile passes the compost maturity test. If the compost does not pass the test at the jobsite, it will be rejected.

- 1. Use Solvita® Compost Maturity Test Kit or approved equal. Solvita® test kit shall be recently purchased and shall be stored in a refrigerator protected from heat until use at the site. (The two parameters which Solvita® measures (CO₂ / NH₃) are the mostly frequently cited factors that correlate closely with maturity and potential phytotoxicity. Ammonia is also an odorous aerosol toxicant and is a potential worker hazard at agro-cultural and compost facilities.) Provide Compost maturity test results to measure both carbon-dioxide (CO₂) and ammonia (NH₃) evolution and provide a Maturity Index value, useful or compost quality evaluation. Compost maturity test is TMECC Test #05-08A.
- 2. Provide results to Owner's Authorized Representative at the job site.
- 3. Physical inspection of the material shall be performed at the same time by the Owner's Authorized Representative.

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4. Owner's Authorized Representative has the right to reject the material if it does not meet the above parameters.
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- 2.5 PRE-EMERGENCE AND POST-EMERGENCE FOR WEED REMOVAL - ORGANIC HERBICIDE AND HAND PULLING
 - A. Chemical Herbicides will not be used due to detrimental effects on the soils and due to runoff effects to the site detention basin and into the storm system.
 - B. Organic herbicide will be used to remove weeds prior to turf grass installation.
 - C. Use of any herbicide is to be of limited nature because of the potential to damage the viability of the soil and therefore the retardation of future plant growth.
 - D. Non-selective post emergence herbicide: Ammonium Nonanoate – 40%, AXXE® Broad Spectrum Herbicide, OMRI listed, as manufactured by BioSafe Systems, LLC, 22 Meadow Street, East Hartford, CT 06108, (888-273-3088).
 - E. Supplier: San Jacinto Environmental Supplies, Houston, TX (713-957-0909), local representative: Lanse Fullinwider, cell: (214-534-2317), or other suppliers.
 - F. Nonselective organic herbicide, such as Agricultural grade (20%) vinegar or 20% vinegar based product mixed with citrus oil.
 - G. Hand weeding or plant specific application of organic herbicide shall be used to control weeds during plant establishment.
 - 2.6 ORGANIC FUNGICIDES
 - A. As needed for specific conditions.
 - B. No chemical fungicides shall be used.
 - C. MicroGro Granular Root Protector - Biological Fungicide as supplied by San Jacinto Environmental Supplies, Houston, TX (713) 957-0909, local representative: Lanse Fullinwider, cell: (214-534-2317), or available locally at Southwest Wholesale Nursery, Lewisville, TX, or equivalent product as approved by the Owner's Authorized Representative or Landscape Architect.
 - D. Contractor shall recommend products for submittal and approval by the Owner's Authorized Representative or Landscape Architect depending on final plant selections and their susceptibility to certain fungi.
 - 2.7 ORGANIC INSECTICIDE - FIRE ANTS
 - A. Fire Ant Bait:
 1. PayBack® Fire Ant Bait with Conserve® Insecticide (spinosad 0.015%) granular form as manufactured by Southern Agricultural Insecticides, Inc., Palmetto, FL 34220, (941-722-3285).
 2. Ferti-lome Come and Get It! Fire Ant Killer with Conserve® Insecticide (spinosad 0.015%) granular form as manufactured by Ferti-lome – Voluntary Purchasing Groups, Inc., 230 FM 87, Bonham, TX 75418.
 - B. Dusting Powder: Perma-Guard® Commercial Insecticide D-20 (pyrethrins 0.02%, technical piperonyl butoxide 1.0%, silicon dioxide from diatomaceous earth 88.0%) as manufactured by Perma-Guard, Inc., Albuquerque, NM 87102, (505-243-1460), or equivalent product as approved by the Owner's Authorized Representative or Landscape Architect.

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- 2.8 SEED FOR TEMPORARY GRASS (If required - if the project schedule occurs such that the permanent sodded grass areas cannot be installed and established prior to October 15th.)
- A. Provide seed free of all weeds, including but not limited to quack grass, bentgrass, nut sedge, Johnson grass, clover, dock, cheat, chess, chickweed, dallisgrass, plantain, black medic, red fescue, and tall fescue.
 - B. Seed shall have a germination and purity that will produce, after allowance for Federal Seed Act tolerances, a pure live seed content of not less than 90%. All seed must be fresh, clean and new crop seed. Seed must be dated material from last available crop, with date of test not more than nine (9) months before date of sowing. Seed shall be labeled in accordance with U.S.D.A. and State Department of Agriculture requirements.
 - C. Refer to plan for areas scheduled for sodding.
 - D. Temporary seed and rate for areas of turf grass:
Annual Ryegrass (*Lolium multiflorum*) – winter cover crop
- 2.9 BONDED FIBER MATRIX (used for hydroseeding of temporary seeding)
- A. Erosion Control Product:
 - 1. Hydraulically applied product of degradable wood fiber, providing one continuous layer of elongated fiber strands held together by water-resistant bonding agent. It eliminates direct rain drop impact on soil with no holes greater than one (1) millimeter in size and allows no gaps between the product and the soil. Has a high water holding capacity but will not form a water-insensitive crust that can inhibit plant growth. Biodegrades completely into materials known beneficial to plant growth.
 - B. Composition:
 - 1. All components of the bonded fiber matrix shall be pre-packages by the manufacturer to assure material performance and compliance with the following typical values. Under no circumstances will field mixing of additives or components be accepted.
 - a. Thermally processed wood fibers (moisture content 12%±3%).....>88%±2%
 - b. Proprietary crosslinked hydro-colloid tackifiers and activators.....<12%±2%
 - C. Acceptable products:
Soil Guard® as manufactured by Weyehauser, Mat, Inc., 12402 Hwy 2, Floodwood, Minnesota 55736, (1-888-477-3028), or Mat-NuWood, LLC, 811 Price Place, Lenior, North Carolina 28645, (1-828758-4463), or equivalent product as approved by the Owner's Authorized Representative or Landscape Architect.
- 2.10 WATER AND IRRIGATION
- A. Potable. Available on site. Applied and monitored by Contractor to establish seed and sod areas.
 - B. Keep seed and sod moist with watering schedules to promote deep roots and to prevent runoff. The site will be watered by permanent underground irrigation systems. Overwatering of planting areas should not occur. Refer to irrigation plans.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive Work.
 - 1. Verify that all areas to receive turf grasses are clear of stones larger than one (1) inch diameter, weeds, debris and other extraneous materials.

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2. Verify that rough grades are left below finish grades in order to accommodate the following work, the addition of stockpiled/manufactured topsoil, soil amendments and sod (if sod is shown on the plans). The top of sod with amended soil after settlement shall meet the finished grade as shown in the grading plans. Report all variations in writing.

B. Soil Moisture:

Inadequate Moisture: Do not commence work of this section when soil moisture content is so great that excessive compaction will occur, nor when it is so dry that dust will form in air or that clods will not break readily. Apply water, as necessary, to bring soil to an optimum moisture content for planting.

- C. By beginning Work, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the owner.

3.2 PREPARATION

- A. Examine rough grade, verify elevations noted on the Drawings, observe the conditions under which work is to be performed, and notify Owner's Authorized Representative of unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Owner's Authorized Representative. Beginning of installation means acceptance of existing site conditions.
- B. Thoroughly rip/disrupt/break-up/shatter the soil to a minimum depth of eight (8) inches, preferably deeper due to typical construction site compaction areas of site and areas outside of existing tree drip line/critical root zone (CRZ). Only lightly scarify the soils (about two (2) inches) where tree roots are present. Re-compact to industry standards using a standard gill or comparable piece of equipment.
- C. Remove non-soil materials and construction debris such as wood, rock, brick, cement, pipe, sheetrock, metal, paint, plastic, glass, etc. and unacceptable clays, then re-grade subsoil to established grades for proper drainage.
- D. Ripping/disrupting/breaking-up/shattering of the soils should occur prior to irrigation line installation. If the turf grass sprinkler system has already been installed, then it will be necessary to stake heads and to take necessary measures to prevent damage to the system.
- E. Remove foreign materials and undesirable plants and their roots. Do not bury foreign material beneath areas to be sodded. Remove contaminated subsoil.
- F. Ensure positive drainage away from building and all planting areas adjacent to the building. Ensure positive drainage at all turf grass areas. Maintain lines, levels, profiles and contours. Make changes in grade gradual. Blend slopes into level areas.
- G. Unless it has rained at least one (1) inch within twenty-four (24) hours prior to planting, water turf grass areas thoroughly to provide a moist, not wet, bed before planting.

3.3 AREAS OF APPROVAL

- A. Delineate the area scheduled for sodding on the site using the drawing to scale the shape and size of the planting area.
- B. The Owner's Authorized Representative shall approve the area delineated to receive sod prior to planting.

3.4 PREPARING SOIL & FINE GRADING

- A. Note: During hauling operations, keep walkway and roadway surfaces clean. Promptly remove compost or other material.
- B. Per the soil analysis report, determine if additional organic amendments are to be integrated into the soil preparation for plant health and horticultural suitability. Coordinate addition of amendments with the soil preparation as noted below. If no further soil amendments are required, then soil preparation shall be as noted below.

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C. Weed removal:

1. If site has been freshly graded, compacted or disturbed due to construction efforts and placement of manufactured topsoil, water site for minimum two (2) weeks to encourage weed germination and growth. (If site was graded more than two (2) weeks prior, watering is not needed to encourage weed growth.)
 2. Area scheduled for grass: Totally remove all grasses and weeds, unless directed otherwise by Owner's Authorized Representative. Apply organic herbicide to thoroughly exterminate existing grasses, weeds, or other vegetation (unless noted on the drawing or in the field by the Owner's Authorized Representative for protection) in area scheduled to receive turf grass for grasses.
 3. Clear and remove these existing weeds upon organic herbicide's completed action by grubbing off all plant parts and roots to at least one and one-half (1.5) inch below the surface of the soil.
 4. In area adjacent to existing trees to remain lightly scarify the soil to remove seedlings and other ground vegetation to a depth not to exceed one and one-half (1.5) inches. Keep all scarification a minimum of eight (8) feet from the base of all existing trees. If exposed roots are on the surface of the soil DO NOT SCARIFY.
- D. Remove branches, roots, weeds, rocks, trash and other material foreign in nature from the existing stockpiled topsoil prior to placing stockpiled topsoil or use manufactured topsoil if no suitable stockpiled topsoil material is available. If pulling from a stockpile, push weed growth off top and pull from the lower inside portion of the pile where weed seeds have been heated and are less likely to germinate. Amend stockpiled topsoil to provide organic matter as per 2.5.
- E. Once subsoil is lightly but firmly re-compacted, spread topsoil over areas to be sodded to a depth which will produce a two (2) inch depth minimum after natural settlement and will conform to finish lines, grades and elevations. Add this soil from the outside of the site in, so the subsoil and topsoil create an interface (mingled) layer instead of two (2) distinct layers with the possibility of a pan layer being generated.
- F. Do not drive over re-graded/scarified subsoil clays - dump topsoil on the outside of the site and with a tractor/dozer push topsoil onto scarified clays. Make equipment ride on top of topsoil as this will allow topsoil to partially mix with subsoil clays creating an interface layer instead of a compacted pan layer.
- G. Fine grade, level and scarify with a weighted spike harrow, spike float drag, or by hand raking. Leave no depressions, ruts, soft spots or humps. Finish to lines or elevations shown and parallel to proposed finished grade, as approved. Maintain positive drainage on site. Remove rocks, clods, weeds, trash or debris from area to be sodded. Remove rocks and other foreign materials one (1) inch or greater in any dimension. Legally dispose debris off site.
- H. Place and spread compost over topsoil to depth which will produce a one-half (1/2) inch depth after natural settlement and will conform to finish lines, grades and elevations.
- I. Spread organic biological fertilizer at rate of twenty (20) pounds per one thousand (1,000) square feet over top of spread compost.
- J. Till or disk topsoil and compost with organic biological fertilizer to five (5) inch minimum depth into existing subsoil to eliminate slip-plane between the three (3) materials and to prepare an acceptable bed for sod. Make a minimum of one (1) pass to break up clods and integrate compost evenly into the existing soil. Penetration of soil to a depth of five (5) inches is desired to encourage dormant seed grass and weed growth. Do not till if soil is wet.
- K. Under adjacent existing trees, place and spread compost over area to depth which will produce a one (1) inch depth after natural settlement and will conform to finish lines, grades and elevations. Hand rake mix compost into native soil to two (2) inch depth to eliminate slip-plane between the materials and to prepare an acceptable bed for sod. Make a minimum of one (1) pass to break up clods and integrate compost evenly into the existing soil.

