Project Manual

January 26, 2026

STANTEC Project No. 21400 1329

Crosby Sixth Grade Center

Crosby Independent School District

Crosby, Texas



01.26.2026

Issue for Permit and Proposal

Volume 1 of 2

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SECTION 00 01 01 – PROJECT TITLE PAGE

TITLE AND LOCATION OF THE WORK:

CROSBY SIXTH GRADE CAMPUS
Red Summit Dr.
Crosby, TX 77532



01.26.2026

NAME AND ADDRESS OF THE OWNER:

CROSBY INDEPENDENT SCHOOL DISTRICT
14670 FM 2100
Crosby, Texas 77532

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FOOD SERVICE CONSULTANT
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281-664-1900

TITLE OF DOCUMENTS BOUND HEREWITH:

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Texas Engineering Firm No. 20740

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SECTION 00 31 32 - GEOTECHNICAL DATA

PART 1 - GENERAL

1.1 SOIL INVESTIGATION DATA

A. The Owner has retained Alpha Testing to perform a geotechnical investigation at the project site. This section contains a complete copy of the Geotechnical Report for the Construction Manager's and Subcontractor bidders' information.

B. Investigation and Report:

Report # H254405
December 5. 2025

Geotechnical Engineering Report
Crosby Sixth Grade Campus, Crosby ISD - Final Study
Site Location: 560 ft. west of intersection of Red Summit Drive and FM 2100
Crosby, Texas

Prepared for LAN – West Houston Parkway
Houston, Texas 77042
Prepared by UES Professional Solutions

A copy of the original report is included herein as attachments for the convenience of the Proposers.

Proposers are urged to examine soils investigation data and to make their own investigation of the site before submitting proposals.

C. Interpretation:

Soil investigation data is provided only for information and the convenience of the Proposers. The Owner and Architect/Engineer disclaim any responsibility for the accuracy, true location and extent of the Soils Investigation that has been prepared by others. They further disclaim responsibility for interpretation of that data by Proposers, as in projecting soil-bearing values, rock profiles, soil stability and the presence, level and extent of underground water.

Soil investigation data is not a part of the Contract Documents.

(SOIL INVESTIGATION REPORT ATTACHED)

END OF SECTION plus report

GEOTECHNICAL ENGINEERING REPORT

CROSBY SIXTH GRADE CAMPUS – FINAL STUDY

Red Summit Drive

Crosby, Texas

UES Project No. H254405

December 5, 2025

Prepared for:

LAN - WEST SAM HOUSTON PARKWAY

3700 West Sam Houston Parkway South, Suite 400

Houston, Texas 77042

Attention: Robert Arcement

Prepared by:

Environmental
Geotechnical Engineering
Materials Testing
Field Inspections & Code Compliance
Geophysical Technologies

December 5, 2025

Robert Arcement
LAN – West Houston Parkway
3700 West Houston Parkway South, Suite 400
Houston, Texas 77042

Re: GEOTECHNICAL ENGINEERING REPORT
Crosby Sixth Grade Campus
Crosby, Texas
UES Project No.H254405

Dear Mr. Arcement:

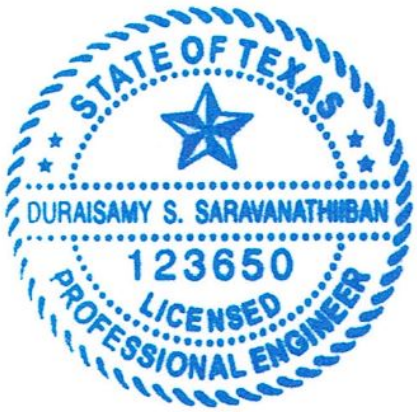
UES Professional Solutions 44, LLC (hereinafter "UES"), is pleased to submit this Preliminary Geotechnical Engineering Report for the referenced project. The results of this exploration, together with our recommendations, are presented in the accompanying report, an electronic copy of which is being transmitted herewith. This geotechnical study was authorized by Paula Patterson with Crosby ISD on November 11, 2025, and performed in accordance with UES Proposal No. 116733 dated October 22, 2025.

UES appreciates the opportunity to be of service on this project. If we can be of further assistance, such as providing materials testing services during construction, please contact our office.

Respectfully submitted,

UES Professional Solutions 44, LLC

Victor Guevara Jr., E.I.T.
Staff Geotechnical Engineer



12/05/2025

Duraisamy S. (Roy) Saravanathiiban, Ph.D., P.E.
West Houston Geotechnical Department Manager

VG/RS/vg

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1.0 INTRODUCTION

Purpose and Scope. The purpose of this preliminary geotechnical study was to evaluate some of the physical and engineering properties of subsurface materials at selected locations on the subject site to develop preliminary geotechnical engineering design parameters and recommendations for the proposed project. To accomplish this, the scope of this preliminary study included field exploration consisting of drilling test borings and collecting samples of the subsurface materials, performing laboratory testing on selected samples obtained during the field exploration, performing preliminary engineering analysis and evaluation of the subsurface conditions with respect to the project characteristics, and development of preliminary foundation and pavement recommendations suitable for the proposed project. The scope of services did not include an environmental assessment of the site.

Project Location. The project is located off Red Summit Drive, approximately 560 feet west of its intersection with FM 2100 in Crosby, Texas. The general location and orientation of the site are provided in Appendix A - Project Location Diagram.

Project Description. The project consists of a proposed two-story, structural steel, sixth grade school building (approximately 93,000 SF) with associated parking and drive areas.

UES previously performed the preliminary geotechnical study for this project site as UES Report No. H243343, dated September 15, 2025. Information from this preliminary study was used for this Final Report.

Loading Information. Based on information provided by the client, the maximum foundation load for the structure will be up to 200 kips. *Any change in the structural loads should be brought to our attention to review the design and assess the suitability of the recommendations provided.*

Site Grading Plan. Based on the most recent grading plan provided by the client ("Crosby Sixth Grade Campus", Site Grading Plan, Sheet C-3.02) dated November 07, 2025, the approximate existing grade range across the proposed building footprint areas, the proposed Finished Floor Elevations (FFE), and the resulting required cut depths and fill material thicknesses are summarized in the table below. The site grading plan is provided in Appendix D. The cut and fill thicknesses presented are approximate and do not consider over-excavation or fill thicknesses resulting from any necessary site remediation as discussed in forthcoming sections of this report.

Building	Estimated Existing Elevation (feet)	Finished Floor Elevation, FFE (feet)	Approximate Range to Achieve Final Grade	
			Required Cut (feet)	Required Fill (feet)
School Building	44 to 45	48.5	0	3 to 4

Any changes to the site grading plan should be brought to the attention of UES for review and revision of recommendations, as appropriate.

Cautionary Statement Regarding Use of this Report. As with any geotechnical engineering report, this report presents technical information and provides detailed technical recommendations for civil and structural engineering design and construction purposes. UES, by necessity, has assumed the user of this document possesses the technical acumen to understand and properly utilize the information and recommendations provided herein. UES strives to be clear in its presentation and, like the user, does not want potentially detrimental misinterpretation or misunderstanding of this report. Therefore, we encourage any user of this report with questions regarding its content to contact UES for clarification. Clarification will be provided verbally and/or issued by UES in the form of a report addendum, as appropriate.

Report Specificity. This report was prepared to meet the specific needs of the client for the specific project identified. Recommendations contained herein should not be applied to any other project at this site by the client or anyone else without the explicit approval of UES.

This Report is NOT a Specification. Recommendations in this report are not specifications. Geotechnical engineering requires significant experience and professional judgment. Conditions vary in the field which require and/or allow modification to recommendations provided herein at the discretion of the Geotechnical Engineer of Record.

2.0 FIELD EXPLORATION

Subsurface study. The subsurface study for this project is summarized in the following table. Boring locations are provided in Appendix B - Boring Location Diagram.

Boring Nos.	Depth, feet bgs[1]	Date Drilled	Location[2]
B-01 to B-15 and PB-01	25 and 30	8/6/2025, 10/27-28/2025 and 11/03/2025	Proposed School Building
B-16 to B-27	5	10/28/2025 and 11/03/2025	Proposed Paving Area
PB-02 and PB-03	30	8/6/2025	Spaced Across the Site

Notes:
1. bgs = below ground surface.
2. Boring locations provided in Appendix B - Boring Location Diagram were not surveyed and should be considered approximate. Borings were located by recreational hand-held GPS unit. Horizontal accuracy of such units is typically on the order of 20-feet.

Boring Logs. Subsurface conditions were defined using the sample borings. Boring logs generated during this study are included in Appendix C – Boring Logs, Laboratory Results and

Unified Soil Classification System. Borings were advanced between sample intervals using continuous flight auger drilling procedures.

Cohesive Soil Sampling. Cohesive soil samples were generally obtained using Shelby tube samplers in general accordance with American Society for Testing and Materials (ASTM) D1587. The Shelby tube sampler consists of a thin-walled steel tube with a sharp cutting edge connected to a head equipped with a ball valve threaded for rod connection. The tube is pushed into the undisturbed soil by the hydraulic pulldown of the drilling rig. The soil specimens were extruded from the tube in the field, logged, tested for consistency using a hand penetrometer, sealed, and packaged to maintain "in situ" moisture content.

Consistency of Cohesive Soils. The consistency of cohesive soil samples was evaluated in the field using a calibrated hand penetrometer. In this test a 0.25-inch diameter piston is pushed into the undisturbed sample at a constant rate to a depth of 0.25-inch. The results of these tests are tabulated at the respective sample depths on the boring logs. When the capacity of the penetrometer is exceeded, the value is tabulated as 4.5+.

Groundwater Observations. Groundwater observations are shown on the boring logs.

Borehole Plugging. Upon completion of the borings, the boreholes were backfilled with onsite soil cuttings from the top and plugged at the surface.

3.0 LABORATORY TESTING

UES performs visual classification and any of several laboratory tests, as appropriate, to define pertinent engineering characteristics of the soils encountered. Tests are performed in general accordance with ASTM or other standards and the results included at the respective sample depths on the boring logs or separately tabulated, as appropriate, and included in Appendix C – Boring Logs, Laboratory Results and Unified Soil Classification System. Laboratory tests and procedures routinely utilized, as appropriate, for geotechnical studies are tabulated in the following table.

Test Procedure	Description
ASTM D1140	Standard Test Methods for Amount of Material in Soils Finer than the No. 200 (75-µm) Sieve
ASTM D2166	Standard Test Method for Unconfined Compressive Strength of Cohesive Soil
ASTM D2216	Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
ASTM D2487	Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D2488	Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)
ASTM D4220	Standard Practices for Preserving and Transporting Soil Samples

Test Procedure	Description
ASTM D4318	Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils
ASTM D4546	Standard Test Methods for One-Dimensional Swell or Settlement Potential of Cohesive Soils

4.0 SITE CONDITIONS

4.1 General

Review of Aerial Photographs. Review of aerial images available from Google Earth™ indicate the site was previously developed with multiple buildings and a baseball field and the buildings were demolished and removed in the past. It is not known whether the foundations supporting the former structures at the site were removed and backfilled or abandoned in-place. In addition, a low-lying area was noted in the project site. Our review revealed obvious areas of fill on-site. **Demolition considerations, existing fill recommendations and existing low-lying area backfill recommendations are provided in Sections 5.6, 5.7 and 5.8, respectively.**

Due to the intermittent nature and relatively low resolution of aerial photographs, as well as lack of provided information regarding the past land use of the site, our review should not be interpreted as eliminating the possibility of past activities on site which could detrimentally affect future construction. No additional information was provided for this study regarding previous site activities or development.

Topography. Based on the review of a United States Geological Survey (USGS) topographic map of the site, the site is relatively flat.

4.2 Geology

Geologic Formation. Based on available surface geology maps and our experience, it appears this site is located in the Beaumont Formation, predominantly clay. Soil within the Beaumont Formation can generally be characterized as clay, silt, and sand.

4.3 Soil Conditions

Stratigraphy. Descriptions of the various strata and their approximate depths and thickness per the Unified Soil Classification System (USCS) and terms and symbols used in the USCS are provided in Appendix C – Boring Logs, Laboratory Results and Unified Soil Classification

System. A summary of the stratigraphy indicated by the borings is provided in the following table.

Generalized Subsurface Conditions at Proposed Building Location (Borings B-01 to B-15 and PB-01)[1]			
Nominal Depth, feet bgs (Except as Noted)		General Description	Detailed Description of Soils/Materials Encountered
Top of Layer	Bottom of Layer		
0	25 and 30	FAT CLAY	FAT CLAY (CH) Note: Fill soils consisting of Clayey Sand (SC) and Lean Clay With Sand (CL) were encountered in borings B-09 and PB-01 from the existing ground surface extending to a depth of about 2 feet.
Note: 1. Boring Termination Depths = 25 and 30 feet bgs.			

Generalized Subsurface Conditions at Proposed Paving Location (Borings B-16 to B-27)[1]			
Nominal Depth, feet bgs (Except as Noted)		General Description	Detailed Description of Soils/Materials Encountered
Top of Layer	Bottom of Layer		
0	5	FAT CLAY	FAT CLAY (CH). Note: Fill soils consisting of Clayey Sand (SC) and Fat Clay (CH) were encountered in borings B-19 and B-20 from the existing ground surface extending to a depth of about 2 feet.
Note: 1. Boring Termination Depth = 5 feet bgs.			

Generalized Subsurface Conditions Spaced Across the Site (Borings PB-02 and PB-03)[1]			
Nominal Depth, feet bgs (Except as Noted)		General Description	Detailed Description of Soils/Materials Encountered
Top of Layer	Bottom of Layer		
0	30	FAT CLAY	FAT CLAY (CH).
Note: 1. Boring Termination Depth = 30 feet bgs.			

4.4 Groundwater

Groundwater Levels. The test borings were advanced using continuous flight augers and air-rotary drilling methods, with intermittent sampling methods. These dry drilling techniques enable observation of potential groundwater seepage levels. Groundwater levels

encountered in the borings during this study are identified in the table below. Depths referenced in this report and in the table below are measured from the existing ground surface at the respective boring location at time of the field exploration.

Boring No.	Depth Groundwater Initially Encountered (feet, bgs)	Groundwater Depth after 15 Minutes (feet, bgs)
All borings, B-01 to B-27 and PB-01 to PB-03	Not Encountered	Not Measured

Long-term Groundwater Monitoring. These groundwater observations are indicative of the groundwater conditions present at the time the borings were drilled. The amount of water in an open borehole largely depends on the permeability of the soil encountered at the boring location. In relatively impervious soils, such as clayey soils, a suitable estimate of the groundwater depth may not be possible, even after several days of observation. Long-term monitoring of groundwater conditions via piezometers or groundwater monitoring wells was not performed during this study and was beyond the scope of this study. Long-term monitoring can reveal groundwater levels materially different than those encountered during measurements taken while drilling the borings.

Groundwater Fluctuations. It is difficult to accurately predict the magnitude of subsurface water fluctuations that might occur based upon short-term observations. Future construction activities may alter the surface and subsurface drainage characteristics of this site. Seasonal variations, temperature, land-use, proximity to water bodies, and recent rainfall conditions may influence the depth to the groundwater. With these considerations UES recommends that the contractor verifies the groundwater elevation before construction starts.

5.0 ANALYSIS AND RECOMMENDATIONS

5.1 Seismic Site Classification

The Site Class assigned for seismic design considers various factors, such as the soil profile (whether it's soil or rock), shear wave velocity, and strength, averaged over a depth of 100 feet. As our borings didn't reach depths of 100 feet, we made determinations under the assumption that the subsurface materials beneath the borehole bottoms resembled those encountered at the termination depth. Following the guidelines outlined in Section 1613.2.2 of the 2024 International Building Code and Table 20.2-1 in the 2022 ASCE-7, UES recommends using Site Class D (stiff soil) for seismic design purposes at this location.

5.2 Potential Vertical Rise (PVR)

Estimated Potential Movement. Our findings indicate grade supported structures at grades referred in Section 1.0 could experience post construction movements of about **4½ inches** due to shrinking and swelling of expansive soils (active clays). For the purpose of this report, movement due to shrinking and swelling of active clays will be referred to as potential vertical movement/rise (PVR).

Method of Estimation. PVR is estimated in general accordance with methods outlined by Texas Department of Transportation (TxDOT) Test Method Tex-124-E, from results of absorption swell tests, and engineering judgment and experience. Estimated PVR calculated assuming the moisture content of the in-situ soil within the normal zone of seasonal moisture content change varies between dry condition to wet condition as defined by Tex-124-E. Also, it was assumed that a 1 psi surcharge load from the floor slab acts on the subgrade soils. Movements exceeding our estimates could occur if positive drainage of surface water is not maintained or if soils are subject to an outside water source, such as leakage from a utility line or subsurface moisture migration from off-site locations.

Assumptions. PVR was estimated based on the assumption that any fill used to raise the grade consists of onsite or similar soil with a plasticity index (PI) of 20 or less. The use of fill material with a PI greater than 20 could result in potential movements exceeding our estimates.

5.3 Construction Excavations

The contractor is responsible for designing any excavation slopes, temporary sheeting or shoring. Design of these structures should include any imposed surface surcharges. Construction site safety is the sole responsibility of the contractor, who shall also be solely responsible for the means, methods and sequencing of construction operations. The contractor should also be aware that slope height, slope inclination or excavation depths (including utility trench excavations) should in no case exceed those specified in local, state and/or federal safety regulations, such as OSHA Health and Safety Standard for Excavations, 29 CFR Part 1926, or successor regulations.

Stockpiles should be placed well away from the edge of the excavation and their heights should be controlled so they do not surcharge the sides of the excavation. Surface drainage should be carefully controlled to prevent flow of water over the slopes and/or into the excavations. Construction slopes should be closely observed for signs of mass movement, including tension cracks near the crest or bulging at the toe. If potential stability problems are observed, a geotechnical engineer should be contacted immediately. Shoring, bracing or underpinning required for the project (if any) should be designed by a professional engineer registered in the State of Texas.

5.4 Groundwater Control

Groundwater was not encountered at the borings during the subsurface study. If groundwater is encountered during excavation, dewatering to bring the groundwater below the bottom of excavations may be required. Dewatering could consist of standard sump pits and pumping procedures, which may be adequate to control seepage on a local basis during excavation. Supplemental dewatering will be required in areas where standard sump pits and pumping is not effective. Supplemental dewatering could include submersible pumps in slotted casings, well points, or eductors. If groundwater is encountered during construction, then the contractor should submit a groundwater control plan, prepared by a licensed engineer experienced in that type of work.

5.5 Earthwork

5.5.1 Site Preparation

In the area of improvements, all concrete, trees, stumps, brush, debris, septic tanks, abandoned structures, roots, vegetation, rubbish, and any other undesirable matter should be removed and properly disposed. All vegetation should be removed, and the exposed surface should be scarified to an additional depth of at least 6 inches. It is the intent of these recommendations to provide a loose surface with no features that would tend to prevent uniform compaction by the equipment to be used.

5.5.2 Proofroll

Building pad and paving subgrades should be proofrolled with a fully loaded tandem axle dump truck or similar pneumatic-tire equipment to locate areas of loose subgrade. In areas to be cut, the proofroll should be performed after the final grade is established. In areas to be filled, the proofroll should be performed prior to fill placement. Areas of loose or soft subgrade encountered in the proofroll should be removed and replaced with engineered fill, moisture conditioned (dried or wetted, as needed) and compacted in place.