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- L. If soil or weather conditions are unsuitable, cease compost operations. Resume compost operations when proper conditions prevail.
- M. Compact amended soil with lawn roller to final compacted thickness as approved.
- N. Second (2nd) weed and grass removal in areas scheduled for - sodded grass: Water the tilled and fine graded areas to receive grass three (3) weeks prior to sodding to encourage additional disturbed weed and native grass germination and growth. Apply an organic herbicide to thoroughly exterminate existing grasses, weeds, or other vegetation (unless noted on the drawing or in the field by the Owner's Authorized Representative for protection) in areas scheduled to receive sodded grasses. Totally remove all grasses and weeds, unless directed otherwise by Owner's Authorized Representative.
- O. If weeds should germinate prior to sodding, hand pull or re-apply organic herbicide by wick method to eradicate weeds, but do not injure grass.

3.5 SUBSTRATE AND SEEDBED PROTECTION (if temporary seeded perennial rye is required)

- A. Examine substrates and conditions where seeding with bonded fiber matrix will be applied.
- B. Stabilize and protect area from runoff of surrounding plazas and pavements by diversion of runoff away from the face of the slope or into the slope.
- C. Do not proceed with installation until satisfactory conditions are established.

3.6 SODDING

- A. After soil preparation (Section 3.4) is approved by the Owner's Authorized Representative, commence with sodding.
- B. Scope of work: Refer to the plans for the location of areas to receive sod. Sod will also be required in areas designated for turf grass that exceed 4:1 slope, unless noted otherwise on the drawings. Delineate areas to receive sod and receive approval for area by Owner's Authorized Representative prior to planting.
- C. Laying Sod:
 - 1. Time frame for laying sod is from April 15 to October 15.
 - 2. Extend or reduce specified period for laying sod as approved and as necessitated by weather and soil conditions.
 - 3. Final selection of sod: As approved.
 - 4. Do not lay sod when sodding area is muddy or frozen nor when sod is frozen. When soil surface is hot or dry, wet soil to a depth of two (2) inches, six (6) to eight (8) hours prior to sodding.
 - 5. Lift sod from trucks or storage piles and place by hand with close joints and no overlapping. When Beck Roll of sod is used, lay as specified and in accordance with the supplier's instructions.
 - 6. Lay first row of sod in straight line. Place subsequent rows parallel to and tightly against each other. Stagger lateral joints to promote more uniform growth and strength. Do not stretch sod. On slopes, lay sod parallel to contours of slope.
 - 7. Peg sod placed on slopes 2:1 or greater. Peg each strip or section of sod with at least two stakes not more than two (2) feet apart. Use stakes one-half (½) inch by one (1) inch by twelve (12) inches driven flush with top of sod so that roots are in contact with topsoil.
 - 8. Water sod immediately to prevent excessive drying during progress of work. Sod which dries out will be rejected.
 - 9. Roll entire area as sodding is completed in one section so that sod is without surface irregularities, such as depressions and high spots.
 - 10. Irrigate immediately after rolling to wet underside of sod and one (1) inch of soil immediately below.

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11. For athletic fields (if applicable), the sod must be laid to be without bumps, dips or unlevel areas. Continue to level and proof roll field to meet Owner's or Owner's Authorized Representative's approval.

3.7 SEEDING OF TEMPORARY TURF (if required)

- A. Depending on construction schedule, it may be necessary to establish temporary turf to prevent erosion and provide an acceptable appearance of areas scheduled to receive sod. A temporary turf will be required in those areas designated for turf grass for which installation must be delayed until the specified sodding dates. Turf must be accepted after June 1 and prior to November 15, otherwise a temporary turf must be installed. Perform seeding, fertilizing, watering, weeding and other maintenance to ensure full coverage of temporary turf.
 1. Eliminate weeds from all areas to be seeded as specified in Section 3.4.
 2. Application rate: Annual Ryegrass seed over entire area sod at the rate of ten (10) pounds P.L.S. per 1,000 square feet.
 3. Apply with bonded fiber matrix per 3.8 at manufacturer's recommendation for slope and soil type OR equivalent as approved by Owner's representative.
 4. Water all seeded areas to establish full stand within sixty (60) days. Do not allow areas to become dry, or water to the extent that seed will be lost by erosion.
 5. When it is time to install the permanent turf grass or other planting in these areas, kill the temporary lawn with organic herbicide and scarify the soil to remove the temporary grass to depth of three-quarter (3/4) inch to receive new grass sodding.

3.8 BONDED FIBER MATRIX APPLICATION (if required)

- A. Installation (over top of temporary seeded areas and with hydroseeding application):
 1. Strictly comply with manufacture's installation instructions and recommendations.
 2. Erosion control and revegetation:
 - a. Mix and apply bonded fiber matrix at a rate of fifty (50) pounds per one hundred (100) gallons of water over freshly prepared drill seeded surfaces. Confirm loading rates with equipment manufacturer. Do not leave seeded surfaces unprotected especially if precipitation is imminent.
 - b. Do not apply on saturated soils or substrates. Do not apply if precipitation is anticipated within 24-48 hours.
 - c. Minimum curing temperature is forty (40) degrees F. Best results and more rapid curing are achieved at temperatures exceeding sixty (60) degrees F. Curing times may be accelerated in high temperature, low humidity conditions with product applied on dry soils.
 3. Mixing: A mechanically agitated hydraulic-application machine is recommended.
 4. Application: Use a fan-type nozzle (50-degree tip) whenever possible for best soil/seed bed surface coverage. Apply bonded fiber matrix from opposing directions, reducing the "shadow effect" and assuring a minimum of ninety-five (95) percent soil surface coverage. Increase application rates on highly erosive soils or chiseled disked, furrowed, or tracked slopes. Materials show not be applied in channels, swales or other areas where concentrated flows are anticipated.
 5. Do not allow treated areas to be trafficked.

3.9 ESTABLISHMENT PERIOD AND REPLACEMENT

- A. The establishment period for sodding of grasses shall commence at installation and continue throughout the construction period until final acceptance by the Owner's Authorized Representative.

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- B. Maintain sodding and incidental work by performing the following and other operations of care necessary for promotion of growth so that work is in an approved condition throughout establishment period; uniform in color, quality, and coverage; and free of weeds, insects, diseases, surface damage, and other imperfections.
1. Watering: Provide labor and materials for establishment watering.
 - a. First two (2) weeks: Perform watering daily to keep sod beds continuously moist and to maintain moist topsoil to a depth of at least four (4) inches. Water during heat of day to help prevent wilting. Water with frequent, light watering and avoid runoff or puddling. Water may be needed more than once a day depending on weather conditions. Water to ensure germination and root growth for resodding work.
 - b. Remaining weeks: Perform watering weekly, decreasing frequency and increasing amount per application to encourage deep root growth.
Recommended schedule:
 - 1) Next four (4) weeks: Perform watering to provide two (2) soil-wetting events to a depth of four (4) inches per each week.
 - 2) Remainder of growing season: March to November, water to provide two (2) soil-wetting events to a depth of six (6) inches per each month.
 - 3) In prolonged drought, over six (6) weeks in summer with no rain, irrigate once every five (5) to six (6) weeks to keep the dormant turf alive, but not trigger "green-up", unless more regular watering is desired to keep the turf green.
- C. Eliminate weeds that emerge as soon as they appear, in a timely fashion mechanically and/or with an herbicide to prevent establishment and resodding. Use an herbicide that will not injure the newly sodded grass and apply according to manufacturer's recommendations. The Contractor should allow for a minimum of two (2) herbicide applications of areas scheduled for grasses during the establishment period.
- D. Mowing: Turf solid sod grass areas.
1. Mow grass when it reaches a height of four (4) inches. Do not mow until sod is firmly rooted and securely in place. Mow to height of two (2) inches at first cutting. Thereafter, do not remove more than one third (1/3) of grass leaf at any cutting and mow only to enhance root growth. After Thunder Turf (Buffalo, Blue Gramma and Curly Mesquite) grass is established, mow every ten (10) days until final acceptance.
- E. Rolling and reshaping: Roll to maintain uniform surface. Roll to eliminate uneven places in sod. Reshape soil surface to maintain positive drainage. Resod to provide one hundred (100%) percent coverage.
- F. Applying organic biological fertilizer:
1. MicroLife Multi-Purpose 6-2-4 All Organic Biological Fertilizer, as supplied by San Jacinto Environmental Supplies, (713) 957-0909.
 2. Rate: Twenty (20) pounds per one thousand (1,000) square feet of turf area.
 3. Application:
 - a. March
 - b. June
 - c. October
- G. For high-use turf grass areas with heavy foot traffic, additionally top dress with one-half (1/2) inch organic compost in the fall plus aeration to open the compacted soils.
- H. Applying organic herbicides, organic fungicides and/or organic insecticides:
1. Apply as needed to ensure one hundred (100%) percent coverage of turf grass that is weed, disease and pest free.
 2. Apply in spray form by certified applicator.
 - a. Do not apply when temperature exceeds 80 deg. F. or during periods of drought.

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3. Treat fire ant mounds as they appear with approved organic materials.
 - I. Replacing sodding:
 1. Replace sodded areas that are dead or are in an unhealthy, unsightly, or badly impaired condition as soon as possible during specified planting seasons.
 2. Make such replacements in the same manner as specified for original sodding.
 - J. Coordinate watering schedules with other plantings during installation and until final acceptance. DO NOT overwater as this will promote weeds.
 - K. Maintenance Instructions: Submit one (1) electronic copy and two (2) copies of typewritten instructions recommending procedures to be established by the Owner for the maintenance of grasses for one (1) full year. Submit one (1) set of instructions to Owner's Authorized Representative for approval. Submit two (2) copies of revised instructions prior to expiration of Contractor's maintenance period(s) required under the contract.
- 3.10 FIELD QUALITY CONTROL
- A. Owner will engage an independent testing and inspecting agency to perform field inspections and tests and to prepare test reports.
 1. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from requirements.
 - B. Correct deficiencies in or remove and replace that inspections and test reports indicate do not comply with specified requirements.
 - C. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.
- 3.11 CLEANING
- A. Daily removal of rubbish and debris caused by this work from the site.
 - B. Keep site clean during maintenance period.
- 3.12 PROTECTION
- A. Turf grass areas shall be protected against damage from the time work is started until the date of acceptance by the Owner's Authorized Representative. The moving of heavy equipment or materials over turf grass areas shall be done on planks if necessary.
- 3.13 INSPECTIONS
- A. Make written request for inspection after areas have been sodded.
 - B. Submit request for inspection to Owner's Authorized Representative at least two (2) days prior to anticipated inspection date.
- 3.14 FINAL ACCEPTANCE
- A. Due to seasonal requirements, final acceptance of this section may not coincide with that of the remaining contract work.
 - B. Request inspection for final acceptance at least ten (10) calendar days before the end of the establishment period.
 - C. Final acceptance shall be considered the time at which warm season turf grass areas are 100% established, and weed, pest and disease free with complete lush cover and no exposed soil areas showing. Weeds shall not occupy more than 2% of any 40'x40' test area.
 - D. Replace rejected sodded areas as specified so that repair or replacement is rooted and established prior to approval.

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3.15 WARRANTY

- A. In accordance with the General Provisions warranty for grasses shall be valid for one (1) year after final acceptance. Replace dead materials and materials not in vigorous, thriving condition as soon as weather permits. Re-sod areas where grasses have not established. The opinion of the Owner's Authorized Representative as to what constitutes a dead stand of grass shall be final.
- B. Replace grasses with same kind as originally planted at no cost to the Owner. Provide one (1) year warranty on replacement plants. Plants should be replaced at start of next season. Protect irrigation system, other piping conduit, or other work during replacement. Repair any damage immediately.
- C. Warranty excludes replacement of plants after final acceptance because of injury by storm, drought, drowning, hail, freeze, insects, or diseases. Warranty excludes replacement of plants due to negligence, over watering, or improper maintenance by the Owner or Owner's maintenance contractor.
- D. Plants will be guaranteed to be true to species, variety or cultivar as specified.

TABLE 32 9200-1

This chart indicates minimum length of time by which material samples must be submitted for approval before intended use and minimum quantity of each. Usable samples will be returned.

<u>ITEM</u>	<u>TIME</u>	<u>QUANTITY</u>	<u>COMMENT</u>
SOD	7 days	3 square feet	Each variety specified
ORGANIC COMPOST	7 days	1 gallon bag	Organic finished compost
ORGANIC HERBICIDE	7 days	1/2 pint	Unopened container
ORGANIC FERTILIZER	14 days	1 quart	Provide sample
ORGANIC FUNGICIDE	14 days	1 quart	Provide sample
SCREENED SOIL	14 days	1 gallon bag	
MANUFACTURED TOPSOIL	14 days	1 gallon bag	
SEED	10 days	1 pound	Each variety specified
BONDED FIBER MATRIX	7 days	1 quart	
OTHER	7 days	As directed	
MATERIAL		or as approved.	

END OF SECTION

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SECTION 32 9300

LANDSCAPING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Furnish all work and materials, appliances, tools, equipment, facilities, transportation, and services necessary for and incidental to performing all operations in connection with the installation of the landscape.
- B. Conform to the requirements of the general conditions of the contract.

1.2 SUMMARY

- A. Work Includes:
 - 1. Providing complete landscaping as shown.
 - 2. Excavation of plant pits.
 - 3. Percolation test of tree pits in lawn.
 - 4. Eliminating weeds – minimal two treatments.
 - 5. Provide spike harrowing/ripping of compacted soils for beds.
 - 6. Providing plant materials and related items.
 - 7. Providing manufactured topsoil.
 - 8. Providing expanded shale.
 - 9. Providing organic professional compost.
 - 10. Providing organic biological fertilizer.
 - 11. Providing bed preparation and planting.
 - 12. Providing weed barrier under mulch topdressing.
 - 13. Providing mulch topdressing.
 - 14. Providing tree ground anchoring frame.
 - 15. Providing edging.
 - 16. Providing organic herbicide and organic fungicide.
 - 17. Providing organic insecticides.
 - 18. Finished grading of planting areas.
 - 19. Watering with water-wise practices to establish and not over-water plants.
 - 20. Warranty and replacements.

1.3 REFERENCES

- A. The following Codes, Regulations, Reference Standards, and Specifications apply to work included in this Section and Section 32 9200.
 - 1. Codes and regulations of the jurisdictional authorities.
 - 2. Reference Codes and Standards (current standards):
 - a. AASHTO: M288.
 - b. ASTM: A6, C33/C33M.
 - c. American Standard for Nursery Stock, Edition approved April 14, 2014 by American Nursery and Landscape Association (ANSI Z60.1-2014) - plant materials.

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d. Hortus Third, 1976 - Cornell University - plant nomenclature.

- B. Observation at growing site does not preclude right of rejection at the Worksite. Plants damaged in transit or at the Worksite shall be rejected.
- C. Personnel: Perform work only with qualified personnel familiar with required landscaping methods and materials.

1.4 DEFINITIONS

- A. Weeds: Any plant not specified on the drawings or accepted as a substitute.

1.5 QUALITY ASSURANCE

- A. Source quality control: Furnish certificates of inspection of landscape materials, to accompany shipments, as required by governmental authorities or as requested for inspection by Owner. Comply with applicable federal, state, county and local regulations governing landscape materials.
- B. Growing location: Furnish certificates showing where materials have been grown or balled and burlapped.
- C. Qualifications:
 - 1. Manufacturer: Company specializing in manufacturing Products specified with minimum seven (7) years documented experience.
 - 2. Installer: Company specializing in performing the Work of this Section with minimum seven (7) years documented experience installing projects of similar size and scope. The Landscape Contractor shall furnish a list of references or previous work experience as requested by the Owner. The Landscape Contractor shall employ only skilled personnel and provide adequate supervision.
- D. Mockups: Contractor shall provide three (3) foot x three (3) foot representative mockups of each type of bed preparation and aggregate area (if applicable) for approval by the Owner's Authorized Representative and the Landscape Architect to show compliance with Section 3 – Execution.

1.6 SUBMITTALS

- A. Provide representative quantities (1 gallon plastic bag or container) of manufactured topsoil, expanded shale, organic compost and rustic cut mulch. Samples shall be approved by Owner's Authorized Representative prior to installation. Attach product name, address of manufacturer and/or supplier and appropriate literature and composition of material or gradation for each sample. Literature or Product Data shall consist of manufacturer's current specifications, with catalog cuts, data sheets and installation instructions. Samples shall be submitted no less than sixty (60) days prior to installation.
 - 1. Organic Fertilizers: Copy of each products information labeled with manufacturer's name and address and analysis. Submit manufacturer's information or cut sheets on products.
 - 2. Organic Herbicide: Copy of product information labeled with manufacturer's name and address and analysis. Submit manufacturer's information or cut sheets on products.
 - 3. Organic Fungicide: Copy of product information labeled with manufacturer's name and address and analysis. Submit manufacturer's information or cut sheets on products.
 - 4. Organic Insecticide(s): Copy of each products information labeled with manufacturer's name and address and analysis. Submit manufacturer's information or cut sheets on products.
 - 5. Edging: Manufacturer's literature and 12" long sample.
 - 6. Tree Anchoring Frame: Copy of product information labeled with manufacturer's name and address. Submit manufacturer's information or cut sheets on products.

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7. Weed Barrier - Recycled Newsprint Roll Stock Paper: Manufacturer's literature and 12" square sample.
- B. Plant Material Samples: Submit documentation no less than sixty (60) days prior to installation that all plant materials have been located and are ready to be secured. Arrange specific review procedure of plant materials at time of submission. Submittals and review shall be organized as follows:
1. Preliminary Review: Submit representative photographs for review of all plant materials in the required sizes and in available quantity at no less than sixty (60) working days prior to shipment to the site.
 2. Submittal shall include each of these items per plant: 1) a minimum of one (1) high quality color bond image or 2) one (1) color digital image. Include one (1) set for each plant type and size required for the project. The 8-1/2" x 11" sheet/image is to include the name and address of the supplier, size of the plant in the picture and Botanical and English name of the plant and variety/cultivar name. Digital submittals are preferred due to expediting time and for reduction in the carbon footprint.
 3. Tree photographs shall include a person or device to determine scale, and shall include two (2) photographs of each tree type or group. The two (2) photographs shall be taken at approximately 90 degrees from each other. One (1) additional photograph shall be taken at the base of each tree to show root flare and root conditions at the soil surrounding the root flare.
 4. Provide any additional tree groups and specimen photographs as required to illustrate the quality and/or quantity of material.
 5. Poor quality photographs, photographs that are not in color, not labeled, or photographs which do not adequately represent the plant material will be rejected.
 6. Photograph Acceptance and Nursery Review: Acceptance of material through photographs/digital images does not preclude rejection of unsatisfactory material upon delivery. The Owner's Authorized Representative reserves the right to refuse review from photographs or at the grower if, in his judgment suitable material or sufficient quantities are not available. Contractor shall insure a sufficient quantity of plants will be available whenever trips are arranged to a nursery for the purposes of tagging material for the project.
 7. Specific sources of materials may be listed in the plant schedule for availability, size, quality control of plant character and for matching of specific plant growing conditions.
 8. Unavailable Material: If proof is submitted that any plant specified is not obtainable, a proposal will be considered for use of the nearest equivalent size or variety with corresponding adjustment of Contract price. Substantiate such proof in writing no less than sixty (60) days prior to installation.
- C. Sources: Within at least sixty (60) days prior to delivery to site, notify Owner and Owner's Authorized Representative in writing of source of plant material and bed preparation materials required for the project. This data is to be furnished in addition to representative samples.
- D. Special Warranty: Submit written special warranty registered with manufacturer as specified in this Section.
- E. Provide documentation and testing of compost materials as specified in Parts 2 and 3 of this Section.
- F. Maintenance Instructions: Submit two (2) copies of typewritten and one (1) electronic copy of instructions for one (1) full year. Submit to Owner's Authorized Representative for approval. Submit two (2) copies and one (1) electronic copy of revised instructions prior to expiration of Contractor's maintenance period(s) required under the contract.

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1.7 PROJECT CONDITIONS OR SITE CONDITIONS

- A. Verify and examine site conditions with the Owner's Authorized Representative. Proceed when official notice is given to the Contractor that the Work site is ready. Proceed with and complete the landscape work as rapidly as portions of the site become available.
- B. Planting Restrictions: Perform actual planting only when weather and soil conditions are suitable in accordance with locally accepted practice. Do not install plant life when ambient temperatures may drop below 35 degrees F or above 100 degrees F. Commence landscaping work when the Site is free of rocks and debris. All planting areas to be left at depth per drawing details/sections from finished grade by others for landscape contractor to add soil amendments.
- C. Protection:
 - 1. Do not move equipment over existing or newly placed paving without approval of Owner's Authorized Representative.
 - 2. Provide road-boarding to protect paving.
 - 3. Protect paving, structures and any other site improvement from damage, with protection boards, ramps, and protective sheeting.
- D. Utilities:
 - 1. Determine locations of underground utilities and perform work in a manner which is intended to avoid possible damage. Hand excavate, where required, to minimize possibility of damage to underground utilities.
 - 2. Coordinate work with Owner's Authorized Representative to prevent damage to existing underground sprinkler (irrigation) system at trees.
 - 3. Water is available on site. Refer to irrigation system drawings for proposed underground irrigation system.

1.8 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver packaged materials in sealed containers showing weight, analysis and name of manufacturer, supplier or grower. Protect materials from deterioration during delivery and while stored at the site.
- B. Storage: Store products with protection from weather or other conditions which would damage or impair the effectiveness of the product. Protect metal containers from sun during summer months with temperatures above 80 degrees F.
- C. Preparation of Plant Materials:
 - 1. Balled and Burlapped (B&B) Plants: Dig and prepare shipment in a manner intended to protect roots, foliage and branches from damage and protect the shape, and future development.
 - 2. Container Grown Plants: Prepare shipment in a manner intended to protect roots, foliage and branches from damage, and protect the shape for future development.
 - 3. Plants should bear label from the grower certifying genus and species. Labels should be securely attached and waterproof bearing legible designation of botanical and common name. Plants not labeled may be rejected.
- D. Deliver trees, shrubs and other plants after preparation for planting have been completed and plant immediately.
- E. Damage: Protect plant material in transit and at the site. Material not properly protected and which is damaged will be rejected.
- F. Unloading, Handling and Staging of Trees:
 - 1. Staging systems shall be prepared in advance to adequately hold trees above ground for optimum tree health prior to planting. Many times, even with the best planning and coordination, trees cannot be planted when they are delivered.

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2. Use extreme caution when handling trees. Use a strap cradle, adequate for weight and size of tree and root ball, attached to the root ball to unload and move trees. Strapping and wire baskets can break or loosen. Never move, lift, or handle by attaching to or by putting pressure on the trunk. Be very careful not to damage or scar trunks and branches.
3. Prior to unloading, proper moisture shall be maintained in root balls. Trucks shall be staged in the shade prior to unloading. Unloading time shall be no more than two (2) hours per trunk.
4. Immediately after unloading, no more than one hour after unloading, stand the trees up to reduce risk of sun scald. Properly staged trees shall be standing, untied and spaced.
5. Remove cardboard trunk protector within forty-eight (48) hours of trees being stood upright to reduce the risk of damage.
6. Monitor moisture in the root ball by probing the soil with a soil probe and manage supplemental irrigation accordingly. Be careful not to over or under irrigate.
7. During cold weather periods, root balls must be protected from freezing temperatures.
8. Storage is at Contractor's own risk.

G. Handling of Plant Materials:

1. Do not deliver plants until the site conditions are ready for planting. If planting is delayed, heel-in bare rooted or freshly dug plants in a bed containing adequate mulch to keep roots moist. Separate bundles and trim roots, if long or damaged, using sharp pruning shears. Place plants in flats, pots, or other containers in a sheltered spot protected from sun, wind and mechanical damage and keep roots moist. Storage is at Contractor's own risk.
2. Do not lift or handle any plants by tops, stems or trunks at any time. Do not bind or handle plants with wire or rope at any time.

1.9 MOCK-UPS

- A. Mockups of bed preparation and aggregate beds shall each be provided on site in two (2) locations with Owner and Owner's Authorized Representatives to show compliance with Section 3 – Execution.
- B. Coordinate with General Contractor for sequencing of mock-ups to demonstrate soil preparation for planting beds. Mockup may be part of installed area if it shows compliance with Section 3 – Execution.
- C. Contractor shall demonstrate installation of the weed barrier with mulch topdressing prior to planting.
- D. Refer to Section 3.2 Site Preparation.

1.10 SEQUENCING

- A. Coordinate rough and landscape grading, soil preparation, irrigation, and other related units of Work specified in other Sections to ensure that plant material can be supported and installed as indicated.
- B. Coordinate with General Contractor for sequencing of aggregate and/or river rock installation (if applicable). Must occur after all other site work disturbance is complete.

1.11 SCHEDULING

- A. Submit a proposed work schedule to the Owner's Authorized Representative for approval at least sixty (60) days prior to start of work under this Section. After approval, no modification shall be made to this schedule without written authorization by the Owner.
- B. In general, the work shall proceed as rapidly as the site becomes available, consistent with normal seasonal limitations for planting work.