5.5.3 Construction Considerations

<u>Surface Sandier/Siltier Soils</u>. The sandier/siltier soils encountered at and near the ground surface at this site are very susceptible to changes in moisture. The presence of surface water due to precipitation or groundwater may result in a decrease in the ability to compact and work with the soil. It is common for these soils to pump when subjected to high levels of moisture. In addition, these soils located at and near the ground surface will allow surface water to infiltrate until the water becomes perched on a less permeable layer at depth. As

such, construction difficulties should be anticipated, especially during the wet season or immediately after rain events. Although having a thin layer of non-plastic or low plasticity soils overlying cohesive soils is typical of this geologic region, our experience suggests that the local contractors find these materials troublesome and can often be the source of change orders, construction delays, and budget over runs. Soils of this type are especially prone to requiring the implementation of wet weather/soft subgrade recommendations provided in this report.

Maintenance of Subgrade during Construction. While the exposed subgrade is expected to remain relatively stable initially, unstable conditions may arise during general construction activities, particularly if the soil is exposed to wet weather conditions and repetitive construction traffic. The use of lighter construction equipment can help minimize disturbance to the subgrade. In the event of unstable conditions, stabilization measures will be necessary. After grading is completed, it's crucial to maintain the moisture content of the subgrade before proceeding with pavement/building slab construction. Minimizing construction traffic over the finished subgrade is advisable. If the subgrade becomes frozen, desiccated, saturated, or disturbed, the affected material should either be removed or treated by scarification, moisture conditioning, and recompaction before pavement/building slab construction begins. UES should be retained to observe earthwork and to perform necessary tests and observations during subgrade preparation.

5.5.4 Grading and Drainage

Every attempt should be made to limit the extreme wetting or drying of the subsurface soils because swelling and shrinkage of these soils will result. Standard construction practices of providing good surface water drainage should be used. A positive slope of the ground away from any foundation should be provided. Ditches or swales should be provided to carry the run-off water both during and after construction. Stormwater runoff should be collected by gutters and downspouts and should discharge away from the buildings.

Root systems from trees and shrubs can draw a substantial amount of water from the clay soil at this site, causing the clays to dry and shrink. This could cause settlement beneath grade-supported slabs such as floors, walks and paving. Trees and large bushes should be located a distance equal to at least one-half their anticipated mature height away from grade slabs.

Lawn areas should be watered moderately, without allowing the clay soil to become too dry or too wet.

5.5.5 Wet Weather/Soft Subgrade

Soft and/or wet surface soils may be encountered during construction, especially following periods of wet weather. Wet or soft surface soil can present difficulties for compaction and

other construction equipment. If specified compaction cannot be achieved due to soft or wet surface soils, one of the following corrective measures will be required:

1. Removal of the wet and/or soft soil and replacement with select fill,
2. Chemical treatment of the wet and/or soft soil to improve the subgrade stability, or
3. If allowed by the schedule, drying by natural means.

Chemical treatment is usually the most effective way to improve soft and/or wet surface soils. UES should be contacted for additional recommendations if chemical treatment is planned due to wet and/or soft soils during construction. The treatment depth and chemical reagent type and application rate depend on the site condition during construction.

5.5.6 Fill

Select Fill. **Any fill placed in building pad areas should consist of select fill.** Select fill should consist of soil with a liquid limit of less than 40 and a Plasticity Index between 8 and 20. The select fill should be placed in loose lifts not exceeding 8-inches and should be compacted to at least 95 percent maximum dry density (per ASTM D-698) and at a moisture content between optimum and 4 percent above optimum moisture content. The subgrade to receive select fill should be scarified to a depth of 6 inches and compacted to 93 to 96 percent of the material's maximum standard Proctor dry density (ASTM D-698) at a workable moisture level at least 3 percentage points above optimum.

Lime-treated Native Clay Soil. Based on the laboratory testing conducted for this study, the native clay on-site soils will not meet requirements for select fill outlined in the section titled "Fill". As an alternative to importing select fill, the native clay soil may be blended with lime to reduce the plasticity index to meet select fill requirements. Based on our experience, we expect that it will require between 6- and 8-percent lime (by dry unit weight) to reduce the plasticity index of the native clay soils to select fill requirements. Prior to selecting this alternative, lime series tests should be performed to assess the amount of lime required.

General Fill. General fill may be placed in improved areas outside of building pad areas. General fill should consist of material similar to onsite soils. General fill should be placed in loose lifts not exceeding 8-inches and should be uniformly compacted to a minimum of 95 percent maximum dry density (per ASTM D-698) and within ±2 percent of the optimum moisture content.

Fill Restrictions. Select fill and general fill should consist of those materials meeting the requirements stated. Select fill and general fill should not contain material greater than 4-inches in any direction, debris, vegetation, waste material, environmentally contaminated material, or any other unsuitable material.

Unsuitable Materials. Materials considered unsuitable for use as select fill or general fill include low and high plasticity silt (ML and MH), silty clay (CL-ML), organic clay and silt (OH and OL) and highly organic soils such as peat (Pt). These soils may be used for site grading and restoration in unimproved areas as approved by the Geotechnical Engineer. Soil placed in unimproved areas should be placed in loose lifts not exceeding 10-inches and should be compacted to at least 92 percent maximum dry density (per ASTM D-698) and at a moisture content within ±4 percentage points of optimum.

Utilities and Deep Fills. In cases where utility lines and/or mass fills are more than 10 ft deep, the fill/backfill below 10 ft should be compacted to at least 100 percent of standard Proctor maximum dry density (ASTM D 698) and within –2 to +2 percentage points of the material's optimum moisture content. The portion of the fill/backfill shallower than 10 ft should be compacted as previously outlined. Density tests should be performed on each lift (maximum 12-inch thick) and should be performed as the trench is being backfilled.

Even if fill is properly compacted, fills in excess of about 10 ft are still subject to settlements over time of up to about 1 to 2 percent of the total fill thickness. This should be considered when designing pavements and other structures over utility lines or adjacent to retaining walls with deep fill, or any other structure in deep fill areas. To reduce the risk of fill settlement, the portion of the fill below a depth of 10 ft below final grade should be compacted to a minimum of 100 percent of the material's maximum standard Proctor dry density (ASTM D-698). This procedure will reduce (but not eliminate) the risk of fill settlement. If this risk of subgrade settlement is not acceptable, consideration could be given to backfilling portions or all of the excavation with flexible base material, cement-stabilized sand, or flowable fill.

If utility trenches or other excavations extend to or beyond a depth of 5 ft below construction grade, the contractor or others shall be required to develop an excavation safety plan to protect personnel entering the excavation or excavation vicinity. The collection of specific geotechnical data and the development of such a plan, which could include designs for sloping and benching or various types of temporary shoring, is beyond the scope of this study. Any such designs and safety plans shall be developed in accordance with current OSHA guidelines and other applicable industry standards.

Cautionary Note. It is extremely important that select fill placed within building pads be properly characterized using one or more representative proctor samples. The use of a proctor sample which does not adequately represent the select fill being placed can lead to erroneous compaction (moisture and density) results which can significantly increase the potential for swelling of the select fill. The plasticity index of select fill soils placed during construction should be checked every day to confirm conformance to the project requirements and consistency with the proctor being utilized.

5.5.7 Testing

Required Testing and Inspections. Field compaction and classification tests should be performed by UES. Compaction tests should be performed in each lift of the compacted material. We recommend the following minimum soil compaction testing be performed: one test per lift per 2,500 square feet (SF) in the area of the building pad, one test per lift per 5,000 SF outside the building pad, and one test per lift per 100 linear feet of utility backfill. If the materials fail to meet the density or moisture content specified, the course should be reworked as necessary to obtain the specified compaction. Classification confirmation inspection/testing should be performed daily on select fill materials (whether on-site or imported) to confirm consistency with the project requirements. The testing frequency recommended herein can be altered (increased or decreased) at the discretion of the geotechnical engineer of record.

Liability Limitations. Since proper field inspection and testing are critical to the design recommendations provided herein, UES cannot assume responsibility or liability for recommendations provided in this report if construction inspection and/or testing is performed by another party.

5.6 Demolition Considerations

Applicability. Recommendations in this section apply to the removal of any existing foundations, utilities or pavement which may be present on this site.

General. Special care should be taken in the demolition and removal of existing floor slabs, foundations, utilities and pavements to minimize disturbance of the subgrade. Excessive disturbance of the subgrade resulting from demolition activities can have serious detrimental effects on planned foundation and paving elements.

Existing Foundations. Existing foundations are typically slabs, shallow footings, or drilled piers. If slab or shallow footings are encountered, they should be completely removed. If drilled piers are encountered, they should be cut off at an elevation at least 24-inches below proposed grade beams or the final subgrade elevation, whichever is deeper. The remainder of the drilled pier should remain in place. Foundation elements to remain in place should be surveyed and superimposed on the proposed development plans to determine the potential for obstructions to the planned construction. UES should be contacted if drilled piers are to be excavated and removed completely. Additional earthwork activities will be required to make the site suitable for new construction if the piers are to be removed completely.

Existing Utilities. Existing utilities and bedding to be abandoned should be completely removed. Existing utilities and bedding may be abandoned in place if they do not interfere

with planned development. Utilities which are abandoned in place should be properly pressure-grouted to completely fill the utility.

Backfill. Excavations resulting from the excavation of existing foundations and utilities should be backfilled in accordance with Section 5.5.6.

Other Buried Structures. Other types of buried structures (wells, cisterns, etc.) could be located on the site. If encountered, UES should be contacted to address these types of structures on a case-by-case basis.

5.7 Existing Fill

Our subsurface study indicates existing fill on site. Existing fill was encountered in borings PB-01, B-09, B-19, and B-20. Existing fill extended to a depth of up to about 2-feet bgs. It is worth noting that existing fill may also be present, potentially at greater depths, in other parts of the site. Accurately delineating fill soils, especially those resembling native soils, based on discrete test boreholes is challenging. As such, the recorded fill depths should be considered as estimates and may slightly deviate from the actual fill depths. Although not encountered in the borings for this project, uncontrolled fills may contain trash, debris, concrete rubble, construction debris, boulders, and other unsuitable materials.

If there is no record indicating that the fill was placed and compacted in a controlled manner (engineered fill), it will be necessary to excavate and recompact it in accordance with section 5.5.6 prior to construction of the building pad and foundations. Considering the depth of excavation required for subgrade improvement to reduce movements due to shrinking and swelling of active clays (see Section 5.8), we anticipate most or all of the existing fill will be removed from the building/foundation area. Any remaining uncontrolled fill after excavation for subgrade improvement should be removed (below the 5.5 ft of select fill pad) to expose firm native soils. The resulting excavation subgrade should be observed, proof-rolled as recommended in Section 5.5.2, and tested by UES prior to backfilling to verify conditions are as anticipated and that all existing fill is removed from the building pad/foundation area. Also, any loose or soft soil should be removed.

After the proofroll, the resulting excavation should be properly backfilled to the bottom of the subgrade improvement depth (5.5 ft) with controlled fill as described in Section 5.5.6. Any excavated materials proposed for re-use as controlled fill in the building pad below the subgrade improvement depth should be free of organics, debris, or other unsuitable materials.

In pavement areas, the existing fill at the pavement subgrade level should be proof-rolled with a heavy roller to detect possible weak areas. Any weak soils identified as part of the

proof-rolling process should be removed and replaced with well-compacted soil as outlined in Section 5.5.6 of this report.

5.8 Existing Low-Lying/Pond Backfill

Based on the aerial photographs and our subsurface investigation, we understand that the west side of the project site will be located within the existing low-lying area/pond. Before placing backfill in the low-lying area/pond, it's imperative to completely remove sediments and soft soil from the sides and bottom of the existing low-lying area/pond until reaching the surface of undisturbed competent native soil. As a minimum, the excavation should extend at least one foot below the bottom of the loose soils or sediments and at least 2 ft beyond the perimeter of the low-lying area/pond. Furthermore, the exposed undisturbed competent native soil after excavating the low-lying area/pond should undergo proof rolling using a fully loaded tandem axle truck to ensure a suitable working surface, as per Section 5.6.2. Following successful proof-rolling, the low-lying area/pond can be backfilled according to our recommendations outlined in Section 5.6.6- Fill. A UES representative must be present to oversee the preparation of the low-lying area/pond bottom, including excavation, proof rolling, and backfilling.

5.9 Slab-on-Grade and Subgrade Improvement

Potential Vertical Slab Movements. Based on the information gathered during this study, a slab constructed on-grade will be subject to potential vertical slab movements of about 4½-inches.

Subgrade Treatment Using Select Fill. The depth of subgrade treatment is dependent on desired post-construction PVR. The following table presents recommended depth of subgrade treatment to reduce the post-construction PVR to 1-inch.

Subgrade Treatment - Select Fill Option		
Required PVR (inches)	Minimum Thickness of Select Fill Soil (feet, bgs) [1]	Thickness of Compacted Subgrade below Select Fill (inches) [2]
1	5½	6

Notes:
1. Depth measured below bottom of the slab-on-grade.
2. The subgrade to receive select fill soil should be scarified to a depth indicated above. The scarified subgrade should be compacted to 93 to 96 percent of the material's maximum standard Proctor dry density (ASTM D-698) at a workable moisture level at least 4 percentage points above optimum.

Subgrade treatment should extend at least 5-feet horizontally beyond the perimeter of the building.

Subgrade Treatment at Exterior Doorways. Subgrade treatment should extend beneath sidewalk areas that abut exterior doorways to the building. Failure to perform subgrade treatment in these areas can increase the probability of differential heaving between exterior sidewalks and doorways, resulting in exterior doors that will not or have difficulty opening outward due to "sticking" caused by heaving sidewalk slabs. Sidewalks tied to pavements and other flatworks that extend beyond the subgrades treated for PVR reduction may be subjected to movements similar to those experienced for untreated subgrades.

Subgrade Moisture. The slab subgrade is prone to drying after being exposed and should be kept moist prior to slab placement.

Moisture Barrier. A moisture barrier should be used beneath the slab foundation in areas where floor coverings will be utilized (such as, but not limited to, wood flooring, tile, linoleum, and carpeting).

Fill Related Slab Settlement. Fill will settle under its own weight. A properly constructed fill will generally settle up to 2% of the fill thickness due to its own weight and independent of external loads. That settlement begins as soon as lift placement begins. The time required for settlement to occur is a function of soil type, pore water, and drainage path conditions and therefore can vary widely. As a result, fill-related settlement should be expected before AND after construction of the slab. Slab movement related to settling fill can be reduced by allowing as much time as possible between the time the fill is placed and construction of the slab. Furthermore, we recommend survey monitoring of constructed fills be performed to verify the rate and magnitude of settlement has been reduced to an acceptable level prior to construction of slabs on the fill.

Load Related Slab Settlement. Slabs on grade will settle when subjected to load. Slab settlement is a function of soil type, load intensity, load geometry, and other factors. Upon request by the Structural Engineer for this project, settlement estimates will be provided for the specific loading application in question.

Movement Risk. Recommendations have been provided to mitigate the effects of soil movement. Some soil movement and related structural cracking and floor unevenness should be expected even after following recommendations in this report. The elimination of risk related to soil movement is typically not feasible. If this risk is intolerable, the user of this report should be prepared to utilize a structural slab suspended adequately above the subgrade surface and supported on deep foundations.

5.10 Foundation System

Appropriate Foundation Types. The following foundation types are appropriate to the site based on the geotechnical conditions encountered:

- Shallow footings, or
- Underreamed drilled piers.

Foundation Determination. We have assumed that structural loads will be typical for the type and size of building proposed. Recommendations for the foundation types are presented below. Final determination of the foundation type to be utilized for this project should be made by the Structural Engineer based on loading, economic factors and risk tolerance.

Avoidance of Mixing Foundation Types. Mixing of foundation types for a given building should be avoided. Where mixing of shallow footings and underreamed drilled piers is required for a given building, we should be contacted to review the foundation plans prepared by the Structural Engineer prior to construction. Shallow footing foundations and underreamed drilled pier foundations can have incompatible movement characteristics.

Foundations Adjacent to Slopes. Foundations placed too close to adjacent slopes steeper than 5H:1V may experience reduced bearing capacities and/or excessive settlement. Recommendations provided herein assume foundations are not close enough to adjacent slopes in excess of 5H:1V to be detrimentally affected. Therefore, foundations closer than 5 times the depth of adjacent slopes, pits, or excavations in excess of 5H:1V should be brought to our attention in order that we may review the appropriateness of our recommendations.

Foundation Plans Review. We recommend contacting our office to review the foundation plans, details and related structural loads, prior to finalizing the design to check conformance with our geotechnical recommendations.

5.10.1 Shallow Footings

General Requirement. Shallow strip and spread footing foundations may be used for support of the proposed structure if recommendations in the sections 5.6 “Demolition Considerations”, 5.7 “Existing Fill”, 5.8 “Existing Low-Lying/Pond Area Backfill” and 5.9 “Slab-on-Grade and Subgrade Improvement” are followed.

Foundation Depth. Shallow strip and spread footing foundations should bear on select fill or competent native soil at a minimum depth of 3-feet below the surrounding grade.

Bearing Capacity. Continuous strip footings can be proportioned using a net dead load plus sustained live load bearing pressure of 2,000 psf or a net total load bearing pressure of 3,000 psf, whichever condition results in a larger bearing surface. Individual spread footings can be

proportioned using a net dead load plus sustained live load bearing pressure of 2,600 psf or a net total load bearing pressure of 3,900 psf, whichever condition results in a larger bearing surface. These bearing pressures are based on a safety factor of 3 and 2, respectively.

Geometry. Individual spread footings should be at least 30 inches wide and continuous strip footing foundations should be at least 16 inches wide.

Settlement. Settlement of footing foundations is influenced by several factors, including load (pressure), soil consolidation properties, depth to groundwater, geometry (width and length), depth, spacing, and quality of construction. Although a detailed settlement analysis is beyond the scope of this study, settlement for foundations, with a maximum horizontal dimension of 10-feet, constructed as described above should be about 1 inch. We should be allowed to review foundations larger than 10 feet to assess their settlement. Our settlement estimate assumes that proper construction practices are followed and there are no overlapping stresses due to adjacent footings. To mitigate any overlapping stresses due to adjacent footings, we recommend a minimum clear spacing of one footing width (width of larger footing) between adjacent footings.

Lateral Resistance. Resistance to lateral loads may be provided by the soil adjacent to the footings. We recommend using an equivalent fluid weight of 180 pcf for lateral resistance. A coefficient of sliding friction of 0.25 between the concrete footings and underlying soil may be combined with the passive resistance. Appropriate safety factors should be utilized by the structural engineer for lateral stability of the shallow footings.

Construction and Observation. The geotechnical engineer should monitor foundation construction to verify conditions are as anticipated and that the materials encountered are suitable for support of foundations. Soft or unsuitable soils encountered at the foundation bearing level should be removed to expose suitable, firm soil. Foundation excavations should be dry and free of loose material. Excavations for foundations should be filled with concrete before the end of the workday or sooner if necessary to prevent deterioration of the bearing surface. Prolonged exposure or inundation of the bearing surface with water will result in changes in strength and compressibility characteristics. If delays occur, the excavation should be deepened as necessary and cleaned, in order to provide a fresh bearing surface. If more than 24 hours of exposure of the bearing surface is anticipated in the excavation, a “mud slab” should be used to protect the bearing surfaces. If a mud slab is used, the foundation excavations should initially be over-excavated by approximately 4 inches and a lean concrete mud slab of approximately 4 inches in thickness should be placed in the bottom of the excavation immediately following exposure of the bearing surface by excavation. The mud slab will protect the bearing surface, maintain more uniform moisture in the subgrade, facilitate dewatering of excavations if required and provide a working surface for the placement of formwork and reinforcing steel.

5.10.2 Underreamed Drilled Piers

General. Underreamed drilled pier foundations bearing in native soil may be utilized at this site for the proposed structure provided that recommendations in the sections 5.6 "Demolition Considerations", 5.7 "Existing Fill", 5.8 "Existing Low-Lying/Pond Area Backfill" and 5.9 "Slab-on-Grade and Subgrade Improvement" are followed.

Foundation Depth. We recommend that underreamed piers should bear in native soil at a depth of 10-feet below the existing grade.

Bearing Capacity. The piers may be proportioned using a net dead load plus sustained live load bearing pressure of 2,600 psf or a net total load pressure of 3,900 psf, whichever condition results in a larger bearing surface. These bearing pressures are based on a safety factor of 3 and 2, respectively, against shear failure of the foundation bearing soils.

Settlement. Settlement of underreamed drilled pier foundations is influenced by several factors, including load (pressure), soil consolidation properties, depth to groundwater, geometry (width and length), depth, spacing, and quality of construction. Although a detailed settlement analysis is beyond the scope of this study, soil related settlement for foundations, 8-feet in diameter or less, constructed as described above should be about 1 inch. We should be allowed to review piers greater than 8-feet in diameter to assess their settlement. However, pier foundation settlement is heavily affected by construction quality and, as a result, oftentimes exceeds 1 inch. Our settlement estimate assumes that proper construction practices are followed and there are no overlapping stresses due to adjacent piers. To mitigate any overlapping stresses due to adjacent piers, we recommend a minimum clear spacing of one bell diameter (larger bell diameter) between adjacent piers.

Lateral Capacity. Because of the potential for the upper two feet of the soil to shrink and pull away from drilled piers during dry periods, we recommend soil resistance to lateral loads on drilled piers be ignored in the upper 2-feet of the soil profile. For resistance of lateral loads on drilled piers, we recommend the following LPILE design parameters.

Depth (feet) [1]	Soil Type	Effective Soil Unit Weight (pcf) [2]	Allowable Cohesion, c (psf) [3]	Angle of Internal Friction, ϕ (degrees)	Strain at ½ Peak Strength, ε_{50}	Soil Modulus Parameter, k (for lateral loads) (pci)
0 - 2	Clay	120	0	0	NA	NA
2 - 10	Clay	120	700	0	0.007	300

Notes:
1. Depth below existing grade.
2. Effective soil unit weight based on assumed groundwater depth greater than 10-feet.
3. Factor of safety 3 is included in the recommended cohesion parameter.

Uplift. Each pier should contain full length reinforcing steel and should be designed to resist the uplift pressure (soil-to-pier adhesion) due to potential soil swell along the shaft from post-construction heave and other uplift forces applied by structural loadings. The magnitude of uplift adhesion due to soil swell along the pier shaft cannot be defined accurately and can vary according to the actual in-place moisture content of the soils during construction. It is estimated this uplift adhesion will not exceed about 1,000 psf. This soil adhesion is approximated to act uniformly over the upper 8 ft of the pier shaft in contact with clayey soils.

Uplift Resistance. The uplift force due to swelling of active clays should be resisted by the underreamed portion of the pier. The underreamed portion should be at least two (2) and not exceeding 3 times the diameter of the shaft. The minimum clear spacing between edges of adjacent piers should be at least one (1) underream diameter, based on the larger underream.

Shaft/Diameter Ratio. The piers should be provided with an underream diameter to shaft diameter ratio of not less than 2 to 1 and not greater than 3 to 1. **There is an inherent risk of bell collapse during construction. Unforeseen sand seams and silt pockets/seams and/or laminated/slickensided structures in clays or variable groundwater conditions can cause significant loss of tensile strength resulting in bell collapse. Therefore, UES recommends test piers with underreams be constructed prior to finalizing the foundation design to assess the risk of bell collapse**.

If underream collapse occurs during test pier drilling, we should be contacted for further recommendations. Some field adjustments in the depth of the underreamed piers may still be required in some areas to maintain the bottom of the piers above any possible groundwater seepage and caving soils encountered near the bearing depth. Adjustments in the depths of the piers should be approved and observed in the field by UES personnel.

Grade Beams. Grade beams may be used to support loads by spanning the drilled-and-underreamed piers. Grade beams should be designed to transfer loads to the piers as a simply supported beam, ignoring any support from the soil between the piers. The depth of exterior and interior grade beams can be varied according to the structural requirements of the floor slab. However, we recommend that exterior grade beams extend at least 12 inches below the lowest adjacent grade. Additionally, backfill soils placed adjacent to grade beams must be compacted as outlined in Section 5.5.6 of this report.

Construction Observation. The construction of all piers should be observed as a means to verify compliance with design assumptions and to verify:

1. the bearing stratum;
2. underream size;
3. the removal of all smear zones and cuttings;

4. that groundwater seepage, when encountered, is correctly handled; and
5. that the shafts are vertical (within acceptable tolerance).

We should be contacted for further evaluation and recommendations if soils other than those anticipated to be encountered at the design foundation bearing level, or if groundwater seepage and/or underream collapse occurs.

Groundwater. Groundwater was not encountered in the borings during drilling. However, groundwater may be encountered during pier excavation and the risk of groundwater seepage is increased during or after periods of precipitation. Submersible pumps may be capable of controlling seepage in the pier excavation to allow for concrete placement.

Applicable TxDOT Standards. Drilled pier foundations should be constructed in accordance with the requirements of TxDOT Item 416 (standard specification for construction of drilled pier foundations).

Concrete Placement. Concrete should be placed in the shafts immediately after excavation to reduce the risk of significant groundwater seepage, deterioration of the foundation-bearing surface and underream collapse. Concrete should have a slump of 5 to 7 inches and should not be allowed to strike the shaft sidewall or steel reinforcement during placement.

5.11 Pavement

General. Recommendations for rigid pavement and preparation of the pavement subgrade are provided in the following sections. A traffic study indicating the number and type of vehicles on which to base the pavement design was not provided. Therefore, our recommendations are based upon our experience with similar projects assuming normal vehicular loading. **Any unusual loading conditions should be brought to our attention prior to finalizing the pavement design so that we may assess and modify our recommendations as necessary.**

Civil and Drainage Consideration. Pavement design is the responsibility of the project Civil Engineer. We have recommended preliminary pavement sections based on geotechnical information and assumed traffic information in accordance with the American Association of State Highway and Transportation Officials (AASHTO) Guidelines for Design of Pavement Structures dated 1993. According to AASHTO design methodology, the pavement design thickness considers pavement performance, traffic, subgrade soils, pavement materials, environment, drainage and reliability. The applicability of our assumptions should be reviewed and approved by the project Civil Engineer before the pavement section is finalized. The recommended pavement sections assume good drainage quality prevails over the life of the pavement and that the pavement subgrade is exposed to moisture levels approaching saturation less than 25 percent of the time. Good drainage is defined by AASHTO as "the

ability to remove water from the pavement within one (1) day". Therefore, it is critical that the project Civil Engineer provide appropriate pavement drainage design to assure validity of the assumed drainage conditions.

5.11.1 Rigid Pavement

Portland cement concrete (PCC) with a minimum 28-day compressive strength of 3,500 pounds per square inch (psi) should be utilized for rigid pavement. Grade 60 reinforcing steel should be utilized in the transverse and longitudinal directions. The following pavement thicknesses and reinforcing are recommended:

Paving Use	Thickness (inches)	Reinforcing
Parking Areas for Automobiles and Light Trucks	5	No. 3 bars spaced on 22-inch intervals
Fire Lane, Bus Lane and Drive Lanes and Areas Subjected to Light to Medium Trucks	6	No. 3 bars spaced on 18-inch intervals
Areas Receiving Heavy Trucks and Dumpsters	7	No. 3 bars spaced on 16-inch intervals
Notes: 1. Recommended pavement reinforcement is in accordance with ACI guidelines. 2. Pavement subgrade should be chemically stabilized per Section 5.11.2.		

Pavement Joints. Contraction joints should be spaced at about 25 times the pavement thickness up to a maximum of 15 feet in any direction. Saw cut control joints should be cut within 6 to 12 hours of concrete placement. ACI recommendations indicate that regularly spaced expansion joints may be deleted from concrete pavements. Therefore, the installation of expansion joints is optional and should be evaluated by the Civil Engineer. Dowels should have a diameter equal to $^1/_8$ the slab thickness, be spaced on 12-inch intervals, and be embedded at least 9 inches. Appropriate joint sealant is recommended to keep water from saturating the pavement subgrade and to prevent the introduction of incompressible material into the joints. Routine monitoring and maintenance of joint sealants are recommended. Where not specified herein, concrete pavement should comply with Texas Department of Transportation (TxDOT) Standard Specifications, Item 360, "Concrete Pavement", or local equivalent.

5.11.2 Pavement Subgrade

Preliminary Potential Vertical Soil Movements. We have assumed that site treatment as recommended in Section 5.9 - Slab-on-Grade and Subgrade Improvement will not be performed within the pavement areas for this project. As a result, pavements will be subjected to the calculated PVR for this site. Based on the information gathered during this study, a pavement constructed on-grade will be subject to potential vertical movements of about 4½-inches. Because heave is generally associated with a source of water, it can occur

differentially. Edge lift, excessive cracking, corner breaks, and poor ride quality are just a few of the many examples of pavement issues that can occur when in-situ PVR values are high. We should be contacted to provide PVR mitigation strategies to help reduce potential movements if desired. Strategies available for reducing potential soil movements include soil stabilization with lime or cement, removal of the on-site expansive soils and replacement with select fill.

Subgrade Preparation for Clayey Soils (PI>15). High plasticity clay is expected to be encountered or exposed at pavement subgrade. The pavement subgrade should be placed in loose lifts not exceeding 8-inches and should be uniformly compacted to a minimum of 95 percent maximum dry density (per ASTM D-698) and within ±2 percent of the optimum moisture content. We recommend the subgrade be stabilized using the following:

Reagent	Application Rate (pounds per square yard)	Application Depth (inches)
Lime	36	6

Lime stabilization should be performed in accordance with TxDOT Standard Specifications, Item 260, “Lime Stabilized Subgrade”, or local equivalent.

Subgrade Preparation for Sandy Soils (PI≤15). Clayey sand is expected to be encountered or exposed at pavement subgrade. The pavement subgrade should be placed in loose lifts not exceeding 8-inches and should be uniformly compacted to a minimum of 95 percent maximum dry density (per ASTM D-698) and within ±2 percent of the optimum moisture content. We recommend the subgrade be stabilized using either of the following:

Reagent	Application Rate (pounds per square yard)	Application Depth (inches)
Portland Cement	23	6
70% Flyash/30% Lime Blend	50	6

Cement stabilization should be performed in accordance with TxDOT Standard Specifications, Item 275, “Portland Cement Treated Materials” or local equivalent, and lime-fly ash stabilization should be performed in accordance with TxDOT Standard Specifications, Item 265, “Lime-Fly Ash Treatment of Materials Used as Subgrade” or local equivalent.

Cautionary Note Regarding Stabilized Subgrades. Stabilized subgrades are not suitable for supporting heavy construction traffic. Stabilized subgrades that have been subjected to heavy construction traffic should be re-inspected and re-stabilized as necessary prior to the construction of overlying pavement.

6.0 LIMITATIONS

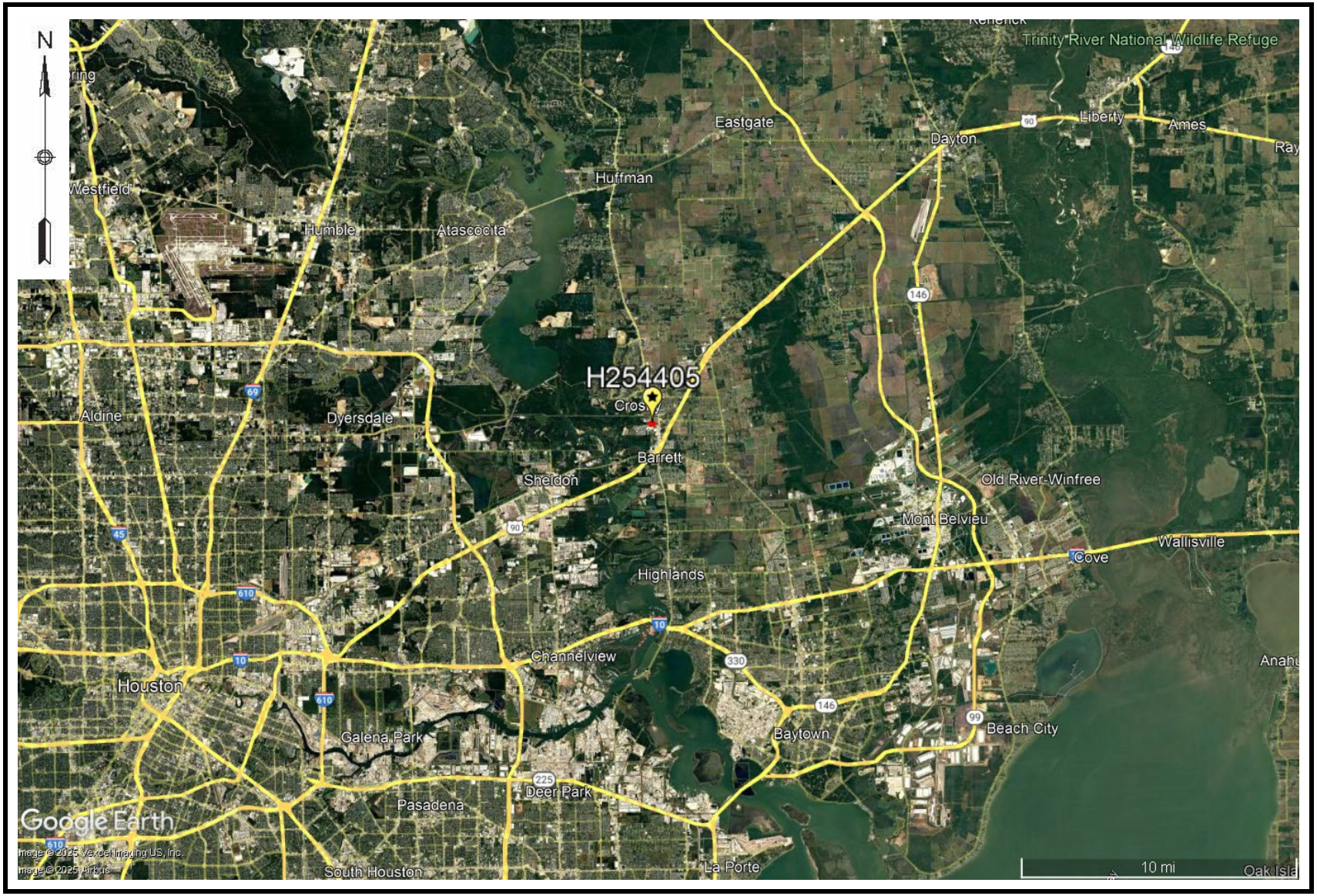
Professional services provided in this geotechnical exploration were performed, findings obtained, and recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices. The scope of services provided herein does not include an environmental assessment of the site or investigation for the presence or absence of hazardous materials in the soil, surface water or groundwater. UES, upon written request, can be retained to provide these services.

UES is not responsible for conclusions, opinions or recommendations made by others based on this data. Information contained in this report is intended for the exclusive use of the Client (and their designated design representatives) and is related solely to design of the specific structures outlined in Section 1.0. No party other than the Client (and their designated design representatives) shall use or rely upon this report in any manner whatsoever unless such party shall have obtained UES's written acceptance of such intended use. Any such third party using this report after obtaining UES's written acceptance shall be bound by the limitations and limitations of liability contained herein, including UES's liability being limited to the fee paid to it for this report. Recommendations presented in this report should not be used for design of any other structures except those specifically described in this report. In all areas of this report in which UES may provide additional services if requested to do so in writing, it is presumed that such requests have not been made if not evidenced by a written document accepted by UES. Further, subsurface conditions can change with passage of time. Recommendations contained herein are not considered applicable for an extended period of time after the completion date of this report. It is recommended our office be contacted for a review of the contents of this report for construction commencing more than one (1) year after completion of this report. Non-compliance with any of these requirements by the Client or anyone else shall release UES from any liability resulting from the use of, or reliance upon, this report.

Recommendations provided in this report are based on our understanding of information provided by the Client about characteristics of the project. If the Client notes any deviation from the facts about project characteristics, our office should be contacted immediately since this may materially alter the recommendations. Further, UES is not responsible for damages resulting from the workmanship of designers or contractors. It is recommended the Owner retain qualified personnel, such as a Geotechnical Engineering firm, to verify construction is performed in accordance with plans and specifications.