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1.12 WARRANTY

- A. General: Warranties specified in this Section shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.
- B. In accordance with the General Provisions, warranty for plants and trees shall be valid for one (1) year after final acceptance. Replace dead materials and materials not in vigorous, thriving condition as soon as weather permits. The opinion of the Owner's Authorized Representative as to what constitutes a dead plant shall be final.
- C. Replace dead trees or trees not in vigorous, thriving condition as soon as weather permits. Replace trees, which have partially died thereby damaging shape, size, or symmetry. The opinion of the Owner's Authorized Representative as to what constitutes a dead plant shall be final.
- D. Replace plants and trees with same kind and size as originally planted at no cost to the Owner. Provide one (1) year warranty on replacement plants. Trees should be replaced at start of next planting or digging season. In such cases, remove dead trees immediately. Protect irrigation system, other piping conduit, or other work during replacement. Repair any damage immediately.
- E. Warranty excludes replacement of plants after final acceptance because of injury by storm, drought, drowning, hail, freeze, insects, or diseases.
- F. Plants will be guaranteed to be true to species, variety or cultivar as specified.
- G. Warranty: Warrant that all shrubs and groundcover planted under this Contract will be healthy and in flourishing condition of active growth one (1) year from date of Substantial Completion.

1.13 REPLACEMENTS

- A. As soon as weather conditions permit, replace, without cost to Owner all dead plants and all plants not in a vigorous, thriving condition, as determined by Owner's Authorized Representative during and at the end of Warranty Period.
- B. General:
 - 1. Plant materials exhibiting conditions which are determined as being unacceptable due to workmanship by the Contractor shall be repaired and/or replaced at no additional cost to the Owner.
 - 2. Closely match replacements to adjacent specimens of the same species. Apply all requirements of this Specification to all replacements.
- C. Replacement Quantities: Contractor shall be held responsible for a maximum of two (2) replacements for each failed tree and shrub, and same area of groundcover and perennial planting after final acceptance during the Warranty Period.

PART 2 - PRODUCTS

2.1 PLANTS

- A. General: Provide healthy, field-grown ball and burlapped plants or nursery-grown container and boxed plants, well-formed No. 1 grade from a recognized, local nursery, and of the species and variety shown on the drawings, well-developed branches conforming to and complying with the last edition of American Standard for Nursery Stock, Edition approved April 14, 2014 by American Nursery and Landscape Association (ANSI Z60.1-2014). Listed plant heights are from tops of root balls to nominal tops of plants.

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- B. Provide only healthy, vigorous stock, grown under climatic conditions similar to conditions in the locality of the project and free of disease, insects, eggs, larvae, and defects such as knots, sunscald, injuries, abrasions, or disfigurement. Plants will have been grown within a two hundred and fifty (250) mile radius of the site.
- C. Vigor: Plants shall be sound, healthy and vigorous, well branched and densely foliated when in leaf. They shall be free of disease, insect pests, eggs, or larvae. They shall have healthy, well-developed, vigorous and fibrous root systems. Plants shall be free from physical damage or adverse conditions which would prevent thriving growth.
- D. Container and Boxed Stock material:
 - 1. Verify that all container stock has been grown in the containers in which delivered for at least six (6) months, but not over two (2) years.
 - 2. Plants shall have a root ball size of minimum of ten (10) inches in diameter for each one (1) inch caliper, measured six (6) inches above root ball.
 - 3. Root system development:
 - a. Multi-trunked trees must share same root with no single stemmed trees planted together to form a multi-trunk with competing root systems.
 - b. Samples must prove to be free of kinked, circling or girdling roots and with no evidence of a pot-bound condition.
 - c. Trees shall have been grown in heavy or heavy clay soil and irrigated with drip irrigation. Loose potting soils are not acceptable since root mass will flex with trunk sway and allow potential overturn of tree.
 - d. Field grown plants recently planted into containers will be accepted if roots have developed into new soils.
 - 4. Root flare of plant material shall be visible at nursery prior to delivery, and after transplanting into the landscape.
 - 5. Root balls shall not be cracked or broken prior to shipment.
 - 6. Do not remove self-locking tags prior to delivery to site.
 - 7. Remove all weeds and other invasive plants from the base of the nursery plant's root container prior to delivery to site.
- E. Nursery grown B&B material:
 - 1. Plants shall have a root ball size of minimum of ten (10) inches in diameter for each one (1) inch caliper, measured six (6) inches above root ball.
 - 2. Root system development:
 - a. All named cultivars shall be own root clones; no grafted or bud-grafted trees will be accepted.
 - b. 100% mechanically root-pruned at least once and transplanted a minimum of three (3) times during the first three (3) years of the tree's life.
 - c. Trees shall have been grown in heavy clay soil and irrigated with drip irrigation.
 - d. Plants shall be well healed in for a minimum of thirty (30) days with a flush of new roots at the edge of the burlap prior to shipping. Recently dug plants will not be accepted.
 - e. Trees shall have no girdling roots, have no "J" shaped roots, and the trunk flare shall be visible.
 - 3. Ensure balls are firm, neat, slightly tapered, and well burlapped.
 - 4. Root balls shall not be cracked or broken prior to shipment.
 - 5. Root flare of plant material must be above ground and visible at nursery before harvest, prior to delivery, and after transplanting into the landscape.

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6. Root liner grown trees shall have been planted such that their root flare is visible above the finished grade of the liner. No buried tree flares will be submitted or accepted.
 7. Do not remove self-locking tags prior to delivery to site.
 8. Remove all weeds and other invasive plants from the base of the nursery plant's root ball prior to delivery to site.
- F. Shade and Ornamental Trees - Canopy development:
1. No. 1 grade nursery stock healthy, vigorous, full-branched, well-shaped, trunk diameter, and height requirements as specified
 2. There shall be a strong central leader to the top of the canopy. The tip of the leader on the main trunk must be intact and it's terminal bud must be the highest part of the tree.
 3. No branch can have a diameter greater than 2/3 the trunk diameter measured directly above the branch crotch. The tree will have no inclusions or co-dominant branches.
 4. The tree crown shall be structurally uniform. Branches shall be evenly distributed around the trunk. The crown shall be full of foliage which is evenly distributed around the tree.
 5. Trees that have had branches tipped or cropped will not be accepted.
 6. Provide trees with full rounded crowns, meeting height and spread standards after pruning. No flat sided trees or trees with open areas on any side will be acceptable. Trees shall be consistently superior in form and branching, and typical of the growth habit of their species unless otherwise specified.
- G. Tree Caliper Measurement Requirements: for a single stem tree, the diameter (caliper) of the trunk shall be measured twelve (12) inches above the top of the root ball for a tree having a diameter up to and including eight (8) inches, and measured at four and one-half feet above the top of the root ball for a tree having a diameter of more than eight (8) inches. For multi-stem trees, the diameter of the trunk measured at the narrowest point below branching when branching occurs higher than twelve (12) inches above the top of the root ball. When branching occurs at or lower than twelve (12) inches above the top of the root ball, caliper means the diameter of the largest stem plus the average diameter of the remaining stems, measured at four and one-half (4.5) feet above the top of the root ball.
- H. Shrubs, ornamental grasses, yuccas, hesperaloe, opuntia, groundcovers and perennials: Nursery grown, healthy, vigorous, of normal habit of growth for species, free from disease, insect eggs, and larvae. Specified sizes are before pruning and measured with branches in normal position. Plants to be well rooted and established in the container.
- I. Plants shall conform to the sizes and quality notes in the plant list and/or as indicated, with the exception of that larger plants than those specified may be used if approved by the Owner's Authorized Representative. Use of larger plants shall not increase the contract price. Specified sizes shall be after pruning, and plants shall be measured with their branches in normal position.
- J. Pruning: Do not prune plants before delivery. If pruning is necessary, prune with direction from Owner's Authorized Representative (Landscape Architect).
- K. Plant protection during shipping: Wrap canopy of plants prior to loading to ensure that branch structures are protected, and that wind damage is minimized. Shrubs and smaller plant material will be handled and loaded to protect character and form of each plant. Removal of protection strapping and wrapping shall be handled with care to prevent damage to the plant material once it is delivered to the site. Damaged materials will be subject to rejection.
- L. Upon delivery to site:
1. Reject trees with cracked, lose or broken balls when frame or burlap is removed at time of planting.
 2. Trees will be individually approved or rejected by the Owner's Authorized Representative on site.

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3. Trees: Free of physical damage such as scrapes, bark abrasions, or split branches.
 4. Trees for planting adjacent to sidewalk shall be pruned and branched up to seven (7) foot height above the finished grade of the sidewalk or accessible surface for pedestrian clearances as directed by the Owner's Authorized Representative.
- 2.2 ORGANIC BIOLOGICAL FERTILIZER – Refer to Section 32 9200 – 2.2 “Turf and Grasses”.
- 2.3 MANUFACTURED TOPSOIL – Refer to Section 32 9200 – 2.3 “Turf and Grasses”.
- 2.4 COMPOST - Professional Compost - 100% plant based - Refer to Section 32 9200 – 2.4 ‘Turf and Grasses’.
- 2.5 EXPANDED SHALE
- A. Expanded Shale: shall be rotary kiln expanded shale and clay lightweight aggregate as manufactured and supplied by Arcosa Lightweight Arlington, TX (817-635-8541), local representative: Eric Nelson, cell (817-635-8541) or equivalent as determined by the Owner's Authorized Representative.
- 2.6 PRE-EMERGENCE AND POST-EMERGENCE FOR WEED REMOVAL - ORGANIC HERBICIDE AND HAND PULLING – Refer to Section 32 9200 – 2.5 “Turf and Grasses”.
- 2.7 MISCELLANEOUS PLANTING MATERIALS
- A. Wrapping Material: Do not use!
 - B. Tree Paint: Do not use!
- 2.8 WEED BARRIER AND TOPDRESSING
- A. Weed Barrier for Planting Areas: Recycled roll stock newsprint paper as manufactured in the U.S. Available: Global Industrial at (1-888-978-7759), www.globalindustrial.com; or Uline (1-800-958-5463) / (1-800-295-5510), www.uline.com; or Pack Secure at (1-888-511-7225), www.packsecure.com, or equivalent product as determined by the Owner's Authorized Representative.
 - B. Mulch for Planting Beds at Parking Lot Screening and Tree Watering Wells at Turf – material screened to not exceed eight (8) inches:
 1. Rustic Cut Hardwood – native hardwoods; free of: man-made foreign material, lumber, treated materials, woodmill sawdust or pine bark; hammer mill processed, decomposed - heat sterilized two (2) times to remove latent weed seeds, aged for minimum two (2) to four (4) months, screened to remove fines.

No soft green or unprocessed materials allowed. 96% of material will pass through a one (1) inch screen with additional screening down to three-eighths (3/8) inch, 98% of material will not exceed eight (8) inches in length. Material shall have no pungent odors, but will have an earthy smell. As processed and supplied by Soil Building Systems, 2101 Walnut Hill Lane, Dallas, TX 75229 (972-831-8181), attention: Baron Ablon.
 2. Tree Mulch (once ground native hardwood mulch) custom screened material to match properties of mulch noted above and to not exceed eight (8) inches in length. Product must have been heat sterilized (2) times to remove latent weed seeds and aged for minimum two (2) months. No soft green or unprocessed materials allowed. As specially processed and supplied by Living Earth (LETCO), Dallas, TX, if determined to be an equivalent by the Owner's Authorized Representative.
 3. Locally available material meeting equivalent requirements as specified above.

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2.9 ANCHORING SYSTEM FOR SHADE AND ORNAMENTAL TREES

- A. For anchoring of tree root balls in planting bed areas and native grass areas.
- B. Re-bar anchoring ring, with ring cuts to rust apart and to prevent tree girdling, with three (3) six (6) inch U brackets, color: natural metal or painted, and three (3) separate anchors with S-hook and tightening strap.
- C. Anchoring rings to have two (2) cuts per ring, four (4) total, for fail-points.
- D. Below Grade Safety Stakes (ground anchors) as manufactured by Tree Stake Solutions, local representative: Jeff Tuley, (903-676-6143), www.treestakesolutions.com, or equivalent as approved by the Owner's Authorized Representative.

<u>Item #</u>	<u>Description</u>
15-BG	10-15 gal. or 17" root ball with 3 – V68 Anchors
30-BG	20-30 gal. or 22" root ball with 3 – V68 Anchors
45/65BG	45-65 gal. or 27-30" root ball with 3 – V68 Anchors
100-BG	95-100 gal. or 36" root ball with 3 – V68 Anchors

2.10 EDGING

- A. Aluminum Edging with drain ports: PermaStrip™ FLO Series – L-shaped Aluminum Edging with drain port slots at 12" o.c., eight (8) foot sections with notches for bending, 3/16 inch x 3.5 inch, mill finish, heavy duty as supplied by Permaloc, 1(800)358-9660, www.permaloc.com, or equivalent as approved by the Owner's Authorized Representative.