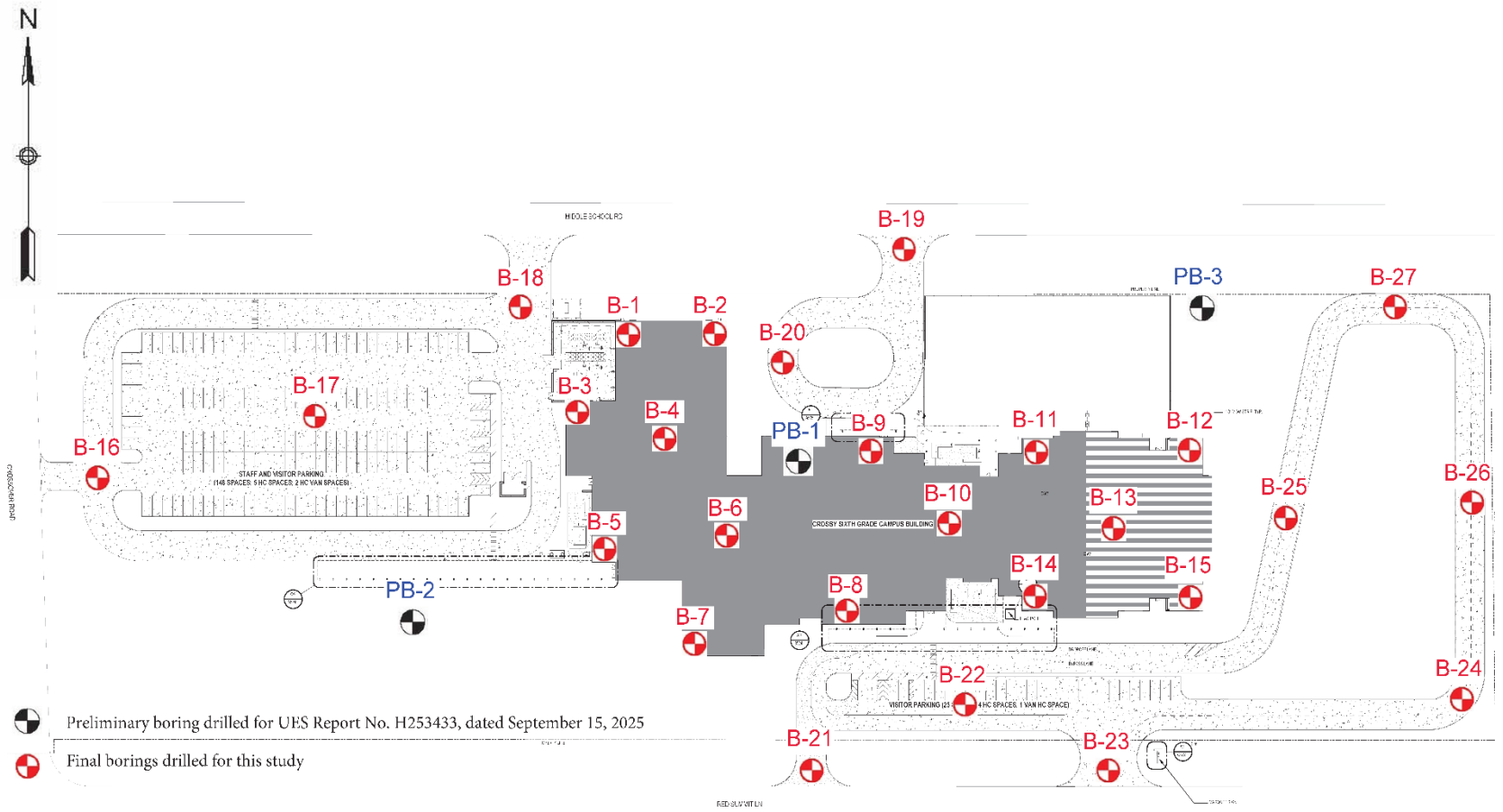
Appendix A - Project Location Diagram

PROJECT LOCATION DIAGRAM



Appendix B - Boring Location Diagram

BORING LOCATION DIAGRAM



Appendix C - Boring Logs, Laboratory Results and Unified Soil Classification System

BORING NUMBER: B-01

PROJECT NAME Crosby Sixth Grade Campus - Final Study
PROJECT NUMBER H254405
DATE STARTED 10/27/2025 **COMPLETED** 10/27/2025
PROJECT LOCATION Crosby, Texas
CLIENT LAN - West Sam Houston Parkway
LATITUDE / LONGITUDE N/A
DRILLING METHOD Auger 0 - 30 feet
BORING ELEVATION N/A
NOTES
HAMMER WEIGHT 140 lbs **HAMMER DROP** 30 inches

Groundwater Data	
During Drilling (ft):	N.E.
After Drilling (ft):	N.M.
After __ Hours (ft):	N/A

Depth (ft)	Graphic Log	Material Description	Samples: Sample Graphic	Samples: REC (%) / RQD (%)	Samples: N-Value / Refusal / TCP	Samples: Pocket Pen (TSF)	Lab: Compressive Strength (TSF)	Lab: Confining Pressure (PSI)	Lab: Dry Density (PCF)	Lab: Moisture Content (%)	Lab: Liquid Limit	Lab: Plastic Limit	Lab: Plasticity Index	Lab: % Fines	Lab: % Swell
		FAT CLAY (CH) - Dark gray				3.00				27	99	32	67	89	
						1.50				36					
5		Gray from 4 to 6 feet.				1.00				38					
		Brownish yellow, light gray from 6 to 30 feet.				1.00				39	88	32	56		0.00
						1.00				34					
10															
						1.00				36					
15															
						1.00				27					
20															
						2.50				32					
25															
						2.00				33					
30		30.0 End of Boring													

BORING NUMBER: B-02

PROJECT NAME Crosby Sixth Grade Campus - Final Study
PROJECT NUMBER H254405
DATE STARTED 10/27/2025 **COMPLETED** 10/27/2025
PROJECT LOCATION Crosby, Texas
CLIENT LAN - West Sam Houston Parkway
LATITUDE / LONGITUDE N/A
DRILLING METHOD Auger 0 - 30 feet
BORING ELEVATION N/A
NOTES
HAMMER WEIGHT 140 lbs **HAMMER DROP** 30 inches

Groundwater Data	
During Drilling (ft):	N.E.
After Drilling (ft):	N.M.
After __ Hours (ft):	N/A

Depth (ft)	Graphic Log	Material Description	Samples: Sample Graphic	Samples: REC (%) / RQD (%)	Samples: N-Value / Refusal / TCP	Samples: Pocket Pen (TSF)	Lab: Compressive Strength (TSF)	Lab: Confining Pressure (PSI)	Lab: Dry Density (PCF)	Lab: Moisture Content (%)	Lab: Liquid Limit	Lab: Plastic Limit	Lab: Plasticity Index	Lab: % Fines	Lab: % Swell
		FAT CLAY (CH) - Dark gray				3.00				31					
						1.00				39					
		Brownish yellow, light gray from 4 to 30.				1.00				39	90	34	56		
						1.00				39					
		With calcareous nodules from 8 to 13 feet.				1.00	0.8		86.0	38					
						2.50				29					
						2.50				28					
						3.00				31					
		With gravel from 28 to 30 feet.				1.50				28					
		30.0 End of Boring													

BORING NUMBER: B-03

PROJECT NAME Crosby Sixth Grade Campus - Final Study
PROJECT NUMBER H254405
DATE STARTED 10/28/2025 **COMPLETED** 10/28/2025
PROJECT LOCATION Crosby, Texas
CLIENT LAN - West Sam Houston Parkway
LATITUDE / LONGITUDE N/A
DRILLING METHOD Auger 0 - 25 feet
BORING ELEVATION N/A
NOTES
HAMMER WEIGHT 140 lbs **HAMMER DROP** 30 inches

Groundwater Data	
During Drilling (ft):	N.E.
After Drilling (ft):	N.M.
After __ Hours (ft):	N/A

Depth (ft)	Graphic Log	Material Description	Samples: Sample Graphic	Samples: REC (%) / RQD (%)	Samples: N-Value / Refusal / TCP	Samples: Pocket Pen (TSF)	Lab: Compressive Strength (TSF)	Lab: Confining Pressure (PSI)	Lab: Dry Density (PCF)	Lab: Moisture Content (%)	Lab: Liquid Limit	Lab: Plastic Limit	Lab: Plasticity Index	Lab: % Fines	Lab: % Swell
		FAT CLAY (CH) - Dark gray.				4.50+				27					
		Gray from 2 to 8 feet.				3.50				32	116	36	80		1.50
5						1.50				39					
						1.50				38					
		Brownish yellow, light gray from 8 to 25 feet. With calcareous nodules from 8 to 13 feet.				1.50				34	82	28	54		
10															
						2.00				34					
15															
						2.00				31					
20															
						2.00				34					
25		25.0 End of Boring													
30															

BORING NUMBER: B-04

PROJECT NAME Crosby Sixth Grade Campus - Final Study
PROJECT NUMBER H254405
DATE STARTED 10/28/2025 **COMPLETED** 10/28/2025
PROJECT LOCATION Crosby, Texas
CLIENT LAN - West Sam Houston Parkway
LATITUDE / LONGITUDE N/A
DRILLING METHOD Auger 0 - 25 feet
BORING ELEVATION N/A
NOTES
HAMMER WEIGHT 140 lbs **HAMMER DROP** 30 inches

Groundwater Data	
During Drilling (ft):	N.E.
After Drilling (ft):	N.M.
After __ Hours (ft):	N/A

Depth (ft)	Graphic Log	Material Description	Samples: Sample Graphic	Samples: REC (%) / RQD (%)	Samples: N-Value / Refusal / TCP	Samples: Pocket Pen (TSF)	Lab: Compressive Strength (TSF)	Lab: Confining Pressure (PSI)	Lab: Dry Density (PCF)	Lab: Moisture Content (%)	Lab: Liquid Limit	Lab: Plastic Limit	Lab: Plasticity Index	Lab: % Fines	Lab: % Swell
0		FAT CLAY (CH) - Dark gray.				1.50				36					
						3.00				35					
5						1.50				38	96	31	65	98	
		Brownish yellow, light gray from 6 to 25 feet.				1.00				39					
						1.00				38					
10															
						1.00	1.4		93.2	36					
15															
						1.50				29					
20															
						2.00				34					
25		25.0 End of Boring													
30															

BORING NUMBER: B-05

PROJECT NAME Crosby Sixth Grade Campus - Final Study
PROJECT NUMBER H254405
DATE STARTED 10/27/2025 **COMPLETED** 10/27/2025
PROJECT LOCATION Crosby, Texas
CLIENT LAN - West Sam Houston Parkway
LATITUDE / LONGITUDE N/A
DRILLING METHOD Auger 0 - 30 feet
BORING ELEVATION N/A
NOTES
HAMMER WEIGHT 140 lbs **HAMMER DROP** 30 inches

Groundwater Data	
During Drilling (ft):	N.E.
After Drilling (ft):	N.M.
After __ Hours (ft):	N/A

Depth (ft)	Graphic Log	Material Description	Samples: Sample Graphic	Samples: REC (%) / RQD (%)	Samples: N-Value / Refusal / TCP	Samples: Pocket Pen (TSF)	Lab: Compressive Strength (TSF)	Lab: Confining Pressure (PSI)	Lab: Dry Density (PCF)	Lab: Moisture Content (%)	Lab: Liquid Limit	Lab: Plastic Limit	Lab: Plasticity Index	Lab: % Fines	Lab: % Swell
		FAT CLAY (CH) - Dark gray.				2.50				35	89	33	56		
						1.00				41					
5						1.00				39					
		Gray from 6 to 8 feet.				1.00				37	98	36	62		0.10
		Brownish yellow, light gray from 8 to 28 feet.				2.00				31					
10															
						2.00				26					
15															
						2.50				30					
20															
						2.00				33					
25															
		Reddish brown, light gray from 28 to 30 feet.				2.50				30					
30		30.0													
		End of Boring													

BORING NUMBER: B-06

PROJECT NAME Crosby Sixth Grade Campus - Final Study
PROJECT NUMBER H254405
DATE STARTED 10/27/2025 **COMPLETED** 10/27/2025
PROJECT LOCATION Crosby, Texas
CLIENT LAN - West Sam Houston Parkway
LATITUDE / LONGITUDE N/A
DRILLING METHOD Auger 0 - 30 feet
BORING ELEVATION N/A
NOTES
HAMMER WEIGHT 140 lbs **HAMMER DROP** 30 inches

Groundwater Data	
During Drilling (ft):	N.E.
After Drilling (ft):	N.M.
After __ Hours (ft):	N/A

Depth (ft)	Graphic Log	Material Description	Samples: Sample Graphic	Samples: REC (%) / RQD (%)	Samples: N-Value / Refusal / TCP	Samples: Pocket Pen (TSF)	Lab: Compressive Strength (TSF)	Lab: Confining Pressure (PSI)	Lab: Dry Density (PCF)	Lab: Moisture Content (%)	Lab: Liquid Limit	Lab: Plastic Limit	Lab: Plasticity Index	Lab: % Fines	Lab: % Swell
		FAT CLAY (CH) - Dark gray.				1.50				38					
						1.50				40					
5		Gray from 4 to 6 feet.				1.00				40	92	33	59		
		Light gray, brownish yellow from 6 to 30 feet.				1.50				30					
		With calcareous deposits from 8 to 13 feet.				2.00				23					
10															
						2.00	1.0		91.9	30					
15															
						0.50				40					
20															
						2.50				33					
25															
		Gray, reddish brown with calcareous nodules from 28 to 30 feet.				3.50				34					
30		30.0 End of Boring													

BORING NUMBER: B-07

PROJECT NAME Crosby Sixth Grade Campus - Final Study
PROJECT NUMBER H254405
DATE STARTED 10/28/2025 **COMPLETED** 10/28/2025
PROJECT LOCATION Crosby, Texas
CLIENT LAN - West Sam Houston Parkway
LATITUDE / LONGITUDE N/A
DRILLING METHOD Auger 0 - 25 feet
BORING ELEVATION N/A
NOTES
HAMMER WEIGHT 140 lbs **HAMMER DROP** 30 inches

Groundwater Data	
During Drilling (ft):	N.E.
After Drilling (ft):	N.M.
After __ Hours (ft):	N/A

Depth (ft)	Graphic Log	Material Description	Sample Graphic	REC (%) / RQD (%)	N-Value / Refusal / TCP	Pocket Pen (TSF)	Compressive Strength (TSF)	Confining Pressure (PSI)	Dry Density (PCF)	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	% Fines	% Swell
		FAT CLAY (CH) - Dark gray.				3.50				30					
						3.00				34	99	31	68	96	
5						1.00				38					
		Brownish yellow, dark gray from 6 to 25 feet.				1.50				37					
						1.00				41	79	29	50		
10															
						1.00				29					
15															
						1.00				37					
20															
						3.00				26					
25		25.0 End of Boring													
30															

BORING NUMBER: B-08

PROJECT NAME Crosby Sixth Grade Campus - Final Study
PROJECT NUMBER H254405
DATE STARTED 10/27/2025 **COMPLETED** 10/27/2025
PROJECT LOCATION Crosby, Texas
CLIENT LAN - West Sam Houston Parkway
LATITUDE / LONGITUDE N/A
DRILLING METHOD Auger 0 - 30 feet
BORING ELEVATION N/A
NOTES
HAMMER WEIGHT 140 lbs **HAMMER DROP** 30 inches

Groundwater Data	
During Drilling (ft):	N.E.
After Drilling (ft):	N.M.
After __ Hours (ft):	N/A

Depth (ft)	Graphic Log	Material Description	Samples: Sample Graphic	Samples: REC (%) / RQD (%)	Samples: N-Value / Refusal / TCP	Samples: Pocket Pen (TSF)	Lab: Compressive Strength (TSF)	Lab: Confining Pressure (PSI)	Lab: Dry Density (PCF)	Lab: Moisture Content (%)	Lab: Liquid Limit	Lab: Plastic Limit	Lab: Plasticity Index	Lab: % Fines	Lab: % Swell
		FAT CLAY (CH) - Dark gray.				4.50+				27					
						3.00				32					
5						1.50				39	90	33	57		0.40
		Brownish yellow, light gray from 6 to 13 feet.				2.00				38					
						1.50				41					
10															
		Reddish brown, light gray from 13 to 23 feet.				3.50				28					
15															
						3.00				29					
20															
		Light gray, brownish yellow from 23 to 30 feet.				4.00				30					
25															
		30.0				1.00				40					
30		End of Boring													

BORING NUMBER: B-09

PROJECT NAME Crosby Sixth Grade Campus - Final Study
PROJECT NUMBER H254405
DATE STARTED 10/28/2025 **COMPLETED** 10/28/2025
PROJECT LOCATION Crosby, Texas
CLIENT LAN - West Sam Houston Parkway
LATITUDE / LONGITUDE N/A
DRILLING METHOD Auger 0 - 30 feet
BORING ELEVATION N/A
NOTES
HAMMER WEIGHT 140 lbs **HAMMER DROP** 30 inches

Groundwater Data	
During Drilling (ft):	N.E.
After Drilling (ft):	N.M.
After __ Hours (ft):	N/A

Depth (ft)	Graphic Log	Material Description	Samples: Sample Graphic	Samples: REC (%) / RQD (%)	Samples: N-Value / Refusal / TCP	Samples: Pocket Pen (TSF)	Lab: Compressive Strength (TSF)	Lab: Confining Pressure (PSI)	Lab: Dry Density (PCF)	Lab: Moisture Content (%)	Lab: Liquid Limit	Lab: Plastic Limit	Lab: Plasticity Index	Lab: % Fines	Lab: % Swell
		LEAN CLAY WITH SAND (CL) FILL - Brownish yellow with root fibers and calcareous nodules. 2.0				1.50				16	36	18	18	75	
		FAT CLAY (CH) - Dark gray.				2.00				33					
5						1.00				36					
		Gray, brownish yellow from 6 to 8 feet.				1.00				36	91	34	57		
		Brownish yellow, light gray from 8 to 30 feet. With gravel from 8 to 13 feet.				1.00				38					
10															
						1.00				27					
15															
						1.00				31					
20															
						1.00				32					
25															
						2.00				32					
30		30.0 End of Boring													

BORING NUMBER: B-10

PROJECT NAME Crosby Sixth Grade Campus - Final Study
PROJECT NUMBER H254405
DATE STARTED 10/28/2025 **COMPLETED** 10/28/2025
PROJECT LOCATION Crosby, Texas
CLIENT LAN - West Sam Houston Parkway
LATITUDE / LONGITUDE N/A
DRILLING METHOD Auger 0 - 25 feet
BORING ELEVATION N/A
NOTES
HAMMER WEIGHT 140 lbs **HAMMER DROP** 30 inches

Groundwater Data	
During Drilling (ft):	N.E.
After Drilling (ft):	N.M.
After __ Hours (ft):	N/A

Depth (ft)	Graphic Log	Material Description	Samples: Sample Graphic	Samples: REC (%) / RQD (%)	Samples: N-Value / Refusal / TCP	Samples: Pocket Pen (TSF)	Lab: Compressive Strength (TSF)	Lab: Confining Pressure (PSI)	Lab: Dry Density (PCF)	Lab: Moisture Content (%)	Lab: Liquid Limit	Lab: Plastic Limit	Lab: Plasticity Index	Lab: % Fines	Lab: % Swell
		FAT CLAY (CH) - Dark gray.				3.00				30					
						1.00				36					
5		Gray from 4 to 8 feet.				1.00				39	89	33	56		
						1.00				36					
		Gray, brownish yellow with calcareous nodules from 8 to 13 feet.				1.50				34					
10															
		Reddish brown, light gray from 13 to 23 feet.				3.00				33					
15															
						3.00				27					
20															
		Light gray, brownish yellow from 23 to 25 feet.				2.50				32					
25		25.0 End of Boring													
30															

BORING NUMBER: B-11

PROJECT NAME Crosby Sixth Grade Campus - Final Study
PROJECT NUMBER H254405
DATE STARTED 11/03/2025 **COMPLETED** 11/03/2025
PROJECT LOCATION Crosby, Texas
CLIENT LAN - West Sam Houston Parkway
LATITUDE / LONGITUDE N/A
DRILLING METHOD Auger 0 - 25 feet
BORING ELEVATION N/A
NOTES
HAMMER WEIGHT 140 lbs **HAMMER DROP** 30 inches

Groundwater Data	
During Drilling (ft):	N.E.
After Drilling (ft):	N.M.
After __ Hours (ft):	N/A

Depth (ft)	Graphic Log	Material Description	Samples: Sample Graphic	Samples: REC (%) / RQD (%)	Samples: N-Value / Refusal / TCP	Samples: Pocket Pen (TSF)	Lab: Compressive Strength (TSF)	Lab: Confining Pressure (PSI)	Lab: Dry Density (PCF)	Lab: Moisture Content (%)	Lab: Liquid Limit	Lab: Plastic Limit	Lab: Plasticity Index	Lab: % Fines	Lab: % Swell
		FAT CLAY (CH) - Dark gray.				3.00				29					
						4.50				27					
5						2.50				30					
						3.00				30					
		Gray from 8 to 12 feet.				3.50				25	84	26	58		1.00
10															
		Brownish yellow, light gray from 13 to 25 feet.				3.00				29					
15															
						3.00				40					
20															
						2.50				31					
25		25.0 End of Boring													
30															

BORING NUMBER: B-12

PROJECT NAME Crosby Sixth Grade Campus - Final Study
PROJECT NUMBER H254405
DATE STARTED 11/03/2025 **COMPLETED** 11/03/2025
PROJECT LOCATION Crosby, Texas
CLIENT LAN - West Sam Houston Parkway
LATITUDE / LONGITUDE N/A
DRILLING METHOD Auger 0 - 30 feet
BORING ELEVATION N/A
NOTES
HAMMER WEIGHT 140 lbs **HAMMER DROP** 30 inches

Groundwater Data	
During Drilling (ft):	N.E.
After Drilling (ft):	N.M.
After __ Hours (ft):	N/A

Depth (ft)	Graphic Log	Material Description	Sample Graphic	REC (%) / RQD (%)	N-Value / Refusal / TCP	Pocket Pen (TSF)	Compressive Strength (TSF)	Confining Pressure (PSI)	Dry Density (PCF)	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	% Fines	% Swell
		FAT CLAY (CH) - Dark gray.				3.50				28					
		Gray from 2 to 8 feet.				2.50				31					
5						2.00				31	85	25	60		
						2.50				33					
		Brownish yellow, light gray from 8 to 30 feet.				4.00	0.8		91.6	30					
10															
						4.00				29					
15															
						4.00				29					
20															
						3.50				29					
25															
						3.00				32					
30		30.0 End of Boring													

BORING NUMBER: B-13

PROJECT NAME Crosby Sixth Grade Campus - Final Study
PROJECT NUMBER H254405
DATE STARTED 11/03/2025 **COMPLETED** 11/03/2025
PROJECT LOCATION Crosby, Texas
CLIENT LAN - West Sam Houston Parkway
LATITUDE / LONGITUDE N/A
DRILLING METHOD Auger 0 - 25 feet
BORING ELEVATION N/A
NOTES
HAMMER WEIGHT 140 lbs **HAMMER DROP** 30 inches

Groundwater Data	
During Drilling (ft):	N.E.
After Drilling (ft):	N.M.
After __ Hours (ft):	N/A

Depth (ft)	Graphic Log	Material Description	Samples: Sample Graphic	Samples: REC (%) / RQD (%)	Samples: N-Value / Refusal / TCP	Samples: Pocket Pen (TSF)	Lab: Compressive Strength (TSF)	Lab: Confining Pressure (PSI)	Lab: Dry Density (PCF)	Lab: Moisture Content (%)	Lab: Liquid Limit	Lab: Plastic Limit	Lab: Plasticity Index	Lab: % Fines	Lab: % Swell
0		FAT CLAY (CH) - Dark gray.				4.00				28	96	29	67	97	
						4.50				26					
5						3.50				28					
						4.00				27					
						3.50				27					
10															
		Brownish yellow, light gray from 13 to 23 feet.				2.00				26					
15															
						1.50				31					
20															
		Light brown from 23 to 25 feet.				2.50				30					
25		25.0 End of Boring													
30															

BORING NUMBER: B-14

PROJECT NAME Crosby Sixth Grade Campus - Final Study
PROJECT NUMBER H254405
DATE STARTED 11/03/2025 **COMPLETED** 11/03/2025
PROJECT LOCATION Crosby, Texas
CLIENT LAN - West Sam Houston Parkway
LATITUDE / LONGITUDE N/A
DRILLING METHOD Auger 0 - 25 feet
BORING ELEVATION N/A
NOTES
HAMMER WEIGHT 140 lbs **HAMMER DROP** 30 inches

Groundwater Data	
During Drilling (ft):	N.E.
After Drilling (ft):	N.M.
After __ Hours (ft):	N/A

Depth (ft)	Graphic Log	Material Description	Samples: Sample Graphic	Samples: REC (%) / RQD (%)	Samples: N-Value / Refusal / TCP	Samples: Pocket Pen (TSF)	Lab: Compressive Strength (TSF)	Lab: Confining Pressure (PSI)	Lab: Dry Density (PCF)	Lab: Moisture Content (%)	Lab: Liquid Limit	Lab: Plastic Limit	Lab: Plasticity Index	Lab: % Fines	Lab: % Swell
0		FAT CLAY (CH) - Dark gray.				3.00				26					
						4.00				27					
5		Dark gray, brownish yellow from 4 to 6 feet.				3.00				28	88	28	60		
		Dark gray from 6 to 8 feet.				3.50				28					
		Brownish yellow, light gray from 8 to 23 feet.				3.50				26					
10															
						3.00	1.2		95.5	27					
15															
						2.50				29					
20															
		Light brown from 23 to 25 feet.				2.50				30					
25		25.0 End of Boring													
30															

BORING NUMBER: B-15

PROJECT NAME Crosby Sixth Grade Campus - Final Study
PROJECT NUMBER H254405
DATE STARTED 11/03/2025 **COMPLETED** 11/03/2025
PROJECT LOCATION Crosby, Texas
CLIENT LAN - West Sam Houston Parkway
LATITUDE / LONGITUDE N/A
DRILLING METHOD Auger 0 - 30 feet
BORING ELEVATION N/A
NOTES
HAMMER WEIGHT 140 lbs **HAMMER DROP** 30 inches

Groundwater Data	
During Drilling (ft):	N.E.
After Drilling (ft):	N.M.
After __ Hours (ft):	N/A

Depth (ft)	Graphic Log	Material Description	Samples: Sample Graphic	Samples: REC (%) / RQD (%)	Samples: N-Value / Refusal / TCP	Samples: Pocket Pen (TSF)	Lab: Compressive Strength (TSF)	Lab: Confining Pressure (PSI)	Lab: Dry Density (PCF)	Lab: Moisture Content (%)	Lab: Liquid Limit	Lab: Plastic Limit	Lab: Plasticity Index	Lab: % Fines	Lab: % Swell
		FAT CLAY (CH) - Dark gray.				4.50				26					
						3.00				30	85	25	60		2.90
5		Gray from 4 to 8 feet.				2.50				29					
						2.00				29					
		Brownish yellow from 8 to 13 feet.				4.50				26	80	24	56		
10															
		Brownish yellow, light gray from 13 to 23 feet.				2.50				31					
15															
						2.50				29					
20															
		Light brown from 23 to 30 feet.				1.50				32					
25															
		30.0				3.00				32					
30		End of Boring													

BORING NUMBER: B-16

PROJECT NAME Crosby Sixth Grade Campus - Final Study
PROJECT NUMBER H254405
DATE STARTED 10/28/2025 **COMPLETED** 10/28/2025
PROJECT LOCATION Crosby, Texas
CLIENT LAN - West Sam Houston Parkway
LATITUDE / LONGITUDE N/A
DRILLING METHOD Auger 0 - 5 feet
BORING ELEVATION N/A
NOTES
HAMMER WEIGHT 140 lbs **HAMMER DROP** 30 inches

Groundwater Data	
During Drilling (ft):	N.E.
After Drilling (ft):	N.M.
After __ Hours (ft):	N/A

Depth (ft)	Graphic Log	Material Description	Samples: Sample Graphic	Samples: REC (%) / RQD (%)	Samples: N-Value / Refusal / TCP	Samples: Pocket Pen (TSF)	Lab: Compressive Strength (TSF)	Lab: Confining Pressure (PSI)	Lab: Dry Density (PCF)	Lab: Moisture Content (%)	Lab: Liquid Limit	Lab: Plastic Limit	Lab: Plasticity Index	Lab: % Fines	Lab: % Swell
		FAT CLAY (CH) - Dark gray. Root fibers and gravel from 0 to 2 feet.				3.00				25	58	25	33	77	
						3.50				34					
		5.0				1.00				39					
5		End of Boring													
10															
15															
20															
25															
30															

BORING NUMBER: B-17

PROJECT NAME Crosby Sixth Grade Campus - Final Study
PROJECT NUMBER H254405
DATE STARTED 10/28/2025 **COMPLETED** 10/28/2025
PROJECT LOCATION Crosby, Texas
CLIENT LAN - West Sam Houston Parkway
LATITUDE / LONGITUDE N/A
DRILLING METHOD Auger 0 - 5 feet
BORING ELEVATION N/A
NOTES
HAMMER WEIGHT 140 lbs **HAMMER DROP** 30 inches

Groundwater Data	
During Drilling (ft):	N.E.
After Drilling (ft):	N.M.
After __ Hours (ft):	N/A

Depth (ft)	Graphic Log	Material Description	Samples: Sample Graphic	Samples: REC (%) / RQD (%)	Samples: N-Value / Refusal / TCP	Samples: Pocket Pen (TSF)	Lab: Compressive Strength (TSF)	Lab: Confining Pressure (PSI)	Lab: Dry Density (PCF)	Lab: Moisture Content (%)	Lab: Liquid Limit	Lab: Plastic Limit	Lab: Plasticity Index	Lab: % Fines	Lab: % Swell
		FAT CLAY (CH) - Dark gray.				2.00				35					
						4.50				30	100	34	66		
5		5.0				1.00				35					
		End of Boring													
10															
15															
20															
25															
30															

BORING NUMBER: B-18

PROJECT NAME Crosby Sixth Grade Campus - Final Study
PROJECT NUMBER H254405
DATE STARTED 10/28/2025 **COMPLETED** 10/28/2025
PROJECT LOCATION Crosby, Texas
CLIENT LAN - West Sam Houston Parkway
LATITUDE / LONGITUDE N/A
DRILLING METHOD Auger 0 - 5 feet
BORING ELEVATION N/A
NOTES
HAMMER WEIGHT 140 lbs **HAMMER DROP** 30 inches

Groundwater Data	
During Drilling (ft):	N.E.
After Drilling (ft):	N.M.
After __ Hours (ft):	N/A

Depth (ft)	Graphic Log	Material Description	Samples: Sample Graphic	Samples: REC (%) / RQD (%)	Samples: N-Value / Refusal / TCP	Samples: Pocket Pen (TSF)	Lab: Compressive Strength (TSF)	Lab: Confining Pressure (PSI)	Lab: Dry Density (PCF)	Lab: Moisture Content (%)	Lab: Liquid Limit	Lab: Plastic Limit	Lab: Plasticity Index	Lab: % Fines	Lab: % Swell
		FAT CLAY (CH) - Dark gray.				1.50				32	89	31	58		
						3.50				31					
		5.0				4.00				30					
5		End of Boring													
10															
15															
20															
25															
30															

BORING NUMBER: B-19

PROJECT NAME Crosby Sixth Grade Campus - Final Study
PROJECT NUMBER H254405
DATE STARTED 10/28/2025 **COMPLETED** 10/28/2025
PROJECT LOCATION Crosby, Texas
CLIENT LAN - West Sam Houston Parkway
LATITUDE / LONGITUDE N/A
DRILLING METHOD Auger 0 - 5 feet
BORING ELEVATION N/A
NOTES
HAMMER WEIGHT 140 lbs **HAMMER DROP** 30 inches

Groundwater Data	
During Drilling (ft):	N.E.
After Drilling (ft):	N.M.
After __ Hours (ft):	N/A

Depth (ft)	Graphic Log	Material Description	Samples: Sample Graphic	Samples: REC (%) / RQD (%)	Samples: N-Value / Refusal / TCP	Samples: Pocket Pen (TSF)	Lab: Compressive Strength (TSF)	Lab: Confining Pressure (PSI)	Lab: Dry Density (PCF)	Lab: Moisture Content (%)	Lab: Liquid Limit	Lab: Plastic Limit	Lab: Plasticity Index	Lab: % Fines	Lab: % Swell
		FAT CLAY (CH) FILL - Gray, brownish yellow, with root fibers and gravel.				3.50				27					
		2.0													
		FAT CLAY (CH) - Dark gray.				4.50+				28	83	30	53		
		5.0				2.50				34					
5		End of Boring													
10															
15															
20															
25															
30															

BORING NUMBER: B-20

PROJECT NAME Crosby Sixth Grade Campus - Final Study
PROJECT NUMBER H254405
DATE STARTED 10/28/2025 **COMPLETED** 10/28/2025
PROJECT LOCATION Crosby, Texas
CLIENT LAN - West Sam Houston Parkway
LATITUDE / LONGITUDE N/A
DRILLING METHOD Auger 0 - 5 feet
BORING ELEVATION N/A
NOTES
HAMMER WEIGHT 140 lbs **HAMMER DROP** 30 inches

Groundwater Data	
During Drilling (ft):	N.E.
After Drilling (ft):	N.M.
After __ Hours (ft):	N/A

Depth (ft)	Graphic Log	Material Description	Samples: Sample Graphic	Samples: REC (%) / RQD (%)	Samples: N-Value / Refusal / TCP	Samples: Pocket Pen (TSF)	Lab: Compressive Strength (TSF)	Lab: Confining Pressure (PSI)	Lab: Dry Density (PCF)	Lab: Moisture Content (%)	Lab: Liquid Limit	Lab: Plastic Limit	Lab: Plasticity Index	Lab: % Fines	Lab: % Swell
		CLAYEY SAND (SC) FILL - Reddish brown, brownish yellow.				3.00				15	24	14	10	32	
		2.0													
		FAT CLAY (CH) - Dark gray.				3.50				33					
						2.00				39					
5		5.0													
		End of Boring													
10															
15															
20															
25															
30															

BORING NUMBER: B-21

PROJECT NAME Crosby Sixth Grade Campus - Final Study
PROJECT NUMBER H254405
DATE STARTED 10/28/2025 **COMPLETED** 10/28/2025
PROJECT LOCATION Crosby, Texas
CLIENT LAN - West Sam Houston Parkway
LATITUDE / LONGITUDE N/A
DRILLING METHOD Auger 0 - 5 feet
BORING ELEVATION N/A
NOTES
HAMMER WEIGHT 140 lbs **HAMMER DROP** 30 inches

Groundwater Data	
During Drilling (ft):	N.E.
After Drilling (ft):	N.M.
After __ Hours (ft):	N/A

Depth (ft)	Graphic Log	Material Description	Samples: Sample Graphic	Samples: REC (%) / RQD (%)	Samples: N-Value / Refusal / TCP	Samples: Pocket Pen (TSF)	Lab: Compressive Strength (TSF)	Lab: Confining Pressure (PSI)	Lab: Dry Density (PCF)	Lab: Moisture Content (%)	Lab: Liquid Limit	Lab: Plastic Limit	Lab: Plasticity Index	Lab: % Fines	Lab: % Swell
		FAT CLAY (CH) - Dark gray.				4.50+				23					
						3.50				33	81	30	51		
		5.0				1.00				38					
5		End of Boring													
10															
15															
20															
25															
30															

BORING NUMBER: B-22

PROJECT NAME Crosby Sixth Grade Campus - Final Study
PROJECT NUMBER H254405
DATE STARTED 10/28/2025 **COMPLETED** 10/28/2025
PROJECT LOCATION Crosby, Texas
CLIENT LAN - West Sam Houston Parkway
LATITUDE / LONGITUDE N/A
DRILLING METHOD Auger 0 - 5 feet
BORING ELEVATION N/A
NOTES
HAMMER WEIGHT 140 lbs **HAMMER DROP** 30 inches

Groundwater Data	
During Drilling (ft):	N.E.
After Drilling (ft):	N.M.
After __ Hours (ft):	N/A

Depth (ft)	Graphic Log	Material Description	Samples: Sample Graphic	Samples: REC (%) / RQD (%)	Samples: N-Value / Refusal / TCP	Samples: Pocket Pen (TSF)	Lab: Compressive Strength (TSF)	Lab: Confining Pressure (PSI)	Lab: Dry Density (PCF)	Lab: Moisture Content (%)	Lab: Liquid Limit	Lab: Plastic Limit	Lab: Plasticity Index	Lab: % Fines	Lab: % Swell
		FAT CLAY (CH) - Dark gray.				3.50				29	68	29	39	91	
						2.00				32					
		5.0				1.50				34					
5		End of Boring													
10															
15															
20															
25															
30															

BORING NUMBER: B-23

PROJECT NAME Crosby Sixth Grade Campus - Final Study
PROJECT NUMBER H254405
DATE STARTED 11/03/2025 **COMPLETED** 11/03/2025
PROJECT LOCATION Crosby, Texas
CLIENT LAN - West Sam Houston Parkway
LATITUDE / LONGITUDE N/A
DRILLING METHOD Auger 0 - 5 feet
BORING ELEVATION N/A
NOTES
HAMMER WEIGHT 140 lbs **HAMMER DROP** 30 inches

Groundwater Data	
During Drilling (ft):	N.E.
After Drilling (ft):	N.M.
After __ Hours (ft):	N/A

Depth (ft)	Graphic Log	Material Description	Samples: Sample Graphic	Samples: REC (%) / RQD (%)	Samples: N-Value / Refusal / TCP	Samples: Pocket Pen (TSF)	Lab: Compressive Strength (TSF)	Lab: Confining Pressure (PSI)	Lab: Dry Density (PCF)	Lab: Moisture Content (%)	Lab: Liquid Limit	Lab: Plastic Limit	Lab: Plasticity Index	Lab: % Fines	Lab: % Swell
		FAT CLAY (CH) - Dark gray. With root fibers from 0 to 2 feet.				4.00				27	71	23	48		
						3.50				25					
		Gray from 4 to 5 feet.				4.50+				25					
5		5.0 End of Boring													
10															
15															
20															
25															
30															

BORING NUMBER: B-24

PROJECT NAME Crosby Sixth Grade Campus - Final Study
PROJECT NUMBER H254405
DATE STARTED 11/03/2025 **COMPLETED** 11/03/2025
PROJECT LOCATION Crosby, Texas
CLIENT LAN - West Sam Houston Parkway
LATITUDE / LONGITUDE N/A
DRILLING METHOD Auger 0 - 5 feet
BORING ELEVATION N/A
NOTES
HAMMER WEIGHT 140 lbs **HAMMER DROP** 30 inches

Groundwater Data	
During Drilling (ft):	N.E.
After Drilling (ft):	N.M.
After __ Hours (ft):	N/A

Depth (ft)	Graphic Log	Material Description	Samples: Sample Graphic	Samples: REC (%) / RQD (%)	Samples: N-Value / Refusal / TCP	Samples: Pocket Pen (TSF)	Lab: Compressive Strength (TSF)	Lab: Confining Pressure (PSI)	Lab: Dry Density (PCF)	Lab: Moisture Content (%)	Lab: Liquid Limit	Lab: Plastic Limit	Lab: Plasticity Index	Lab: % Fines	Lab: % Swell
		FAT CLAY (CH) - Dark gray.				4.50+				24					
						4.50+				25	82	25	57		
		5.0				4.50+				23					
5		End of Boring													
10															
15															
20															
25															
30															

BORING NUMBER: B-25

PROJECT NAME Crosby Sixth Grade Campus - Final Study
PROJECT NUMBER H254405
DATE STARTED 11/03/2025 **COMPLETED** 11/03/2025
PROJECT LOCATION Crosby, Texas
CLIENT LAN - West Sam Houston Parkway
LATITUDE / LONGITUDE N/A
DRILLING METHOD Auger 0 - 5 feet
BORING ELEVATION N/A
NOTES
HAMMER WEIGHT 140 lbs **HAMMER DROP** 30 inches

Groundwater Data	
During Drilling (ft):	N.E.
After Drilling (ft):	N.M.
After __ Hours (ft):	N/A

Depth (ft)	Graphic Log	Material Description	Samples: Sample Graphic	Samples: REC (%) / RQD (%)	Samples: N-Value / Refusal / TCP	Samples: Pocket Pen (TSF)	Lab: Compressive Strength (TSF)	Lab: Confining Pressure (PSI)	Lab: Dry Density (PCF)	Lab: Moisture Content (%)	Lab: Liquid Limit	Lab: Plastic Limit	Lab: Plasticity Index	Lab: % Fines	Lab: % Swell
		FAT CLAY (CH) - Dark gray.				4.50+				23	80	26	54	95	
						4.50+				23					
5		5.0				4.50+				25					
		End of Boring													
10															
15															
20															
25															
30															