2.11 ORGANIC FUNGICIDES - Refer to Section 32 9200 – 2.6 "Turf and Grasses".

2.12 ORGANIC INSECTICIDES

- A. Soft Bodied Insects (aphids, mites, thrips, white flies, lace bugs, etc.):
 - 1. EcoSMART® Organic Insecticides as manufactured by a division of the Kittrich® Corporation, Atlanta, GA 30336, (714-736-1011).
 - 2. Neem Oil.
- B. Scale: Use 2 ounces of Orange Oil mixed with 1 ounce of Neem Oil to a gallon of water. Spray weekly for 3 weeks.
- C. Caterpillars, Army Worms, Sod Webworms: Use Bacillus Thuringiensis (BT) biological agent.
- D. Chinch Bugs:
 - 1. EcoSMART® Granular, as manufactured by a division of the Kittrich® Corporation, Atlanta, GA 30336, (714-736-1011).

2.13 ORGANIC INSECTICIDE - FIRE ANTS – Refer to Section 329200 – 2.7 "Turf and Grasses".

2.14 WATER

- A. Potable. Available on site. Refer to the irrigation specifications and plans. Truck or other means of watering shall be required to establish native grass areas behind the sidewalks where no existing or temporary irrigation system exists.

2.15 MACHINERY AND EQUIPMENT

- A. Machinery requirements listed under this Section are NOT intended to be restrictive of specific manufacturers or models, unless so stated. Specific mention of the manufacturers is intended as a guide to illustrate the final product of the maintenance operations desired. All equipment used shall be and maintained in top working condition at all times.

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- B. Pruning and grinding tools shall be maintained in safe, working condition, cutting edges shall be sharp at all times.
- C. Fertilizer and insecticide spreaders (for organic products) shall be of the hand-held or cyclone type. Vehicle-mounted or push cyclone spreaders shall be allowed. Spreaders shall be in a safe working condition at all times.
- D. Insecticide and fungicide sprayers (for organic products) shall be of the hand-held, backpack, or vehicle-mounted type. Sprayers shall be in a safe working condition at all times.
- E. The Contractor shall be responsible for any grade, plant material (native grass, trees, shrubs, etc.), or hardscape amenity (fence, pavement, arbor, steel edging, stone wall, etc.) damage caused by the spreader or sprayer and the application process.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive Work.
 - 1. Verify that all planting areas are clear of stones larger than one (1) inch diameter, weeds, debris and other extraneous materials.
 - 2. Verify that grades are within one (1) inch plus or minus of the required finished grades. Report all variations in writing.
 - 3. Verify that rough grades are left below finish grades in order to accommodate the following work, the addition of stockpiled topsoil, manufactured topsoil, soil mixes, soil amendments, mulch and aggregates. The top of the amended stockpiled topsoil or manufactured topsoil and top of aggregates shall meet the finished grade as shown in the grading plans. Report all variations in writing.
- B. Soil Moisture:
Inadequate Moisture: Do not commence work of this section when soil moisture content is so great that excessive compaction will occur, nor when it is so dry that dust will form in air or that clods will not break readily. Apply water, as necessary, to bring soil to an optimum moisture content for planting.
- C. By beginning Work, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the owner.

3.2 SITE PREPARATION

- A. Coordinate with General Contractor for scheduling and sequencing of installation of planting bed areas to ensure that the areas are protected from construction sediment runoff.
- B. Examine rough excavated grade/subgrade for planting areas and verify conditions under which work is to be performed. Do not proceed with work until all grading and related work is completed in a satisfactory manner so that the landscape installation can proceed. All lumps, clods, and debris over two (2) inches in diameter shall be removed from the Worksite.
- C. Delineate bed areas and receive approval from Owner's Authorized Representative prior to starting work. Beginning of installation means acceptance of existing site conditions.

3.3 BED PREPARATION AT PLANTING BED AREAS

- A. Ensure rough grading of planting beds is provided to grade elevation to allow for amendment installation and drainage for positive surface flow for runoff.
- B. Coordinate for irrigation installation to allow for plant placement and for height of heads relative to finished topdressed beds.

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- C. Weed and invasive vegetation removal:
 - 1. Organic Herbicide: Treat weeds and invasive vegetation with organic herbicide to eradicate any material growing after rough grading for beds.
 - D. Thoroughly clear and remove the existing weeds and grass roots upon organic herbicide's completed action by grubbing off all plant parts and root systems to depth to allow for proposed planting bed soil amendments and topdressing, and to prevent re-growth of removed plant.
 - E. Thoroughly rip/disrupt/break-up/shatter the soil to a minimum depth of fourteen (14) inches due to typical construction site compaction. Re-compact to industry standards using a standard gill or comparable piece of equipment. Remove non-soil materials and construction debris such as wood, rock, brick, cement, pipe, sheetrock, metal, paint, plastic, glass, etc. and unacceptable clays, then re-grade subsoil to established grades for proper drainage of planting beds.
 - F. Ripping/disrupting/breaking-up/shattering of the soils should occur prior to irrigation line installation. If the native grass sprinkler system has already been installed, then it will be necessary to stake heads and to take necessary measures to prevent damage to the system.
 - G. Upon delivery of stockpiled/manufactured topsoil and planting amendments, ensure that the material is protected and is not contaminated with any materials or soils on the site prior to installation.
 - H. Delineate bed areas and receive approval from Owner's Authorized Representative prior to starting work.
 - I. Open bed areas to receive shrubs, groundcover, ornamental grass and perennials to be prepared as follows to provide a stratified bed mix.
 - 1. Install two (2) inches (settled depth) of topsoil.
 - 2. Till to depth of ten (10) inches to mix topsoil thoroughly with native disrupted soil.
 - 3. Install three (3) inches (settled depth) of expanded shale.
 - 4. Till to a depth of ten (10) inches to mix additives thoroughly with topsoil/native soil.
 - 5. Install three (3) inches (settled depth) of organic compost.
 - 6. Apply organic biological fertilizer at rate per manufacturer's recommendations for bed preparation at forty (40) lbs. per one thousand (1,000) square feet.
 - 7. Till compost and organic biological fertilizer to a depth of ten (10) inches to stratify into shale/soil mix.
 - J. Set beds to finished grade of media to allow for topdressing installation depth.
 - K. Coordinate installation and placement of irrigation mainline at edge of bed to ensure that they are clear of tree root ball installation and do not impede planting. Lateral irrigation lines for bubblers, drip irrigation and spray heads shall be provided per irrigation plans.
 - L. Water beds to promote germination of dormant weeds and grasses, if media has been contaminated or mixed with soils containing native weed seeds prior to installation in planter beds.
 - M. Treat weeds in bed with application of organic herbicide.
 - N. Remove weeds after organic herbicide treatment period by hand digging.
- 3.4 PLANT PREPARATION AT HOLDING AREA PRIOR TO INSTALLATION AT BED AREAS
- A. If plants arrive at site with root flares covered, Contractor shall remove all spider roots that could eventually grow to choke the trees and shall clear the soils off the top of the root ball to provide positive drainage from the exposed root flare elevation.
 - B. Contractor shall completely remove all weeds, vines or plant seedlings, including their root system, growing at top of container or on top of the root ball to ensure that these invasive non-specified plants do not gain foothold to establish in the planting beds and cause additional maintenance to remove.
 - C. Removal and disposal of all weeds, vines or plant seedlings shall occur prior to any plant moving for installation or placement in the planting beds.

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3.5 TOP DRESSING PLANTING BEDS (WEED BARRIER)

- A. After finished grade has been approved, top dress parking lot shrub screening bed areas first with eight (8) rolled layers of recycled roll-stock newsprint paper, as specified in 2.8 A., to provide a weed barrier.
- B. Then top dress bed areas with rustic cut hardwood mulch to a depth of three (3) inches compacted depth.
- C. In planting beds, this top dressing occurs prior to plant installation. Delay this operation until near final acceptance.
- D. Top dressing must achieve specified depth to attain final acceptance.
- E. Hold mulches back to expose the flare of the plant, once the plant is installed, or tree trunk at the root ball if in planting bed. Do not dump mulch over tops or crowns of plants.

3.6 PLANTING OF PLANTING BEDS

- A. After topdressing has been installed Contractor shall mark proposed locations for plants with contractor spray paint or lay out plants over top of topdressing at required spacing. Obtain approval from Owner's Authorized Representative.
- B. The Owner's Authorized Representative reserves right to interchange or shift locations of plants prior to planting.
- C. Once sprayed locations have been approved by Owner's Authorized Representative, pull back topdressing layer of mulch to expose the area of newsprint where the plant will be located.
- D. Carefully cut cross-shaped slits to provide an opening for the plant. Roll/pull back the cut paper for plant installation.
- E. Plant in pits two (2) times greater in diameter than root balls or container diameter. Remove all burlap, ropes, wires and strings from the rootball prior to planting.
- F. Remove the container from the prepared plant.
- G. Score the root ball vertically at four (4) equal points around the edge prior to planting.
- H. Plant the noted sized plants such that top of the root ball at the flare of the plant is:
 - 1. One and one half (1 1/2) inch above finished grade of the weed barrier for plants in two (2) gallon or larger sized containers.
 - 2. One (1) inch above the top of the weed barrier for plants in containers at one (1) gallon or five (5) inch pots.
 - 3. One-half (1/2) above the top of the weed barrier for smaller plant containers and plugs.
- I. Backfill to depths of root balls with planting media. Carefully settle by watering to prevent air pockets. Water in thoroughly.
- J. Fold the cut back sections up to the root flare of the plant and pull compost/mulch topdressing back to cover the newsprint.
- K. Hold mulch back to keep the root flare exposed and to keep moisture away from foliage base and prevent yellowing.
- L. Carefully prune plants to remove dead or broken branches and hand-rake bed areas to smooth even surfaces.

3.7 TREE PIT PERCOLATION TESTING

- A. For all Canopy Shade and Ornamental Trees locations:
- B. For all Canopy Shade and Ornamental Trees locations:
 - 1. Stake locations for approval by Owner's Authorized Representative prior to excavation.

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2. Percolation test for trees in turf or planting beds and turf beds: After approval of tree locations, excavate pit and perform percolation test. The pit shall be the same depth as the height of the root ball or slightly less so that the root ball sits approximately two (2) inches above surrounding grade. The pit shall be dug square so that the pits are twelve (12) inches or more greater in diameter than root balls for trees in planter beds or two (2) times the diameter of the root ball for trees in turf areas. Fill excavated pits with water and wait until next day. If the water level has not dropped at least six (6) inches within twelve (12) to twenty-four (24) hours, then notify the Owner's Authorized Representative. An Owner's Authorized Representative must be present to monitor and record the results of the percolation test.
3. Option: If shallow rock layers are encountered, the bottom of the tree pit may need to be fractured up with a jack hammer to allow drainage. Provide testing as noted in 2 above for determination.
4. Option: If there is a high water table in the area, then a tree drainage system may be required. Provide testing as noted in 2 above for determination.
5. Option: Auger a subdrain sump. Provide testing as noted in 2 above for determination.
6. Option: Install tree root flare elevation at six (6) inches higher than finished grade if the above conditions fail.
7. Install the tree drainage system as approved if needed and mark to prevent damage during tree anchoring.

3.8 CANOPY AND ORNAMENTAL TREE PLANTING

A. General Planting Requirements for all Canopy Shade and Ornamental Trees:

1. Prepare trees: Remove all girdling roots, circling roots, spider roots, excess soil and other vegetative weeds or vines completely from the top of the root ball to expose the tree's natural root flare top of the root ball for installation.
2. Handling trees: Use extreme caution. Use a strap cradle (adequate for weight and size of root ball) attached to root ball to unload and move trees. Strapping and wire basket can break or loosen.
3. Never move, lift or handle by attaching to or by putting pressure on the trunk. Be certain that equipment, including straps, chains, and cradles, are rated for the weights of the trees being lifted.
4. Face tree to give best appearance and to allow for required branching height clearance above walks and streets. Provide branching orientation turned to provide for best growth pattern to prevent conflict with vehicles or adjacent structures. Receive approval from the Owner's Authorized Representative or Landscape Architect prior to final installation to prevent further handling or damage to the root system.
5. Handle tree only by root ball.
6. Maintain tree in a straight and plumb position.
7. After above items have been completed, remove synthetic wrap, cardboard packaging, and cut/remove the wire basket down to the bottom of the tree pit. Remove the burlap from the top portions of the root ball.
8. Position tree anchoring frame over top of root ball and install ground anchors to align to frame above. Connect anchoring hooks and adjust tree to ensure it is plumb and anchored securely to the subgrade per manufacturer's directions prior to starting backfill. Refer to tree anchoring details for further information.
9. Backfill the lower portion against the root ball as noted per specific requirements of B. and C. below.
10. Saturate the planting hole with water after backfilling is one half (½) complete to aid removal of air from the backfill.