BORING NUMBER: B-26

PROJECT NAME Crosby Sixth Grade Campus - Final Study
PROJECT NUMBER H254405
DATE STARTED 11/03/2025 **COMPLETED** 11/03/2025
PROJECT LOCATION Crosby, Texas
CLIENT LAN - West Sam Houston Parkway
LATITUDE / LONGITUDE N/A
DRILLING METHOD Auger 0 - 5 feet
BORING ELEVATION N/A
NOTES
HAMMER WEIGHT 140 lbs **HAMMER DROP** 30 inches

Groundwater Data	
During Drilling (ft):	N.E.
After Drilling (ft):	N.M.
After __ Hours (ft):	N/A

Depth (ft)	Graphic Log	Material Description	Samples: Sample Graphic	Samples: REC (%) / RQD (%)	Samples: N-Value / Refusal / TCP	Samples: Pocket Pen (TSF)	Lab: Compressive Strength (TSF)	Lab: Confining Pressure (PSI)	Lab: Dry Density (PCF)	Lab: Moisture Content (%)	Lab: Liquid Limit	Lab: Plastic Limit	Lab: Plasticity Index	Lab: % Fines	Lab: % Swell
		FAT CLAY (CH) - Dark gray.				3.00				31					
						4.50+				26	100	31	69		
		5.0				3.50				30					
5		End of Boring													
10															
15															
20															
25															
30															

BORING NUMBER: B-27

PROJECT NAME Crosby Sixth Grade Campus - Final Study
PROJECT NUMBER H254405
DATE STARTED 11/03/2025 **COMPLETED** 11/03/2025
PROJECT LOCATION Crosby, Texas
CLIENT LAN - West Sam Houston Parkway
LATITUDE / LONGITUDE N/A
DRILLING METHOD Auger 0 - 5 feet
BORING ELEVATION N/A
NOTES
HAMMER WEIGHT 140 lbs **HAMMER DROP** 30 inches

Groundwater Data	
During Drilling (ft):	N.E.
After Drilling (ft):	N.M.
After __ Hours (ft):	N/A

Depth (ft)	Graphic Log	Material Description	Samples: Sample Graphic	Samples: REC (%) / RQD (%)	Samples: N-Value / Refusal / TCP	Samples: Pocket Pen (TSF)	Lab: Compressive Strength (TSF)	Lab: Confining Pressure (PSI)	Lab: Dry Density (PCF)	Lab: Moisture Content (%)	Lab: Liquid Limit	Lab: Plastic Limit	Lab: Plasticity Index	Lab: % Fines	Lab: % Swell
		FAT CLAY (CH) - Dark gray.				4.00				25	86	31	55		
						4.00				29					
		5.0				3.50				29					
5		End of Boring													
10															
15															
20															
25															
30															

PRELIMINARY BORING NUMBER: PB-01

PROJECT NAME Crosby Sixth Grade Campus
PROJECT NUMBER H253433
DATE STARTED 08/06/2025 **COMPLETED** 08/06/2025
PROJECT LOCATION Crosby, Texas
CLIENT Crosby ISD
LATITUDE / LONGITUDE ,
DRILLING METHOD Auger
BORING ELEVATION N/A
NOTES -
HAMMER WEIGHT 140 lbs. **HAMMER DROP** 30 in.

Groundwater Data	
During Drilling (ft):	N.E.
After Drilling (ft):	N.M.
After __ Hours (ft):	N/A

Depth (ft)	Graphic Log	Material Description	Samples: Sample Graphic	Samples: REC (%) / RQD (%)	Samples: N-Value / Refusal / TCP	Samples: Pocket Pen (TSF)	Lab: Compressive Strength (TSF)	Lab: Confining Pressure (PSI)	Lab: Dry Density (PCF)	Lab: Moisture Content (%)	Lab: Liquid Limit	Lab: Plastic Limit	Lab: Plasticity Index	Lab: % Fines	Lab: % Swell
		FILL - CLAYEY SAND (SC) FILL - Brownish yellow, reddish brown with calcareous nodules.				3.50				10	23	15	8	46	
		2.0													
		FAT CLAY (CH) - Dark gray.				3.00				21					
5						1.50				40					
		Gray from 6 to 8 feet.				1.50				37	83	26	57		
		Light gray, brownish yellow from 8 to 30 feet.				2.50	0.8		85.0	35					
10															
						3.50				28					
15															
		Brownish yellow from 18 to 30 feet.				3.50				27					
20															
						3.00				38					
25															
						2.50				31					
30		30.0													

PRELIMINARY BORING NUMBER: PB-02

PROJECT NAME Crosby Sixth Grade Campus
PROJECT NUMBER H253433
DATE STARTED 08/06/2025 **COMPLETED** 08/06/2025
PROJECT LOCATION Crosby, Texas
CLIENT Crosby ISD
LATITUDE / LONGITUDE ,
DRILLING METHOD Auger
BORING ELEVATION N/A
NOTES -
HAMMER WEIGHT 140 lbs. **HAMMER DROP** 30 in.

Groundwater Data	
During Drilling (ft):	N.E.
After Drilling (ft):	N.M.
After __ Hours (ft):	N/A

Depth (ft)	Graphic Log	Material Description	Samples: Sample Graphic	Samples: REC (%) / RQD (%)	Samples: N-Value / Refusal / TCP	Samples: Pocket Pen (TSF)	Lab: Compressive Strength (TSF)	Lab: Confining Pressure (PSI)	Lab: Dry Density (PCF)	Lab: Moisture Content (%)	Lab: Liquid Limit	Lab: Plastic Limit	Lab: Plasticity Index	Lab: % Fines	Lab: % Swell
		FAT CLAY (CH) - Dark gray.				3.50				32					
						2.00	0.8		81.0	37					
5						2.50				36					
		Gray from 6 to 8 feet.				3.00				33	64	26	38		0.0
		Gray, brownish yellow from 8 to 13 feet. With calcareous deposits from 8 to 13 feet.				2.50				33					
10															
		Gray, light gray, brownish yellow with calcareous nodules from 13 to 18 feet.				3.50				26					
15															
		Brownish yellow, light gray from 18 to 28 feet.				2.50				31					
20															
						2.00				35					
25															
		Brownish yellow, gray, light gray from 28 to 30 feet.				2.00				39					
30		30.0													

PRELIMINARY BORING NUMBER: PB-03

PROJECT NAME Crosby Sixth Grade Campus
PROJECT NUMBER H253433
DATE STARTED 08/06/2025 **COMPLETED** 08/06/2025
PROJECT LOCATION Crosby, Texas
CLIENT Crosby ISD
LATITUDE / LONGITUDE ,
DRILLING METHOD Auger
BORING ELEVATION N/A
NOTES -
HAMMER WEIGHT 140 lbs. **HAMMER DROP** 30 in.

Groundwater Data	
During Drilling (ft):	N.E.
After Drilling (ft):	N.M.
After __ Hours (ft):	N/A

Depth (ft)	Material Description	Samples: Sample Graphic	Samples: REC (%) / RQD (%)	Samples: N-Value / Refusal / TCP	Samples: Pocket Pen (TSF)	Lab: Compressive Strength (TSF)	Lab: Confining Pressure (PSI)	Lab: Dry Density (PCF)	Lab: Moisture Content (%)	Lab: Liquid Limit	Lab: Plastic Limit	Lab: Plasticity Index	Lab: % Fines	Lab: % Swell
0	FAT CLAY (CH) - Dark gray.				3.50				33					
					1.50	0.7		79.0	38	91	28	63		
5					2.00				36					
	Light gray, brownish yellow from 6 to 30 feet. With calcareous deposits from 6 to 23 feet.				3.50				30					
					3.00				30	79	25	54		0.0
10														
					2.50				34					
15														
					3.00				29					
20														
	Light gray, brownish yellow, gray from 23 to 30 feet.				2.50				34					
25														
					2.0				34					
30	30.0													

UNIFIED SOIL CLASSIFICATION SYSTEM

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

COARSE-GRAINED SOILS (more than 50% of material is larger than No. 200 sieve size.)			
GRAVELS More than 50% of coarse fraction larger than No. 4 sieve size	Clean Gravels (Less than 5% fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines
		GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
	Gravels with fines (More than 12% fines)	GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
SANDS 50% or more of coarse fraction smaller than No. 4 sieve size	Clean Sands (Less than 5% fines)	SW	Well-graded sands, gravelly sands, little or no fines
		SP	Poorly graded sands, gravelly sands, little or no fines
	Sands with fines (More than 12% fines)	SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (50% or more of material is smaller than No. 200 sieve size.)			
SILTS AND CLAYS Liquid limit less than 50%		ML	Inorganic silts and very fine sands, rock flour, silty of clayey fine sands or clayey silts with slight plasticity
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
		OL	Organic silts and organic silty clays of low plasticity
SILTS AND CLAYS Liquid limit 50% or greater		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS		PT	Peat and other highly organic soils

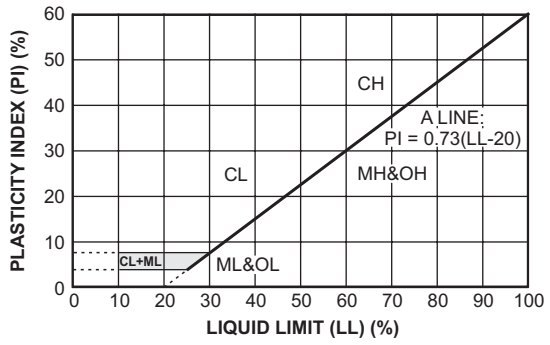
LABORATORY CLASSIFICATION CRITERIA

GW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
GP	Not meeting all gradation requirements for GW	
GM	Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
GC	Atterberg limits above "A" line with P.I. greater than 7	
SW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
SP	Not meeting all gradation requirements for GW	
SM	Atterberg limits below "A" line or P.I. less than 4	Limits plotting in shaded zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols.
SC	Atterberg limits above "A" line with P.I. greater than 7	

Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

Less than 5 percent ..... GW, GP, SW, SP
More than 12 percent ..... GM, GC, SM, SC
5 to 12 percent ..... Borderline cases requiring dual symbols

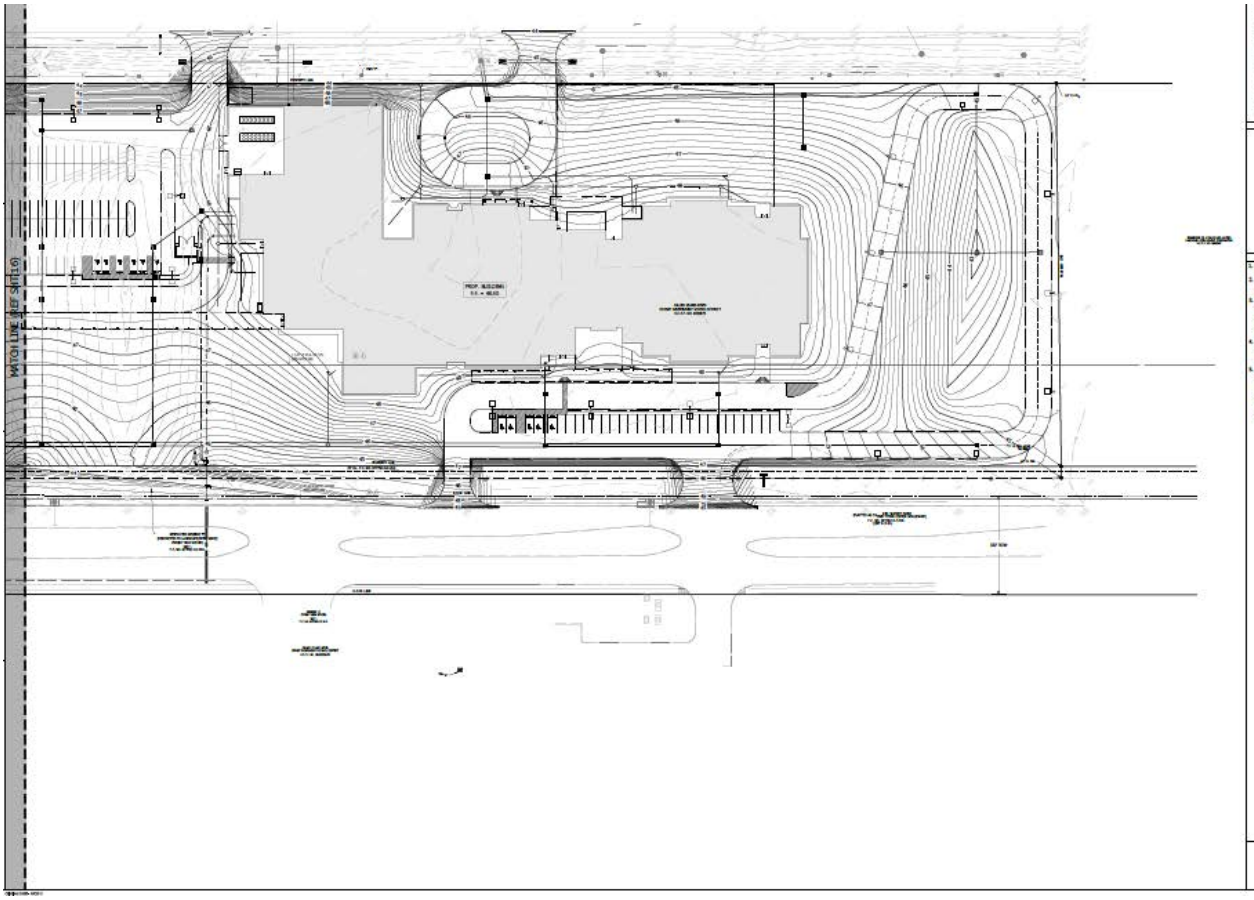
PLASTICITY CHART



TERMS DESCRIBING SOIL CONSISTENCY

Fine Grained Soils		Coarse Grained Soils		
Description	Penetrometer Reading (tsf)	Penetration Resistance (blows/ft)	Description	Relative Density
Soft	0.0 to 1.0	0 to 4	Very Loose	0 to 20%
Firm	1.0 to 1.5	4 to 10	Loose	20 to 40%
Stiff	1.5 to 3.0	10 to 30	Medium Dense	40 to 70%
Very Stiff	3.0 to 4.5	30 to 50	Dense	70 to 90%
Hard	4.5+	Over 50	Very Dense	90 to 100%

Appendix D - Site Grading Plan



KEY PLAN

Permit/Seal

INTERIM REVIEW ONLY

Client/Project Logo

Client/Project
Crosby ISD

Crosby Sixth Grade Campus

FM 3100
Crosby, TX 77532

Title
SITE GRADING PLAN (2 OF 2)

Project No.
214001039

Scale
AS INDICATED

Revision Sheet
17 of 30

Drawing No.
C3.02

SECTION 01 10 00 - SUMMARY OF WORK AND SCHEDULING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Project description.
2. Work by others.
3. Required completion dates.
4. Contractor's use of premises.
5. Owner occupancy.
6. Owner-furnished items.
7. Specification conventions.

1.2 PROJECT DESCRIPTION

A. The Project consists of construction and related sitework for the ground-up construction of the new two story 6th grade campus, located at 202 Red Summit Dr., Crosby, TX 77532, in addition to detention requirements off-site as shown on the Contract Documents prepared by Stantec and consultants.

B. The Work consists of Civil, Structural, Architectural, Mechanical, Electrical, Plumbing, AV/IT/Security, Fire Protection, and Food Service requirements as indicated in the drawings and specifications.

1.3 REQUIRED COMPLETION DATES

A. The Work shall be conducted according to the following schedule to ensure that the Owner has sufficient opportunity to ready the facility for occupancy and permit an orderly transfer of personnel, furnishings, and equipment.

1. Start Date for On-Site Construction: Approximately **May 1, 2026**
2. Substantial Completion): On or before **June 18, 2027**

1.4 CONTRACTOR USE OF PREMISES

A. The Contractor's use of the premises is limited only by the Owner's right to perform construction operations.

1.5 OWNER-FURNISHED ITEMS

A. The Owner will furnish certain items to be installed by the Contractor, including paper towel dispensers and toilet tissue dispensers. The Work includes providing support systems to receive Owner's equipment, and service and utility connections as required for the intended use of the item(s).
1. The Owner will arrange and pay for delivery of Owner-furnished items in accordance with the Contractor's Construction Schedule, and will inspect deliveries for damage.
2. If Owner-furnished and delivered items are damaged by Owner, defective, or missing, the Owner will arrange for replacement. The Owner will also arrange for manufacturer's field services, and the delivery of manufacturer's warranties and bonds to the Contractor.

3. The Contractor is responsible for designating the delivery dates of Owner-furnished items in the Contractor's Construction Schedule and for receiving, unloading and handling Owner- furnished items at the site. The Contractor is responsible for protecting Owner-furnished items from damage, including damage from exposure to the elements, and to repair or replace items damaged as a result of his operations.

1.6 SPECIFICATION CONVENTIONS

A. These specifications are written in imperative mood and streamlined form. This imperative language is directed to the Contractor, unless specifically noted otherwise.

PART 2 - PRODUCTS (Not applicable).

PART 3 - EXECUTION (Not applicable).

END OF SECTION

SECTION 01 21 00 – COST ALLOWANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Administrative and procedural requirements governing handling and processing allowances.

B. Related Sections:
1. Section 01 22 00 - Unit Prices: Procedures for submitting and handling Unit Prices.
2. Section 01 26 00 - Modification Procedures: Procedures for submitting and handling Change Orders.
3. Section 01 40 00 - Quality Requirements: Use of allowances for inspection and testing agencies.

1.2 SUBMITTALS

A. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.

B. Submit invoices or delivery slips to indicate actual quantities of materials delivered to the site for use in fulfillment of each allowance.

1.3 CONTINGENCY ALLOWANCES

A. Use the Owner’s contingency allowance only as directed for the Owner's purposes, and only by Contingency Fund Change Orders which designate amounts to be charged to the allowance.
1. The Contractor's related costs for products or equipment ordered by the Owner under the contingency allowance, including delivery, installation, taxes, insurance, equipment rental, and similar costs are not part of the Contract Sum.
2. Allowance Expenditure Authorizations authorizing use of funds from the Owner’s contingency allowance will not include the Contractor's related costs and reasonable overhead and profit margins. Contractor shall include in base bid, Contractor's overhead, profit, insurance, bond and other direct cost.
3. At Project closeout, credit unused amounts remaining in the contingency allowance to Owner by Change Order or transfer the remaining amounts to other allowances as directed by the Architect.

1.4 UNUSED MATERIALS

A. Return unused materials to the manufacturer or supplier for credit to the Owner, after installation has been completed and accepted.

B. Where it is not economically feasible to return unused material for credit and when requested by the Architect, prepare unused material for the Owner's storage, and deliver to the Owner's storage space as directed. Otherwise, disposal of excess material is the Contractor's responsibility.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect products covered by an allowance promptly upon delivery for damage or defects.

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 construction activities.

3.3 SCHEDULE OF ALLOWANCES

A. **Allowance Number 1 – Owner's Contingency Allowance:** Include the sum of **$500,000.00** for use upon the Owner's instruction.

B. **Allowance Number 2 – Graphics Allowance:** All graphics work identified in Section 10 14 00 Signs and Building Letters, custom perforated signage panels identified in Section 05 50 00 Metal Fabrications, and exterior Post and Panel Signs identified in Section10 14 26 is included in the Base Proposal work and is not part of this Allowance. Include the sum of **$60,000.00** for other graphics items to be provided and installed whether indicated in the drawings or not. Typical tagging and signage for elevators, mechanical equipment, electrical equipment, piping, and exit signs is also included in the Base Proposal work and is not part of this Allowance

END OF SECTION

SECTION 01 22 00 - UNIT PRICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for unit prices.

1. A unit price is an amount proposed by Bidders and stated on the Bid Form as a price per unit of measurement for materials or services that will be added to or deducted from the Contract Sum by Change Order in the event the estimated quantities of Work required by the Contract Documents are increased or decreased.
2. Unit prices all necessary material, overhead, profit and applicable taxes.
3. Refer to individual Specification Sections for construction activities requiring the establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.

B. Schedule: A "Unit Price Schedule" is included at the end of this Section. Specification Sections referenced in the Schedule contain requirements for materials and methods described under each unit price.

1. The Owner reserves the right to reject the Contractor's measurement of work-in-place that involves use of established unit prices, and to have this Work measured by an independent surveyor acceptable to the Contractor at the Owner's expense.

PART 2 - PRODUCTS (Not Applicable).

PART 3 - EXECUTION

3.1 UNIT PRICE SCHEDULE –

A. Unit Price No. A1 – Each 1,000 square yards of bermudagrass sod on prepared soil, with maintenance, including watering, for three months past substantial completion.

B. Unit Price No. A2 – Each 1,000 square yards of bermudagrass hydromulch on prepared soil, with maintenance, including watering, for three months past substantial completion.

C. Unit Price No. A3 – Each 1,000 square yards of prepared topsoil, 2” uniform depth.

D. Unit Price No. A4 – Each cubic yard of excavation of rock, excluding trucking off site.

E. Unit Price No. A5 – Each cubic yard of excavation of dirt or caliche, excluding trucking off site.

F. Unit Price No. A6 – Each cubic yard of excavation of dirt or caliche, including trucking off site.

G. Unit Price No. A7 – Each square yard of 5 inch reinforced concrete paving with 6 inch stabilized subgrade.

H. Unit Price No. A8 – Each square yard of 6 inch reinforced concrete paving with 6 inch stabilized subgrade.

I. Unit Price No. A9 – Each square yard of 7 inch reinforced concrete paving with 8 inch stabilized subgrade.

J. Unit Price No. A10 – Each square yard of 4.5 inch reinforced concrete sidewalk paving.

K. Unit Price No. B1 – Each cubic yard of backfilling, meeting fill requirements of construction documents, from off-site sources, compacted in lifts as required by construction documents.

L. Unit Price No. B2.1 – Each 18” diameter pier casing, complete.

M. Unit Price No. B2.2 – Each 24” diameter pier casing, complete.

N. Unit Price No. B3.1 – Each 18” diameter drilled pier, 40’ depth, complete including reinforcing, concrete, and accessories.

O. Unit Price No. B3.2 – Each 24” diameter drilled pier, 40’ depth, complete including reinforcing, concrete, and accessories.

P. Unit Price No. B4 – Each 1,000 pounds reinforcing steel, straight or bent, placed, and tied, including accessories.

Q. Unit Price No. B5 – Each cubic yard structural concrete, off the truck, no pumping, placement, or finishing.

R. Unit Price No. B6 – Each 1 Ton miscellaneous metals, delivered, excluding fabrication and erection.

S. Unit Price No. C1 – Each 120V duplex receptacle on nearest capable circuit.

T. Unit Price No. C2 – Each 120 V duplex receptacle on dedicated circuit, including 20-amp circuit breaker and pathway to panelboard.

U. Unit Price No. D1 – Each double data port wired to nearest IDF/MDF room.

V. Unit Price No. D2 – Each single data drop, flush mounted in wall j-box with 1-1/4” conduit, terminated at wall and patch panel, labeled, tested, conduit stubbed up wall to above ceiling, placed in cable pathway as required by Contract Documents, and cabling of length to maximum allowable distance under Contract Documents.

W. Unit Price No. E1 – Each exterior fire horn device, including J-box, conduit, cabling, weatherproofing, as required by the Contract Documents.

X. Unit Price No. E2 – Each interior fire horn/strobe device, including J-box, conduit, and cabling, as required by the Contract Documents.

Y. Unit Price No. E3 – Each interior fire voice/strobe device, including J-box, conduit, and cabling, as required by the Contract Documents.

Z. Unit Price No. E4 – Each interior smoke detector device, including J-box, conduit, and cabling, as required by the Contract Documents.

AA. Unit Price No. E5 – Each interior pull station device, including J-box, conduit, and cabling, as required by the Contract Documents.

END OF SECTION

SECTION 01 23 00 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for Alternates.

1. Definition: An Alternate is an amount proposed by Proposers and stated on the Proposal Form for certain construction activities defined in the Proposal Requirements that may be added to or deducted from Base Proposal amount if the Owner decides to accept a corresponding change in either the amount of construction to be completed, or in the products, materials, equipment, systems or installation methods described in Contract Documents.

2. Coordination: Coordinate related Work and modify or adjust adjacent Work as necessary to ensure that Work affected by each accepted Alternate is complete and fully integrated into the project.

3. Notification: Immediately following the award of the Contract, prepare and distribute to each party involved, notification of the status of each Alternate. Indicate whether Alternates have been accepted, rejected or deferred for consideration at a later date. Include a complete description of negotiated modifications to Alternates.

4. Schedule of Alternates: Specification Sections as may be referenced in the Schedule below more completely indicate requirements for the Work described under each Alternate.
   a. Include as part of each Alternate, miscellaneous devices, accessory objects and similar items incidental to or required for a complete installation whether or not mentioned as part of the Alternate.
   b. The Owner reserves the right to accept any, none, or all of the Alternates for a period of 30 days after receipt of proposals. Should the Owner-Contractor Agreement be executed prior to Owner acceptance of an Alternate, the Alternate will be accepted by Change Order at the original bid amount within 30 days after receipt of proposals.

1.3 SCHEDULE OF ALTERNATES

3.1 ALTERNATES

A. **Alternate No. 1: Moisture resistant gypsum board for all interior gypsum board scope**
See drawings for alternate design.

B. **Alternate No. 2A: Air Handling Units by Carrier**
This alternate shall establish the amount to be added to the base proposal for the Contractor to provide Air Handling Units furnished and installed as manufactured

by Carrier as shown on the drawings and listed in the specifications. There are no Air Handling Units included in the base bid.

C. **Alternate No. 2B: Air Handling Units by Trane**

This alternate shall establish the amount to be added to the base proposal for the Contractor to provide Air Handling Units furnished and installed as manufactured by Trane as shown on the drawings and listed in the specifications. There are no Air Handling Units included in the base bid.

D. **Alternate No. 3A: Chillers by Carrier (23 64 16)**

This alternate shall establish the amount to be added to the base proposal for the Contractor to furnish and install chillers as manufactured by Carrier as shown on the drawings and listed in Specification 23 64 16. There are no chillers included in the base proposal.

E. **Alternate No. 3B: Chillers by Trane (23 64 16)**

This alternate shall establish the amount to be added to the base proposal for the Contractor to furnish and install chillers as manufactured by Trane as shown on the drawings and listed in Specification 23 64 16. There are no chillers included in the base proposal.

F. **Alternate No. 4A: Building Management and Control System by Automated Logic Corp. – Automated Logic**

This alternate shall establish the amount to be added to the base proposal for the Contractor to provide building management and control system furnished and installed as manufactured by Automated Logic Corp as shown on the drawings and listed in the specifications. There are no building and control systems included in the base bid.

G. **Alternate No. 4B: Building Management and Control System by Unified Energy Solutions – Reliable Controls**

This alternate shall establish the amount to be added to the base proposal for the Contractor to provide building management and control system furnished and installed as manufactured by Unified Energy Solutions – Reliable Controls as shown on the drawings and listed in the specifications. There are no building and control systems included in the base bid.

H. **Alternate No. 5A: Emergency Natural Gas Generator by Caterpillar**

This alternate shall establish the amount to be added to the base proposal for the Contractor to provide an emergency natural gas generator furnished and installed as manufactured by Caterpillar as shown on the drawings and listed in the specifications. There are no emergency natural gas generators included in the base bid.

I. **Alternate No. 5B: Emergency Natural Gas Generator by Cummins**

This alternate shall establish the amount to be added to the base proposal for the Contractor to provide an emergency natural gas generator furnished and installed as manufactured by Cummins as shown on the drawings and listed in the specifications. There are no emergency natural gas generators included in the base bid.

J. **Alternate No. 5C: Emergency Natural Gas Generator by Generac Industrial**

This alternate shall establish the amount to be added to the base proposal for the Contractor to provide an emergency natural gas generator furnished and installed as manufactured by Generac Industrial as shown on the drawings and listed in the specifications. There are no emergency natural gas generators included in the base bid.

K. **Alternate No. 6A: Automatic Transfer Switch by Caterpillar**
This alternate shall establish the amount to be added to the base proposal for the Contractor to provide an automatic transfer switch furnished and installed as manufactured by Caterpillar as shown on the drawings and listed in the specifications. There are no emergency natural gas generators included in the base bid.

L. **Alternate No. 6B: Automatic Transfer Switch by Cummins**
This alternate shall establish the amount to be added to the base proposal for the Contractor to provide an automatic transfer switch furnished and installed as manufactured by Cummins as shown on the drawings and listed in the specifications. There are no emergency natural gas generators included in the base bid.

M. **Alternate No. 6C: Automatic Transfer Switch by ASCO**
This alternate shall establish the amount to be added to the base proposal for the Contractor to provide an automatic transfer switch furnished and installed as manufactured by ASCO as shown on the drawings and listed in the specifications. There are no emergency natural gas generators included in the base bid.

N. **Alternate No. 7: Parent drop-off drive paving reduction per sheet G511**
See drawings for alternate design.

O. **Alternate No. 8: Stage Proscenium Finish WP-1 option per sheet A601**
See drawings for alternate design.

P. **Alternate No. 9: Aluminum Walkway Canopy Extended – Bus Drop per sheet G511**
See drawings for alternate design.

Q. **Alternate No. 10A: Provide 2x4 Troffer light fixtures per the specifications. There are no 2x4 light fixtures in the base bid**

R. **Alternate No. 10B: Provide 2x4 Flat Panel light fixtures per the specifications. There are no 2x4 light fixtures in the base bid**

S. **Alternate No. 11: Provide optional adjustment to Base Proposal**

END OF SECTION

SECTION 01 25 13 - PRODUCT SUBSTITUTIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for handling requests for substitutions made both prior to receipt of bids and after as herein specified.

B. The Contractor's Construction Schedule and the Schedule of Submittals are included under Section "Submittal Requirements."

C. Standards: Refer to Section "Reference Standards and Definitions" for applicability of industry standards to products specified.

D. Procedural requirements governing the Contractor's selection of products and product options are included under Section "Product Requirements."

1.3 DEFINITIONS

A. Definitions used in this Article are not intended to change or modify the meaning of other terms used in the Contract Documents.

B. Substitutions: Requests for changes in products, materials, equipment, and methods of construction required by Contract Documents proposed by the Contractor 10 days prior to receipt of bids are considered requests for substitutions. The following are not considered substitutions:
   1. Substitutions requested by Bidders during the bidding period, and accepted prior to award of Contract, are considered as included in the Contract Documents.
   2. Revisions to Contract Documents requested by the Owner or Architect.
   3. Specified options of products and construction methods included in Contract Documents.
   4. The Contractor's determination of and compliance with governing regulations and orders issued by governing authorities.

1.4 SUBMITTALS

A. Substitution Request Submittal: Requests for substitution will be considered if received at least 15 days from date of executed contract. Requests received after commencement of the Work may be considered or rejected at the discretion of the Architect.
   1. Submit 3 copies of each request for substitution for consideration. Submit requests in the form attached in this section and in accordance with procedures required for Change Order proposals.
   2. Identify the product, or the fabrication or installation method to be replaced in each request. Include related Specification Section and Drawing numbers. Provide complete documentation showing compliance with the requirements for substitutions, and the following information, as appropriate:
   3. Product Data, including Drawings and descriptions of products, fabrication and installation procedures.

4. Samples, where applicable or requested.
5. A detailed comparison of significant qualities of the proposed substitution with those of the Work specified. Significant qualities may include elements such as size, weight, durability, performance and visual effect.
6. Coordination information, including a list of changes or modifications required for other parts of the Work (or to related construction performed by the Owner and any separate contractors) that will become necessary to accommodate the proposed substitution.
7. A statement indicating the substitution's effect on the Anticipated Project Schedule and Contract Construction Schedule after award of contract compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.
8. Cost information, including a proposal of the net change, if any, from the specified product or assembly, or the contract sum.
9. Certification by the Bidder or Contractor that the substitution proposed is equal-to or better in every significant respect to that required by the Contract Documents, and that it will perform adequately in the application indicated. Include the Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the substitution to perform adequately.

B. ENVIRONMENTAL AND HEALTH CERTIFICATIONS

1. Reference Section 01 33 00 “Submittals” for additional submittal requirements for certain materials indicated in the Materials and/or Finish Schedules regarding “Environmental and Health Certifications”. Such “E&H” certificates and labels are to be provided by the material manufactures and are to be included with the product submittals.

1.5 ARCHITECT'S ACTION:

A. If a decision on use of a proposed substitute cannot be made or obtained within the time allocated, use the specified product only. Acceptance of the proposed substitution will be in the form of an Addendum which lists all prior-approved products prior to award of Contract and a Change Order after the award of Contract.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Conditions: The Bidder's or Contractor's substitution request will be received and considered by the Architect when all of the mandatory conditions are satisfied and one or more of the optional conditions are satisfied, as determined by the Architect; otherwise requests will be returned without action except to record noncompliance with these requirements.
1. Mandatory Conditions:
   a. Submitted as required prior to bidding.
   b. Extensive revisions to Contract Documents are not required.
   c. Proposed changes are in keeping with the general intent of Contract Documents.
   d. The request is timely, fully documented and properly submitted.

2. Optional Conditions:
   a. The request is directly related to an "or equal" clause or similar language in the Contract Documents.
   b. The specified product or method of construction cannot be provided within

the Contract Time. The request will not be considered if the product or method cannot be provided as a result of failure to pursue the Work promptly or coordinate activities properly.

c. The specified product or method of construction cannot receive necessary approval by a governing authority, and the requested substitution can be approved.

d. A substantial advantage is offered the Owner, in terms of cost, time, energy conservation or other considerations of merit, after deducting offsetting responsibilities the Owner may be required to bear. Additional responsibilities for the Owner may include additional compensation to the Architect for redesign and evaluation services, increased cost of other construction by the Owner or separate Contractors, and similar considerations.

e. The specified product or method of construction cannot be provided in a manner that is compatible with other materials, and where the Bidder or Contractor certifies that the substitution will overcome the incompatibility.

f. The specified product or method of construction cannot be coordinated with other materials, and where the Bidder or Contractor certifies that the proposed substitution can be coordinated.

g. The specified product or method of construction cannot provide a warranty required by the Contract Documents and where the Bidder or Contractor certifies that the proposed substitution provide the required warranty.

h. The Contractor's submittal and Architect's acceptance of Shop Drawings, Product Data or Samples that relate to construction activities not complying with the Contract Documents does not constitute an acceptable or valid request for substitution, nor does it constitute approval.

2.2 FAILURE OF TIMELY ORDER

A. The contractor is responsible for assuring the timely order of all materials specified. If a specified material or color of material cannot be delivered by the contract completion date, due to failure to order the material in a timely manner, the contractor shall be responsible for supplying an equal or better material. The Architect shall be the sole determinant of the approved substitute material.

B. The contractor shall also be charged an amount equal to 5% of the value of the specified material. This amount shall be credited to the owner through a change order to the contract.

C. The word "material", as used in this section, includes all items specified in the specifications or shown on the drawings.

PART 3 - EXECUTION (Not Applicable).

END OF SECTION

(SUBSTITUTION REQUEST FORM ATTACHED)

STANTEC
Chris Hopkins
910 Louisiana, Suite 2600
Houston, Texas 77002
713.548.5700
713.548.5701 fax

PRODUCT AND MATERIAL SUBSTITUTION REQUEST FORM

(This substitution request form may be used for **Pre-Proposal** Substitution Requests or **Post - Proposal** Substitution Requests as specified in Divisions 1 Section -"Product Substitutions".)

Project:_____

From (company): _____ Date:_____

Address:_____Telephone:_____

[ ] Bidding G.C. [ ] CM @ Risk [ ] Bidding subcontractor [ ] Bidding vendor or manufacturer

Substitution approval is an acceptance of only the manufacturer and product for general conformance with the design concept reflected in the Contract Documents. The A/E has made no attempt to verify specific performance data, or to check the details of the proposed substitution as to special features, capacities, physical dimensions or code and/or regulatory compliance, all of which remain the responsibility of the person/entity submitting the proposed substitution.

Specified Product:_____

Specification Title:_____ Section No._____

Page No. _____ Paragraph No._____ or previous Addendum No. _____

Proposed
Substitution:_____

Manufacturer:_____ Phone:_____

Model/Series Number:_____ Trade Name _____

Area Distributor_____Contact _____ Phone_____

History: [ ] New product [ ] 2-5 years old [ ] More than 10 years old

Differences between proposed substitution and specified product: _____

_____

_____

Similar Installations:
(attach any additional related project listings)

Project	Architect	Phone
Address		Year Installed
Owner Contact		Phone

Project	Architect	Phone
Address		Year Installed
Owner Contact		Phone

Proposed substitution affects other parts of work: [ ] No [ ] Yes

If Yes, explain_____

Estimated Cost Savings to Owner (if substitution is proposed by G.C.) [ ] negligible [ ] $ _____

Time Savings for Project (if substitution is proposed by G.C.) [ ] none [ ] saved days [ ] extra days

Supporting Data Attached: [ ] Drawings [ ] Product Data [ ] Samples [ ] Tests [ ] Reports [ ] Other:
Note: Comparative data sufficient for Owner / Architect / General Contractor evaluation is required.

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- For items where color/pattern is named in the documents, proposed color/pattern of the substituted item will be the equivalent, with the final determination made by the Architect.
- Equal or better warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule except as may be clearly identified above.
- Claims for additional costs for this substitution (other than costs clearly indicated above), are the responsibility of the entity making this request.
- Substitutions affecting minor dimensions and clearances are identified herein, and it is the responsibility of the entity requesting the substitution to coordinate such with the Contractor. Approval of such changes is the sole responsibility of the Architect.

Signature of Person Submitting: _____ Title_____

Printed Name: _____ email _____

A/E's RESPONSE **(Accepted substitutions will be included in written addendum issued prior to bidding):**

[ ] Substitution rejected for non-compliance……Use specified materials.
[ ] Substitution rejected for lack of data……Use specified materials.
[ ] Substitution Request received too late……Use specified materials.

[ ] Substitution conditionally approved – Provide submittals after bidding per Division 1 Section "Submittals".
[ ] Plus noted exceptions: _____

Signed	Print	Title	Date

Copied to: [ ] Owner [ ] General Contractor [ ] _____ [ ] _____

SECTION 01 26 00 - MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division 1 Specification sections, apply to this section.

1.2 SUMMARY

A. This section specifies administrative and procedural requirements for handling and processing Contract modifications.

B. Related Sections: The following sections contain requirements that relate to this section:
   1. Division 1 Section "Allowances" for procedural requirements governing the handling and processing of allowances.
   2. Division 1 Section "Submittals" for requirements for the Contractor's Construction Schedule.
   3. Division 1 Section "Application for Payment" for administrative procedures governing applications for payment.
   4. Division 1 Section "Product Substitutions" for administrative procedures for handling requests for substitutions made after award of the Contract.