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11. After initial backfill, watering, and the tree is plumb, then add backfill to nine (9) inches below finished grade, saturate planting hole and adjust root ball, if necessary, to make tree straight and plumb.
 12. Backfill remaining balance of fill at top of root ball as noted per B. and C. below.
 13. Remove all remaining shipping straps, tags, tapes, ties, stakes and other items from the trunk and canopy of the tree.
 14. Provide watering dam at the edge of the tree's drip line/canopy edge to keep the tree's root flare fully exposed.
 15. Provide and apply organic root simulator at one (1) to two (2) ounces per gallon of water. Soak roots well.
 16. If rock is encountered:
 - a. Owner's Representative may select alternative location. Location shall not impede visibility triangles.
 - b. Rock shall be jack-hammered and removed to a minimum of six (6) inches below the plant if an alternative location cannot be selected and tree drainage pits shall be installed.
- B. Canopy Shade and Ornamental Trees in Planting Beds:
1. Excavate tree pits twelve (12) inches greater in diameter than root balls or container diameter.
 2. Rip bottom and sides of pit to break up construction compaction, and then recompact bottom only by hand.
 3. Place tree directly into excavated pit such that the trunk flare will be two (2) inches above surrounding finished grade in planter bed. Refer to planting details for cross-section of tree planters.
 4. Backfill the lower portion of tree pit to not more than one half ($\frac{1}{2}$) the depth of the root ball with excavated native soils.
 5. Backfill the top nine (9) inches with adjacent amended planting media blended with two (2) ounces of organic biological fertilizer per each five (5) gallon increment in tree root ball size and thoroughly saturate top backfill layer with water to aid removal of air pockets.
 6. Provide top dressing per 3.5 for planting beds.
- C. Canopy Shade and Ornamental Trees in Turf Areas:
1. Till soil to ten (10) inch depth within ten (10) foot radius of tree for trees in native grass or turf areas.
 2. Excavate and plant tree in square pits two (2) times greater in diameter than root balls or container diameter.
 3. Rip bottom and sides of pit to break up construction compaction, and then recompact bottom only by hand.
 4. Place tree directly into excavated pit such that the trunk flare will be two (2) inches above surrounding finished grade in turf area. Refer to planting details for cross-section of tree planters.
 5. Backfill the lower portion of tree pit to not more than one half ($\frac{1}{2}$) the depth of the root ball with excavated native soils.
 6. Saturate the planting hole with water after backfilling is one half ($\frac{1}{2}$) complete to aid removal of air from the backfill.
 7. After initial backfill, watering, and the tree is plumb, then add backfill to nine (9) inches below finished grade, saturate planting hole and adjust root ball, if necessary, to make tree straight and plumb.

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8. Backfill the top nine (9) inches with mix of one (1) part compost to one (1) part native stockpiled/manufactured topsoil blended with two (2) ounces of organic biological fertilizer per each five (5) gallon increment in tree root ball size and thoroughly saturate top backfill layer with water to aid removal of air pockets.
9. Topdressing – See 3.11 below, similar.

3.9 TREE SAUCERS

- A. Form a watering saucer around each new tree per construction drawings. Keep root flare exposed and keep watering saucer at edges of tree root ball. Saucer shall be no higher than three (3) inches.
- B. Contractor is responsible for deep watering trees a minimum of once (1) per week until final acceptance and as needed to promote growth.

3.10 TREE ROOT BALL ANCHORING

- A. Anchor trees prior to backfilling to ensure ground anchors are firmly into existing subbase.
- B. Anchor all trees as detailed and per manufacturer's requirements.
- C. Take precautions during staking operation to prevent damage or injury to roots and irrigation or other underground utility lines.

3.11 TOPDRESSING TREES IN TURF AREAS

- A. After watering saucer has been approved, top dress root zone area first with eight (8) rolled layers of recycled roll-stock newsprint paper, as specified in 2.8 A., to provide a weed barrier.
- B. Then top dress tree root balls with rustic cut mulch to a compacted depth of three (3) inches.
- C. Top dressing must achieve specified depth to attain final acceptance.
- D. Hold mulches back minimum of six (6) inches to expose the flare of the tree trunk at the root ball.

3.12 PRUNING OF NEW TREES

- A. Prune trees to preserve natural character of plant. Remove sucker growth, broken or badly bruised branches, and crossed branches.
- B. Thin native trees heavier than nursery grown plants.
- C. When directed by the Owner's Authorized Representative, remove approximately one-third of wood by thinning. Do not cut back terminal branches.

3.13 EDGING

- A. Refer to the drawings for type of edging specified at specific locations.
- B. Provide slotted edging where noted on Drawings on-grade at interface of turf bed to planting bed.
- C. On-grade: Set edging as indicated in true lines as designed with top of edging two (2) to three (3) inches above finish grade. Receive approval from Owner's Authorized Representative for layout of edging prior to installation. Refer to details for additional requirements.

3.14 NEW AND EXISTING TREES

- A. Trees shall be continuously and routinely inspected for distress caused by construction activities. Notify Owner's Authorized Representative at first sign of distress.

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- B. Any Fire Ant mounds around or on top of a new or protected tree root zone shall be treated immediately and the mound removed physically. Do not allow the mound to build on the tree trunk as this will cover the tree root flare and possibly cause injury or death. Ensure that any chemical application to the Fire Ant mound is safe for application atop tree root zones.
 - C. Trees: Pruning will be carried out by experienced pruning personnel.
 - 1. Receive approval in the field for extent of pruning from Owner's Authorized Representative.
 - 2. Sterilize pruning tools between individual plants, especially in the genus *Quercus*.
 - 3. Raise limbs to an acceptable height as approved by the Owner's Authorized Representative. Raise limbs to seven (7) foot height for trees within ten (10) feet of sidewalk.
 - 4. No weed-eaters or edgers are to be used within fifteen (15) inches of any tree. Should the need for trimming be necessary within fifteen (15) inches of any tree, it shall be done so by hand trimming only.
 - D. Remove dead wood, broken branches, mistletoe and suckers from trees as needed. Thin prune by removing no more than twenty (20) percent of growth. Sterilize pruning tools between individual plants to keep down spread of disease.
 - E. Spray paint all wounds of plants of the genus *Quercus* as soon as possible. Spray paint deliberate wounds on genus *Quercus* within one (1) hour and accidental wounds due to storms, etc. as soon as possible.
 - F. Spray type paints that are non-latex or non-petroleum based and are dark brown, dark gray or black in color are acceptable for use only on genus *Quercus*.
 - G. Wounds on other species shall be allowed to compartmentalize naturally, unless determined otherwise by Owner's Authorized Representative or Arborist. Refer to Section 01 5639 – 2.1 for acceptable wound paint.
 - H. Dispose of all waste and removed material off site per requirements of local codes.
- 3.15 WEED REMOVAL
- A. Contractor shall hand-remove foreign grass, weeds and immature weeds prior to formation of seed heads.
 - B. Contractor shall monitor and remove weeds, with root systems, from top of nursery grown plants to prevent competition for plant growth.
 - C. Remove all poison ivy or other native vines, with root systems, from bases of tree's root balls.
 - D. Contractor shall obtain prior approval from the Owner's Authorized Representative before applying the approved organic herbicides. Read and follow all label directions.
 - E. The Contractor shall be held solely responsible for plant loss due to the application of organic herbicides. Any loss of plant material shall be replaced at Contractor's sole expense and all plant replacements shall be of the same species and size of the existing plant materials.
 - F. Hand weeding or plant specific application of organic herbicide shall be used during plant establishment.
- 3.16 DEEP ROOT WATERING
- A. Deep root water all existing trees to remain within the construction limits of the project once every two (2) weeks during the summer and once (1) a month during the winter, during the duration of the project and until final acceptance. This should be adjusted to the amount of rain. However, unless it has rained at least one-half (1/2) inch since the last watering, continue to deep root water. Complete deep root watering by filling each tree saucer three (3) times and letting it percolate dry.

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- B. Water new plantings to provide optimum soil moisture level for plant germination and root development and not to exceed watering requirements.

3.17 PLANT CARE UNTIL FINAL ACCEPTANCE

- A. Water: When irrigation system is not operational, provide necessary hoses and other watering equipment required to complete landscaping.
- B. Maintain plantings and trees by watering, cultivating, weeding, raking, fertilizing, controlling diseases and pests, cleaning, and replacing plants as necessary to keep landscape in a vigorous, healthy condition as needed until final acceptance. Maintenance until final acceptance includes but is not limited to the following:
 - 1. Watering Trees: Tree balls to be kept moistened to the depth of the tree ball.
 - 2. Weeding: Remove weeds and foreign grass over plant areas at least once (1) a week.
 - 3. Cultivating: Gently cultivate bed areas to a depth of approximately three (3) inches once (1) a month. Care should be taken not to damage plant roots.
 - 4. Mowing and Edging; Refer to Section 32 9200.
 - 5. Application of approved organic insecticides, organic herbicides and organic fungicides shall be in accordance with manufacturer's instructions per Owner and Owner's Authorized Representative approval. Remedy damage from use of insecticides.
 - 6. Trimming and pruning includes only removal of dead or broken branches, and treatment of pruned areas and other wounds. Do not shear any plants.
 - 7. Disease control.
 - 8. Maintenance of temporary BMP's to prevent washout, siltation, or damage to planting beds (if applicable).
 - 9. Tree straightening: Best for the health of the trees to wait until dormancy to straighten or reset the trees that have started to root into the backfill. Straighten by carefully digging out around the root ball, attaching seat belt strap to the part of the wire basket that is still intact around the root ball, and lifting with appropriate equipment, or adjusting the anchoring straps for the tree anchoring frame. Never pull, push or put pressure on the trunk. Then repeat applicable planting instructions 3.8.
- C. Coordinate watering schedules during installation and until final acceptance. Provide deep root watering to keep root balls moist on newly installed trees at a minimum of once (1) every two (2) weeks during summer months or as weather conditions indicate.
- D. Maintenance Instructions: Submit two (2) hard copies and one (1) electronic copy of typewritten instructions recommending procedures to be established by the Owner for the maintenance of landscape prior to expiration of Contractor's maintenance period(s) required under the contract. Submit to Owner's Authorized Representative for approval.

3.18 CLEAN-UP

- A. Keep premises neat and orderly including organization of storage areas.
- B. Remove trash and debris from excavated planting areas, preparing beds, or planting plants from Work site daily as work progresses.
- C. Clean faces of building, walls, and other architectural features to remove sediments.
- D. Keep paved areas clean by sweeping or hosing.

3.19 SITE ENVIRONMENTAL PROCEDURES

- A. Waste Management: Comply with requirements of local codes for recycling and reusing waste.
- B. Waste Disposal: Disposal of waste, including accessories and used items, by recycling or reusing waste to the extent practical. When washing containers for recycling, do not permit runoff to enter storm drains or sewer systems or penetrate soils.

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3.20 FINAL ACCEPTANCE

- A. Due to seasonal requirements, final acceptance of this section may not coincide with that of the remaining contract work.
- B. Request inspection for final acceptance at least ten (10) calendar days before the end of the plant care and maintenance as described in 3.17.
- C. Final acceptance shall be considered the time at which planting, related work and clean-up are one hundred (100%) percent completed.

END OF SECTION

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SECTION 334100

STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.01 SCOPE

- A. Section Includes: Furnishing high density corrugated and corrugated smooth lined Polyethylene storm sewer tube and fittings for gravity flow sewers, including all clearing and grubbing, excavation, sheetings, shoring, dewatering, pipe laying, jointing, backfilling, and any other work that is required or necessary to complete the installation as shown on the plans and as specified herein.

1.02 DESCRIPTION

- A. This item shall govern for the furnishing and installing of all High Density Corrugated Polyethylene (HDPE) Smooth Lined Pipe and / or materials for constructing of culverts, side road pipes, storm sewers, stubs, and all related connections and fittings, all of which shall conform to ASTM F 2306, latest edition. The pipes shall be of the sizes, types, and dimensions shown on the plans, and contained in this specification. In addition, it shall include all connections and joints to new or existing pipes, storm sewer manholes, inlets, headwalls, and other appurtenances as may be required to complete the work.

1.03 SUBMITTALS

- A. The Contractor shall furnish an affidavit that the tubing, specials, fittings, and appurtenances furnished comply with all provisions of this and the ASTM specifications as shown herein.

1.04 RELATED SECTIONS

- A. Section 310000 - Earthwork
- B. Section 312333 - Trenching and Backfilling

PART 2 - PRODUCTS

2.01 MATERIALS

Unless otherwise specified on the plans or herein, thermoplastic pipe and joint fittings shall conform to the following:

- A. High Density Polyethylene (HDPE) Corrugated and Smooth Lined Pipe & Fittings shall be manufactured in accordance with requirements of ASTM F 2306, latest edition. Type S: This pipe shall have a full circular cross section, with an outer corrugated pipe wall and a smooth inner wall.
- B. High Density Polyethylene (HDPE) Corrugated and Smooth Lined Pipe shall be manufactured from virgin PE compounds which conform with the requirements of cell class 335400C as defined and described in ASTM D 3350.
- C. Minimum Pipe Stiffness (PS) at five percent deflection shall be as described in ASTM F 2306, Section 6.3 when tested in accordance with ASTM D 2412.
- D. All HDPE Corrugated and Smooth Lined Pipe shall be certified through the Plastics Pipe Institute (PPI) Third Party Certification program. All HDPE pipe delivered and used shall bear the Third Party Administered PPI seal.

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PART 3 - EXECUTION

3.01 INSTALLATION

Installation shall be in accordance with ASTM D 2321, "Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity Flow Applications".

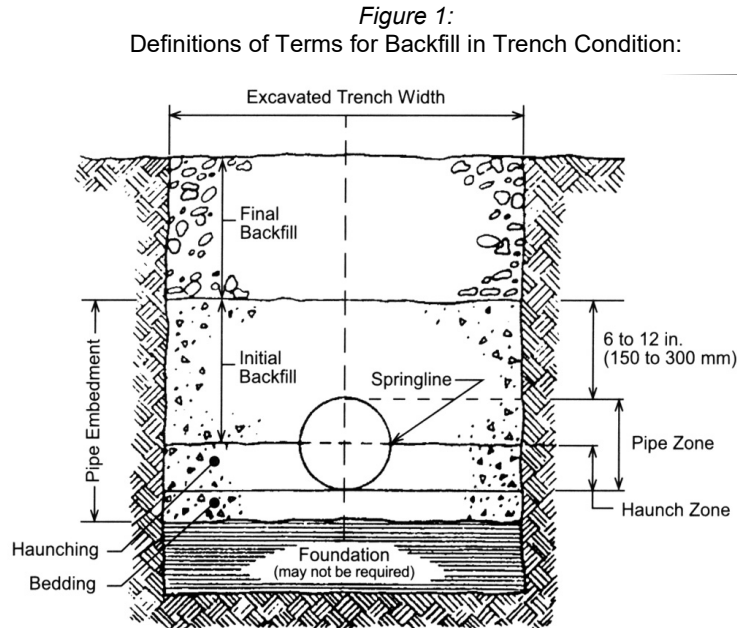


Figure 1. Trench Cross Section Showing Terminology

ASTM D-2321 *

- A. General Installation Requirements: Thermoplastic pipe shall be unloaded and handled with reasonable care. Pipe shall be placed in the bed starting at the downstream end. Trenches must be excavated in such a manner as to insure that the sides will be stable under all working conditions. Trench walls shall be sloped or supported in conformance with all standards of safety. Only as much trench as can be safely maintained shall be opened. All trenches shall be backfilled as soon as practicable, but no later than the end of each working day.

Trench details, including foundation, bedding, haunching, initial backfill, final backfill, pipe zone, and trench width are shown in Figure 1.

- B. Trench Widths: Trench width shall be in accordance with ASTM D2321 and shall be sufficient to ensure working room to properly and safely place and compact haunching and other backfill materials. Minimum trench width shall not be less than 1.25 times the pipe outside diameter plus 12 inches. ($1.25 \times \text{O.D.} + 12"$)

Note: On multiple pipe barrel runs the clear distance between pipes is as follows:
12"-24" Diameters: Clear span = 12"
24" & Greater Diameter: Clear span = $\frac{1}{2} \times \text{Diameter}$

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- C. Outside the Right-of-Way Bedding and Backfill: Bedding material shall meet the requirements of ASTM D2321 Class I material. A minimum of 6" of bedding shall be provided prior to placement and shall be loosely compacted. Bedding material size shall be 1½" granular material and shall extend to the springline of the pipe. Initial backfill material shall meet the requirements of ASTM D2321 Class I material and shall extend from the springline to 6" over the top of the pipe. Backfill material shall be placed in 6 inch lifts and compacted to 90% Std. Proctor Density.
- D. Inside the Right-of-Way Bedding and Backfill: Bedding material shall meet the requirements of ASTM D2321 Class I material. A minimum of 6" of bedding shall be provided prior to placement and shall be loosely compacted. Bedding material size shall be 1½" maximum granular material. Initial backfill material shall meet the same requirements as the bedding material and shall extend to 6 inches above the top of the pipe. Final backfill material shall meet the requirements of ASTM D2321 Class I material. All initial and final backfill material shall be placed in 6 inch lifts and compacted to 90% SPD.
- E. Minimum Cover: The minimum cover is one foot (1.0') for HS-25 Live Loads (4"-42" Diameters) and two feet for (2.0') for larger diameter structures (48"- 60" Diameter); however, care should be taken when heavy construction equipment loads cross the pipe trench during construction. If the passage of construction equipment over an installed pipeline is necessary during project construction, compacted fill in the form of a ramp shall be constructed to a minimum elevation of three (3.0') feet over the top of the pipe. Any damaged pipe shall be replaced at the contractor's expense.
- F. Installation Deflection: At the Engineer's discretion, all pipe exceeding 5% deflection may require replacement at the contractor's expense when measured or inspected not less than 60 days following completion of installation or prior to paving operations. Deflection is defined per ASTM D 2321. All pipe shall be video inspected (CCTV) at the contractor's expense prior to acceptance.
- G. Joints: Joints shall be installed that the connection of pipe sections will form a continuous line free from irregularities in the flow line. Joints shall meet one of the following:
 - 1. Soil tight joints shall be as specified in ASTM F2306.
 - 2. Watertight joints must meet a 74kPa (10.8 psi) laboratory test per ASTM D3212 and utilize a bell and spigot design with a gasket meeting ASTM F477.
- H. High Groundwater Table: In installations where a high groundwater table is encountered, a soil filter fabric as per manufacturer's recommendations shall be installed around the initial backfill material. In flowable fill or high groundwater installations, pipe shall be restrained as per manufacturer's recommendations.
- I. Measurement and Payment: This item shall be measured for payment by the linear foot. Such measurements shall be made between the ends of the barrel along its flow line. For multiple pipes, the measured length shall be the sum of the lengths of the barrels, measured as described above. Pipe shall be paid for at the contract unit price per linear foot, complete in place, as provided by the proposal and contract. The contract price per linear foot shall be the total compensation for the furnishing of all labor, materials, tools, equipment, and incidentals necessary to complete the work including excavation, backfill, and disposal of surplus materials in accordance with the plans and these specifications.
- J. Comply with requirement in 3.02 A.

3.02 LAYING AND JOINTING

- A. Installation: Installed tube produced to these specifications shall be installed according to the standard practice of ASTM Designation F 449 except where installations are under proposed or existing paving. Such installations must utilize an envelope of standard crushed rock bedding materials to a minimum of 6 inches above the crown of the pipe. In either case, the internal diameter of the installed barrel of the tube must not be reduced by more than 5% of its base inside diameter when measured not less than 30 days following completion of installment.

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- B. Assembly of Joints: All joints shall be assembled in accordance with the recommendations of the manufacturer.

3.03 BACKFILL

- A. After the bedding has been prepared and the pipes installed as required, backfill shall be placed in accordance with SECTION 32 18 23. If the material, when tested, fails to meet the density requirements, the backfill shall be required to be removed and replaced to meet the proper density.
- B. The backfill shall not be placed until the Architect/Engineer or his representative has observed the trench and authorized the placing of backfill. All debris shall be removed from the trench prior to beginning the backfilling operations. Sheet, shoring and bracing shall be pulled and removed during the progress of the backfilling in such a manner to protect the trench and the pipe.
- C. Backfilling shall then be brought up to an elevation slightly above the original ground level to allow for subsequent settlement. The top surface of slopes of all backfill shall be neatly graded off in a workmanlike manner, and where select topsoil, sod, or other material is removed and piled separately, such material shall be carefully replaced in a manner satisfactory to the Architect/Engineer. The top 1' of backfill material shall be of as good quality as the original topsoil which was removed.

3.04 TESTING

- A. Testing: All polyethylene tubing shall be tested for elongation, brittleness, joint separation, quality and ring stiffness as specified in the applicable ASTM Designations.
- B. Rejection: This pipe and fittings may be rejected for failure to meet any of the requirements of this specification, and may be retested to establish conformity in accordance with agreement between the Owner and the Contractor.

END OF SECTION

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SECTION 33 4114

LANDSCAPE DRAINAGE SYSTEM

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Furnish all work and materials, appliances, tools, equipment, facilities, transportation, and services necessary for and incidental to performing all operations in connection with the installation of the landscape drainage/underdrain system.
- B. Conform to the requirements of the general conditions of the contract.

1.2 SUMMARY

- A. Section Includes: Providing and installing landscape drainage/underdrain system.
 - 1. Augering.
 - 2. Trenching and backfilling.
 - 3. Providing and installing all pipe, including joints and fittings, cutting pipe to conform to structures and attaching to point of connection at storm line.
 - 4. Providing and installing clean outs with solid wye or bend connection.
 - 5. Providing and installing all underdrain pipe, solid and slotted/perforated, for underdrain system within drainage layer at edges of planting beds.
 - 6. Providing and installing shade cloth.
 - 7. Providing and installing drain gravel bridging stone and coarse sand media separating sand.
 - 8. Installing tree drainage chimney.

1.3 REFERENCES

- A. Applicable Standards: Apply the current of latest edition of American Society for Testing and Materials (ASTM).
 - 1. C 33: Specifications for Concrete Aggregates
 - 2. C 131: Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
 - 3. C 136: Method for Sieve Analysis of Fine and Coarse Aggregates
 - 4. C 535: Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
 - 5. D 448: Standard Classification for Sizes of Aggregate for Road and Bridge Construction.
 - 6. D 1785: Polyvinyl Chloride (PVC) Plastic pipe. Schedule 40, 80 and 120.
 - 7. Standard and perforated Schedule 40 PVC pipe and fittings conforming to ASTM D 2729 sewer piping or D2665 DWV piping.
 - 8. F 405: Standard Specification for Corrugated Polyethylene (PE) Pipe and Fittings.
 - 9. F 949: Standard Specification for Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings
 - 10. Standard Specifications – North Central Texas Council of Governments and local municipal Building Code.

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1.4 QUALITY ASSURANCE

- A. General: Perform work in accordance with all applicable laws, codes and regulations required by the local city code, building code or university standards.

1.5 SUBMITTALS

- A. Product Data: Submit manufacturer's latest catalog cuts and specifications for each specified product.
- B. Samples:
 - 1. Solid drain pipe: Manufacturer's literature and twelve (12) inch piece of pipe.
 - 2. Perforated Pipe: Manufacturer's literature and twelve (12) inch piece of pipe.
 - 3. Clean-outs: Manufacturer's literature and gray threaded sewer cap.
 - 4.
 - 5. Drain Gravel – Bridging Stone: Supplier's literature and one (1) gallon sample bag.
 - 6. Coarse Sand Media Separating Sand: Supplier's literature and one (1) gallon sample bag.
 - 7. Shade Cloth: Supplier's literature and twelve (12) inch square piece of cloth.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in original factory unopened, undamaged packaging bearing identification of product, manufacturer, batch number, and expiration data, as applicable.
- B. Store the product in a location protected from damage, construction activity, and precipitation in strict accordance with the manufacturer's recommendations.
- C. Pipe: Cap openings against entry by foreign matter where required.
- D. Damaged Materials: Remove all damaged materials and replace at no expense to Owner.

1.7 COORDINATION

- A. Concealed Work: Verify and locate existing pipes, cast in place pipes for point of connection and structures to be coordinated with landscape drainage work. Review all available records and make all necessary explorations and excavations.
- B. Field Measurements: Establish lines and levels for each drainage system and coordinate with other systems for prevent conflicts and maintain proper clearances.
- C. Notification: Submit to Owner's Authorized Representative written notification of all discrepancies in the Drawings or existing conditions which preclude successful installation of landscape drainage work as specified.

1.8 FINAL ACCEPTANCE

- A. Review Date: Make a written request for review for Final Acceptance at least five days in advance.
- B. Completion: Work will be accepted upon satisfactory completion of all landscape drainage work.
- C. Responsibility: Upon Final Acceptance, Owner will assume responsibility for maintenance of the work.

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PART 2 – MATERIALS

2.1 SOLID POLYVINYL CHLORIDE (PVC and CPVC) PIPE AND FITTINGS

- A. Marking and identification: Schedule 40 PVC pipe shall be continuously and permanently marked with the following information: manufacturer's name, size, type of pipe and material, SDR number, product standard number and the National Sanitation Foundation (NSF) seal. Polyvinyl chloride pipe and fittings PVC 1120, conforming to ASTM D1785-76, sizes as shown on the Drawings.
- B. Flexible PVC shall be made from virgin PVC material and shall comply with ASTM D2287.
- C. Planter Bed Cleanout: Cleanout Adapter Spigot x FIP CPVC Chemical Drain Fitting, color: Gray, ChemDrain CPVC Fittings, Part nos. AW 106C and AW 105XC, as manufactured by Charlotte Pipe and Foundry Company.

2.2 SLOTTED UNDERDRAIN PIPE AND FITTINGS – Refer to Landscape Architectural plans for layout

- A. Slotted/Perforated Pipe: Shall be equal to "ADS" Polyethylene N-12 smooth wall (double wall) perforated (SP) with fittings as manufactured by Advanced Drainage Systems, Inc. Perforations shall be slotted 120 degrees apart alternating corrugations. No filter sock is to be used. If equivalent product is available, submit for review and approval by Owner's Authorized Representative.

2.3 SHADE CLOTH FABRIC

- A. Woven Shade Cloth and Anchor Pins: Shall be equal to DeWitt Woven Shade Cloth – WS 63 - 63% Black, 100% Polypropylene monofilament strands and anchor pins as manufactured by DeWitt, 905 S. Kingshighway, Sikeston, MO 63801, (800-888-9669), www.dewittcompany.com, or equivalent product as reviewed and approved by Owner's Authorized Representative.

2.4 DRAIN GRAVEL, BRIDGING STONE DRAIN GRAVEL AND COARSE SAND MEDIA SEPARATING SAND

- A. In accordance with ASTM C33, C131, C136 and C535.
- B. In accordance with the following additional requirements:
 - 1. Drain Gravel - Size No. 57 Stone, locally available, rounded river gravel, washed, graded and screened with no fines per table below.

ASTM No. 57 Grading Requirements

<u>ASTM Sieve Size</u>	<u>Percent Passing by weight</u>
1-1/2 inch (37.5 mm)	100
1 inch (25 mm)	95-100
1/2 inch (12.5 mm)	25-60
No. 4 (4.75 mm)	0-10
No. 8 (2.36 mm)	0-5

- 2. Bridging Stone Drain Gravel - Size No. 8 Stone, locally available, angular, graded and screened with no fines per table below, washed to remove all silts and fines.
 - a. Material is available from Vulcan Materials Company, www.vulcanmaterials.com. Material called VMC D-Rock, Plant 4013-111, Weatherford Quarry, Product 27771 HMA AGG TYPE D. Meet gradation range as noted below.

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- b. Or equivalent product as reviewed and approved by Owner's Authorized Representative.

ASTM No. 8 Grading Requirements

<u>ASTM Sieve Size</u>	<u>Percent Passing by Weight</u>
1/2 inch (12.5 mm)	100
3/8 inch (9.5 mm)	85-100
No. 4 (4.75 mm)	10-30
No. 8 (2.36 mm)	0-10
No. 16 (1.16 mm)	0-5

3. Coarse Sand Media Separating Sand – Clean, hard, washed, durable particles of natural or manufactured sand; free from frozen material and from injurious amounts of salt, alkali, vegetation matter, or other objectionable material.
- a. Material is available from Vulcan Materials Company, www.vulcanmaterials.com. Plant 4013-111, Weatherford Quarry, Product 30931 Manufactured Sand. TxDOT Conc Fine Agg. Meet gradation range as noted below.
- b. Or equivalent product as reviewed and approved by Owner's Authorized Representative.

Coarse Sand Aggregate

Size Conforming to Grading Requirements

<u>ASTM Sieve Size</u>	<u>Percent Passing by Weight</u>
3/4 inch	100
#4	95-100
#50	25-60
#100	0-10
#200	0-5

PART 3 – EXECUTION

3.1 GENERAL

- A. Existing Utilities: Where grade or alignment or pipe is obstructed by existing utility structures such as conduits, ducts or pipes, permanently support, relocate, remove or reconstruct the obstruction.
- B. Deviations: Make no deviations from specified line or grade without written acceptance of change by Owner's Authorized Representative.
- C. Verification: Verify rim elevations of area drains relative to adjacent walls prior to beginning of work.

3.2 TRENCHING AND BACKFILLING

- A. When trench excavation encounters hardpan, rock, mud, quicksand, debris, or other unsuitable bedding material, trench shall be further excavated to a suitable limit as directed by Owner's Authorized Representative. Excavation shall then be backfilled with approved import material that will provide adequate pipe bedding. Import material will be cement stabilized sand for sections of solid PVC piping between tree pits, unless otherwise specified by Engineer.

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1. Cement stabilized sand shall be used for backfilling around the solid PVC pipe and to twelve (12) inches above the top of the pipe. The remaining trench may be backfilled with excavated material, except that if said material is unsuitable for compaction, imported suitable material shall be used.
- B. All trench backfill shall be compacted to (ninety-five (95%) percent) relative density per ASTM D698.
- C. Excavation shall be backfilled with approved import material that will provide adequate pipe bedding. All trench backfill shall be compacted to (ninety-five (95%) percent) relative density per ASTM D698.

3.3 PIPE INSTALLATION

- A. All pipe shall be installed and tested in accordance with the Standard Specifications prior to covering.
- B. Solid polyvinyl chloride pipe and underdrain pipe shall be installed as detailed in the plans and in accordance with the manufacturer's current printed recommendations.
- C. Ensure all pipe has flow to discharge points or points of connection.

3.4 UNDERDRAIN SYSTEM

- A. Excavate trench to depths and widths or install at edges of amended planting beds areas as shown on the Drawings.
- B. Set underdrain pipe to proper elevations and maintain a continuous flow line between all points.
- C. Install underdrain pipe permitting minor drift from side to side in trench and connect to solid PVC pipe installed where shown on drawings. Pitch pipe to connections at a gradient not less than 0.5 percent.
- D. Tie underdrain pipe to points of connection at storm line.
- E. Provide solid PVC pipe clean outs/extensions off underdrain pipe in direction of flow at maximum seventy-five (75) feet on center (min. fifty (50) feet on center) to six (6) inches above proposed surface finished grade of planting beds.
 1. Cut to one (1) inch above finished grade of planting bed once topdressing is installed and cap with threaded sewer cleanout cap.
- F. Install shade cloth along edges of excavated drainage layer per details to prevent horizontal siltation of drain gravel bridging stone and coarse sand media separating sand. Anchor pin the cloth to the sides of the excavated cell to retain in place while aggregates and underdrain pipe are being installed.
- G. Install washed bridging stone drain gravel around underdrain pipe and over top of underdrain pipe to provide full three (3) inch depth around all sides of the pipe.
- H. Install washed coarse sand media separating sand over top of bridging stone drain gravel to provide a full two (2) inch depth.
- I. Coordinate installation of all underdrain materials in conjunction with excavation and amendments for planting beds.
- J. Provide protection of underdrain system until planting media is installed.
- K. Provide protection of underdrain system while installing irrigation.
- L. For Planting Beds: Refer to plans for installation of subdrainage pipe at low points and trapped edges of planting and turf beds to prevent standing water over in situ saturated clay soils.
- M. For River Rock Beds: to prevent standing water over in situ compacted and saturated clay soils.
- N. Refer to drainage details for applications.

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3.5 TREE DRAINAGE CHIMNEY

- A. Excavate drainage chimney to depths and widths for tree subdrainage as shown on the Drawings.
- B. Install shade cloth per detail to prevent horizontal siltation of drain gravel, bridging stone and coarse sand media separating sand. Anchor pin the cloth to the sides of the excavated chimney to retain in place while aggregates are being installed.
- C. Install washed drain gravel as shown.
- D. Install washed bridging stone as shown over top of drain gravel to provide a full three (3) inch depth.
- E. Install washed coarse sand media separating sand over top of bridging stone to provide a full three (3) inch minimum depth.
- F. Coordinate installation of all underdrain materials in conjunction with excavation and amendments for tree planting beds.
- G. Provide protection of drainage chimney system until planting media is installed.
- H. Provide protection of drainage chimney system while installing irrigation.

3.6 CLEAN-UP

- A. Keep all areas of work clean, neat and orderly at all times.
- B. Upon completion of work, remove off the site all surplus materials, tools, equipment, rubbish, excess materials and debris resulting from the work.

END OF SECTION

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SECTION 334613
FOUNDATION DRAINAGE SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. Work required for this section includes foundation drainage system including supplementary items necessary to complete their installation.

1.2 ACTION SUBMITTALS

- A. Product Data: Manufacturers technical literature for each product and system indicated.
 - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
- B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components and attachments to other work. Distinguish between shop and field-assembled work.
 - 1. Show details and installation drawings for interface with drainage pipe system.
- C. Samples:
 - 1. Geotextile Filter Fabric: Two 12 inch squares.
 - 2. Perforated drain pipe:
 - a. Pipe: 12" inch long piece.
 - b. Fittings: One of each.

1.3 INFORMATIONAL SUBMITTALS

- A. Field Quality Control Reports: Written report of testing and inspection required by "Field Quality Control".

1.4 COORDINATION

- A. Coordinate and schedule sequencing with materials trades for concrete walls, foundations, concrete finishing, waterproofing, excavation, and backfilling.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Molded-Sheet Drainage Panels: Refer to Division 07 waterproofing section.
- B. Filter Fabric: Woven or nonwoven geotextile filter fabric of polypropylene or polyester fibers, or combination of both. Flow rates range from 110 to 330 gpm per sq. ft. when tested according to ASTM D 4491.
- C. Perforated Drainage Pipe: ASTM D 2729 Polyvinyl Chloride nominal 4 inch, bell-and-spigot pipe including fittings, cleanouts, etc.
- D. Impervious Fill: Clay, gravel and sand mixture.
- E. Drainage Fill: Washed, evenly graded mixture of crushed stone, or crushed or uncrushed gravel, ASTM D 448, coarse aggregate, Size 57, with 100 percent passing 1-1/2 inch sieve and not more than 5 percent passing No. 8 sieve.

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PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

3.2 INSTALLATION, GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
1. Respective manufacturer/fabricators written installation instructions.
 2. Accepted submittals.
 3. Contract Documents.

3.3 PREPARATION

- A. General: Comply with manufacturers instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.

3.4 INSTALLATION, FOUNDATION DRAINAGE SYSTEM

- A. Molded-Sheet Drainage Panels: Refer to Division 07 waterproofing section.
- B. Bottom Impervious Fill:
1. Place impervious fill material on subgrade adjacent to bottom of footing after concrete footings have been cured and forms removed.
 2. Place and compact impervious fill not less than 6 inches deep and 12 inches wide.
- C. Filter Fabric:
1. Cut fabric roll to proper width prior to installation.
 2. Include sufficient width to conform to trench perimeter and for minimum six inch top overlap.
 3. Lap upstream roll over downstream roll minimum of two feet, to form shingled effect.
 4. Ensure fabric continuity as fabric conforms to excavation surface during drainage fill placement and compaction.
 5. Following drainage fill placement, fold fabric over aggregate to form longitudinal lap.
 6. Place backfill soil over lap at sufficient intervals to maintain lap during subsequent backfilling.
 7. Exercise care during fabric installation to prevent natural or fill soils from intermixing with drainage aggregate.
- D. Drainage Fill:
1. Place supporting layer of drainage fill over compacted subgrade to compacted depth of not less than 4 inches.
 2. After installing drainage piping, add drainage fill to width of at least 6 inches on side away from wall and to top of pipe to perform tests.
 3. After satisfactory testing, cover piping to width of at least 6 inches on side away from footing and above top of pipe at least 12 inches.
 4. Place drainage fill in layers not exceeding 3 inches in loose depth; compact each layer placed.

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- E. Drain Pipe: Comply with ASTM D 2321 and as follows:
1. Excavate to proper depths, profiles and lines required for proper drainage.
 2. Provide minimum slope of 1 percent (1:100) unless otherwise indicated. Slope to drain.
 3. Lay drain pipe solidly bedded in filtering material with bells facing upslope and spigot end inserted fully into adjacent bell.
 4. Provide full bearing for each pipe section throughout its length to true grades and alignment, and continuous slope in direction of flow.
 5. Lay perforated pipe with perforations down and joints tightly closed in accordance with pipe manufacturer's recommendations.
 6. Provide fittings and couplings as required.
 7. Joint PVC pipe and fittings according to ASTM D 3034 with elastomeric seal gaskets according to ASTM D 2321.
 8. Joint perforated, PVC pipe and fittings according to ASTM D 2729, with loose, bell-and-spigot joints.
 9. Provide riser extensions and clean-outs at grade at approximately 100 feet on center. Locate at beginning of pipe run and changes in direction.
 10. Set top of clean-outs 1 inch above grade and secure in 12 inch square by 4 inch deep concrete anchor.
 11. Extend piping and connect to building storm drainage system or building sump pumps.

3.5 FIELD QUALITY CONTROL

- A. Tests and Inspections, General: Tests and inspections shall take place as installation proceeds to determine compliance with specified performance requirements.
1. Correction of Deficiencies:
 - a. Materials and installation will be considered defective if they do not meet specified requirements.
 - b. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.
 - c. Perform additional tests and inspections, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.
 2. Prepare test and inspection reports.
- B. Contractor Testing: After installing drainage fill to top of pipe, test drain piping with water to ensure free flow before backfilling. Remove obstructions, replace damaged components, and repeat test until results are satisfactory.

3.6 CLEANING

- A. Clear interior of installed piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed. Place plugs in ends of uncompleted pipe at end of each day or when work stops.

END OF SECTION