1.3 MINOR CHANGES IN THE WORK

A. Instructions authorizing minor changes in the Work, not involving an adjustment to the Contract Sum or Contract Time, will be issued by the Architect as part of a request for information on a Request for Interpretation Form as included in the Division-1 Section "Submittals".

B. Supplemental instructions authorizing minor changes in the Work, not involving an adjustment to the Contract Sum or Contract Time, will be issued by the Architect on AIA form G710, Architect's Supplemental Instructions.

1.4 CHANGE ORDER PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Proposed changes in the Work that will require adjustment to the Contract Sum or Contract Time will be issued by the Architect, with a detailed description of the proposed change and supplemental or revised Drawings and Specifications, if necessary.
   1. Proposal requests issued by the Architect are for information only. Do not consider them an instruction either to stop work in progress, or to execute the proposed change.
   2. Unless otherwise indicated in the proposal request, within 20 days of receipt of the proposal request, submit to the Architect for the Owner's review an estimate of cost necessary to execute the proposed change.
   3. Include a list of quantities of products to be purchased and unit costs, along with the total amount of purchases to be made. Furnish survey data to substantiate quantities and costs on Providers' letterheads, including, but not limited to, Subcontractors' letterheads.
   4. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
   5. Include a statement indicating the effect the proposed change in the Work will have on the Contract Time.

B. Contractor-Initiated Change Order Proposal Requests: When latent or other unforeseen conditions require modifications to the Contract, the Contractor may propose changes by submitting a request for a change to the Architect.
   1. Include a statement outlining the 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 Contract Time.

2. Include a list of quantities of products to be purchased and unit costs along with the total amount of purchases to be made. Furnish survey data to substantiate quantities and costs on Providers' letterheads, including, but not limited to, Subcontractors' letterheads.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Comply with requirements in Section "Product Substitutions" if the proposed change in the Work requires the substitution of one product or system for a product or system specified.

C. Proposal Request Form: Use AIA Document G 709 for Change Order Proposal Requests.

1.5 ALLOWANCES

A. Allowance Adjustment: Base each Change Order Proposal Request for an allowance cost adjustment solely on the difference between the actual purchase amount and the allowance, multiplied by the final measurement of work-in-place, with reasonable allowances, where applicable, for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.
   1. Include installation costs in the purchase amount only where indicated as part of the allowance.
   2. Prepare explanations and documentation to substantiate the margins claimed.
   3. Submit substantiation of a change in scope of work claimed in the Change Orders related to unit-cost allowances.
   4. The Owner reserves the right to establish the actual quantity of work-in-place by independent quantity survey, measure, or count.

1.6 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: When the Owner and Contractor are not in total agreement on the terms of a Change Order Proposal Request, the Architect may issue a Construction Change Directive on AIA Form G714, instructing the Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
   1. The Construction Change Directive will contain a complete description of the change in the Work and designate the method to be followed to determine change in the Contract Sum or 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 the change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

1.7 CHANGE ORDER PROCEDURES

A. Upon the Owner's approval of a Change Order Proposal Request, the Architect will issue a Change Order for signatures of the Owner and Contractor on AIA Form G701, as provided in the Conditions of the Contract.

PARTS 2 and 3 - Not Applicable

END OF SECTION

SECTION 01 29 00 - APPLICATIONS FOR PAYMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements governing the Contractor's Applications for Payment.

B. The Contractor's Construction Schedule and Submittal Schedule are included in Section "Submittals".

1.3 SCHEDULE OF VALUES

A. Coordinate preparation of the Schedule of Values with preparation of the Contractor's Construction Schedule.

1. Correlate line items in the Schedule of Values with other required administrative schedules and forms, including:
   a. Contractor's construction schedule.
   b. Application for Payment form.
   c. List of subcontractors.
   d. Schedule of allowances.
   e. Schedule of alternates.
   f. List of principal suppliers and fabricators.
   g. Schedule of submittals.
   h. Include separate line items for project closeout and record documents

2. Submit the Schedule of Values to the Architect at the earliest feasible date, but in no case later than 10 days before the date scheduled for submittal of the initial Application for Payment.

3. Sub-Schedules: Where the Work is separated into phases that require separately phased payments provide sub-schedules showing values of each schedule correlated with each phase of payment.

4. Where the Contractor anticipates invoicing for materials prior-to or separately-from installation, such line items shall be separated into labor and material costs.

5. Identification: Include the following Project identification on the Schedule of Values:
   a. Project name and location.
   b. Name of the Architect.
   c. Project number.
   d. Contractor's name and address.
   e. Date of submittal.

6. Provide a breakdown of the Contract Sum in sufficient detail to facilitate continued evaluation of Applications for Payment and progress reports. Break principal subcontract amounts down into several line items and use no less detail than the level of line-item detail in the Project Manual Table of Contents.

7. Round amounts off to the nearest whole dollar; the total shall equal the Contract Sum.

8. For each part of the Work where an Application for Payment may include materials or equipment, purchased or fabricated and stored, but not yet installed, provide separate line items on the Schedule of Values for initial cost of the materials, for each subsequent stage of completion, and for total installed value of that part of the Work.

9. Margins of Cost: Show line items for indirect costs, and margins on actual costs and list individually in Applications for Payment. Each item in the Schedule of Values and Applications for Payment shall be complete including its total cost.

10. Overhead and Profit: Show separate line item value for overhead and profit.
    a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place shall be shown as separate line items in the Schedule of Values.

11. Schedule Updating: List Change Orders as a separate line item when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.4 APPLICATIONS FOR PAYMENT

A. Each Application for Payment shall be consistent with previous applications and payments as certified by the Architect and paid for by the Owner.

   1. The initial Application for Payment, the Application for Payment at time of Substantial Completion, and the final Application for Payment involve additional requirements.

B. Payment Application Times: Each progress payment date is as indicated in the Agreement. The period of construction Work covered by each Application or Payment is the period indicated in the Agreement. Modification to payment application times shall occur if agreed to by all concerned parties at the pre-construction meeting.

C. Payment Application Forms: Use AIA Document G 702 and Continuation Sheet G 703, or a similar form, as the form for Application for Payment.

D. Application Preparation: Complete every entry on the form, including notarization and execution by person authorized to sign legal documents on behalf of the Contractor. Incomplete applications will be returned without action.

   1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions have been made.
   2. Include amounts of Change Orders and Construction Change Directives issued prior to the last day of the construction period covered by the application.

E. Transmittal: Submit 3 executed copies of each Application for Payment to the Architect by means ensuring receipt within 24 hours.

   1. Transmit each copy with a transmittal form listing attachments, and recording appropriate information related to the application in a manner acceptable to the Architect.

F. Waivers of Mechanics Lien: Owner reserves the right to require Wavers of Mechanics Lien with each Application for Payment. Submit waivers of liens from subcontractors or

sub-subcontractors and suppliers for the period covered by the previous application.

1. Submit partial waivers on each item for the amount requested, prior to deduction for retainage, on each item.
2. When an application shows completion of an item, submit final or full waivers.
3. The Owner reserves the right to designate which entities involved in the Work must submit waivers.

    a. Waiver Delays: Submit each Application for Payment with the Contractor's waiver of mechanics lien for the period of construction covered by the application.
        1.) Submit final Application for Payment with or preceded by final waivers from every entity involved with performance of Work covered by the application who could lawfully be entitled to a lien.

    b. Waiver Forms: Submit waivers of lien on forms, and executed in a manner, acceptable to Owner.

G. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of the first Application for Payment include the following:

1. List of subcontractors.
2. List of principal suppliers and fabricators.
3. Schedule of Values.
4. Contractor's Construction Schedule (preliminary if not final).

H. Application for Payment at Substantial Completion: Following issuance of the Certificate of Substantial Completion, submit an Application for Payment; this application shall reflect any Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

I. Final Payment Application: Administrative actions and submittals which must precede or coincide with submittal of the final payment Application for Payment include the following:

1. Completion of Project closeout requirements.
2. Completion of items specified for completion after Substantial Completion.
3. Assurance that unsettled claims will be settled.
4. Assurance that Work not complete and accepted will be completed without undue delay.
5. Transmittal of required Project construction records to Owner.
6. Removal of temporary facilities and services.
7. Removal of surplus materials, rubbish and similar elements.
8. Change of door locks to Owner's access.

PART 2 - PRODUCTS (Not Applicable).

PART 3 - EXECUTION (Not Applicable).

END OF SECTION

SECTION 01 30 00 - ADMINISTRATIVE REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies administrative and supervisory requirements necessary for Project coordination including, but not necessarily limited to:
   1. Coordination.
   2. Administrative and supervisory personnel.
   3. General installation provisions.
   4. Cleaning and protection.

B. Field engineering is included in Section "Field Engineering".

C. Progress meetings: coordination meetings and pre-installation conferences are included in Section "Project Meetings".

D. Requirements for the Contractor's Construction Schedule are included in Section "Submittal Procedures".

1.3 COORDINATION

A. Coordination: Coordinate construction activities included under various Sections of these Specifications to assure efficient and orderly installation of each part of the Work. Coordinate construction operations included under different Sections of the Specifications that are dependent upon each other for proper installation, connection, and operation.
   1. Where installation of one part of the Work is dependent on installation of other components, either before or after its own installation, schedule construction activities in the sequence required to obtain the best results.
   2. Where availability of space is limited, coordinate installation of different components to assure maximum accessibility for required maintenance, service and repair.
   3. Make adequate provisions to accommodate items scheduled for later installation.
      a. Where necessary, prepare memoranda for distribution to each party involved outlining special procedures required for coordination. Include such items as required notices, reports, and attendance at meetings.
   4. Prepare similar memoranda for the Owner and separate Contractors where coordination of their Work is required.

B. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
   1. Preparation of schedules.
   2. Installation and removal of temporary facilities.
   3. Delivery and processing of submittals.
   4. Progress meetings.
   5. Project Close-out activities.

C. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.

1. Salvage materials and equipment involved in performance of, but not actually incorporated in, the Work. Refer to other sections for disposition of salvaged materials that are designated as Owner's property.

1.4 SUBMITTALS

A. Coordination Drawings: Prepare and submit coordination Drawings where close and careful coordination is required for installation of products and materials fabricated off-site by separate entities, and where limited space availability necessitates maximum utilization of space for efficient installation of different components.
   1. Show the interrelationship of components shown on separate Shop Drawings.
   2. Indicate required installation sequences.
   3. Comply with requirements contained in Section "Submittals."
   4. Refer to Division-23 Section "Basic Mechanical Requirements," and Division-26 Section "Basic Electrical Requirements" for specific coordination drawing requirements for mechanical and electrical installations.

B. Staff Names: Within 15 days of Notice to Proceed, submit a list of the Contractor's principal staff assignments, including the Superintendent and other personnel in attendance at the site; identify individuals, their duties and responsibilities; list their addresses and telephone numbers.
   1. Post copies of the list in the Project meeting room, the temporary field office, and each temporary telephone.

PART 2 - PRODUCTS (Not Applicable).

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION PROVISIONS

A. Inspection of Conditions: Require the Installer of each major component to inspect both the substrate and conditions under which Work is to be performed. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner.

B. Manufacturer's Instructions: Comply with manufacturer's installation instructions and recommendations, to the extent that those instructions and recommendations are more explicit or stringent than requirements contained in Contract Documents.

C. Inspect materials or equipment immediately upon delivery and again prior to installation. Reject damaged and defective items.

D. Provide attachment and connection devices and methods necessary for securing Work. Secure Work true to line and level. Allow for expansion and building movement.

E. Visual Effects: Provide uniform joint widths in exposed Work. Arrange joints in exposed Work to obtain the best visual effect. Refer questionable choices to the Architect for final decision.

F. Recheck measurements and dimensions, before starting each installation.

G. Install each component during weather conditions and Project status that will ensure the best possible results. Isolate each part of the completed construction from incompatible material as necessary to prevent deterioration.

H. Coordinate temporary enclosures with required inspections and tests, to minimize the

necessity of uncovering completed construction for that purpose.

I. Mounting Heights: Where mounting heights are not indicated, install individual components at standard mounting heights recognized within the industry for the particular application indicated. Refer questionable mounting height decisions to the Architect for final decision.

3.2 CLEANING AND PROTECTION

A. During handling and installation, clean and protect construction in progress and adjoining materials in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

B. Clean and maintain completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

C. Limiting Exposures: Supervise construction activities to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period. Where applicable, such exposures include, but are not limited to, the following:
1. Excessive static or dynamic loading.
2. Excessive internal or external pressures.
3. Excessively high or low temperatures.
4. Thermal shock.
5. Excessively high or low humidity.
6. Air contamination or pollution.
7. Water or ice.
8. Solvents.
9. Chemicals.
10. Light.
11. Radiation.
12. Puncture.
13. Abrasion.
14. Heavy traffic.
15. Soiling, staining and corrosion.
16. Bacteria.
17. Rodent and insect infestation.
18. Combustion.
19. Electrical current.
20. High speed operation,
21. Improper lubrication,
22. Unusual wear or other misuse.
23. Contact between incompatible materials.
24. Destructive testing.
25. Misalignment.
26. Excessive weathering.
27. Unprotected storage.
28. Improper shipping or handling.
29. Theft.
30. Vandalism.

END OF SECTION

SECTION 01 30 10 - MECHANICAL AND ELECTRICAL COORDINATION

PART 1 - GENERAL

1.1 REQUIREMENTS

A. Provide necessary work and services required for the complete installation of heating, ventilating, air conditioning, plumbing, and electrical systems in the buildings as shown on the Drawings. For convenience, Drawings showing primarily HVAC have been numbered with an “M”, Drawings showing primarily electrical have been numbered with an “E” and Drawings showing; primarily plumbing have been numbered with a “P”.

B. Make installations in a manner that shall comply with applicable codes and laws. Where the requirements of Contract Documents exceed code requirements, comply with the Contract Documents.

C. Perform electrical Work in accordance with the latest edition of the national Electrical code as minimum standards of quality and safety.

D. Comply with: (ADA) Americans Disability Act and (TAS) Texas Accessibility Standards requirements.

1.2 RELATED REQUIREMENTS

A. Section 01 73 29 – Cutting and Patching.

B. Section 01 31 19 – Project Meetings.

C. Section 01 30 00 – Administrative Requirements.

D. Section 01 33 00 – Submittal Requirements.

E. Section 01 60 00 – Product Requirements: Product options and substitutions.

F. Section 01 70 00 – Execution and Closeout Requirements.

1.3 REQUIREMENTS FOR EQUIPMENT

A. Provide equipment with necessary parts and accessories even though the parts and accessories are not specifically mentioned herein.

B. Provide a factory applied finish on all exterior surfaces. Tough up or refinish items which have the finish marred, before final acceptance.

C. Rotating parts shall be in static and dynamic balance.

D. Electrical materials shall bear the stamp of approval of the Underwriter’s Laboratory.

E. Noise: Eliminate any abnormal noises, which are not an inherent part of the systems as designed. Abnormal buzzing and rattling of equipment, piping, ducts, and air devices and squeaks in rotating equipment components will not be acceptable.

1.4 PROTECTION OF EQUIPMENT

A. Do not deliver equipment to jobsite until progress of construction has reached the stage where equipment is actually needed, or until equipment can be stored inside building to protect equipment from the weather. Equipment allowed to stand in weather will be rejected, and new equipment of a like kind shall be used.

B. Adequately protect equipment from damage after delivery to job site. Cover with heavy drop cloths as required to protect from plaster, dirt, paint, water, adverse weather conditions, and physical damage.

C. Equipment which has been damaged by construction activities will be rejected, and new equipment of a like kind shall be used.

D. At time of Substantial Completion, equipment shall be clean.

E. Insulation material that becomes wet shall be rejected and replaced at no additional cost to Owner.

1.5 OPERATING MANUALS, SERVICE DATA, AND WARRANTIES

A. Upon completion of the project, provide service manuals for each type unit of equipment provided in the project as described in Section 01 70 00 – Execution and Closeout Requirements.

B. Warranties: In addition to the one year warranty specified in the Conditions of the Contract, assume all responsibility for special guarantees which may be required in this specification concerning installation, operation or performance of equipment, materials, and systems provided by a distributor, manufacturer or subcontractor.

1.6 SUBMITTALS

A. Conform to the requirements of Section 01 33 00 – Submittal Procedures, Supplementary Conditions and individual specification sections.

B. Equipment and material submittals shall show sufficient data to indicate complete compliance with Contract Documents as follows:
1. Proper sizes and capabilities.
2. Ability to fit in the available space in a manner that will allow proper service.
3. Construction methods, materials, and finishes.
4. List of accessories.

C. Product data shall include the contract item designation, building, and proposed model number.

D. If proposed air devices are different than models specified, indicate the specified model and beside it the proposed model for each type of device. Do not list quantities.

E. For any item to be installed in or on a finished surface (such as a tee bar, acoustical ceiling, plaster wall) certify that applicable Contract Documents have been checked and that the item submitted is compatible with the surface finish on which it is to be installed.

F. Show Drawings: Sheet metal, piping, mechanical, and electrical fabrication Shop Drawings shall show equipment, ductwork, and piping, including piping in plumbing

chases, sized and drawn in exact location to be installed. Produce Drawings in 1/4 inch scale with all ductwork and piping sized accordingly. Ductwork and piping larger than 3 inches shall be shown with double lines.

G. Coordination Drawings: Coordination Drawings are Drawings which indicate relationships between the various systems and other components of the building such as beams, columns, ceilings, and walls. They shall be drawn to 1/4 inch scale and shall include plans, elevations, sections, and other details as required to clearly define the relationships of the various components. Indicate ducts, conduits, sprinkler systems, light fixtures, piping, and miscellaneous equipment on one drawing for each floor or level. Refer to Mechanical and Electrical Specifications for additional requirements. Submit these within two months of award of contract.

H. Interference Drawings:
1. Interference Drawings are supplementary to Coordination Drawings and indicate conflict between the various systems and other components of the building such as beams, columns, and walls. They shall be drawn to 1/4 inch scale and shall include plans, elevations, sections, and other details as required to clearly define the interference and to indicate the Contractor's proposed solution.

2. Submit Drawings for approval whenever job measurements and an analysis of the Drawings and specifications by the Contractor indicate that the various systems cannot be installed without significant deviation from the intent of the Contract. When such an interference is encountered, Work shall cease in the general areas of the conflict until a solution to the question has been approved by the Architect.

I. All Submittals shall be bound into book form with a table of contents listing all items in that specific submittal. Loose catalog sheets or drawings will not be acceptable. A separate brochure will be required for each type of equipment; e.g., lighting fixtures, switchgear, lighting panels, clock system, mechanical equipment, plumbing items, and ductwork accessories, each in a separate brochure. Miscellaneous apparatuses such as transformers contactors, time switches, and safety switches may be contained in one brochure.

J. Auxiliary system submittals shall contain sufficient information to show conformance with the specifications and shall include a description of the operation of each system to aid the consultant in the evaluation of each submittal.

PART 2 – PRODUCTS: Not Used

PART 3 - EXECUTION

3.1 MANUFACTURER'S DIRECTIONS AND SUPERVISION

A. Follow manufacturer's directions for installation, testing, and operation of all apparatuses and equipment provided.

B. Where supervision by a manufacturer is required in the specification, pay all costs and follow all instructions and recommendations of the manufacturer, who shall supervise the installation, connection, startup adjustment, instruction of the Owner, and final tests of equipment and systems. Where two or more manufacturer's equipment is interrelated, coordinate the Work and supervision.

C. Provide a letter from the manufacturers whose supervision is required stating that they

have supervised the installation and their equipment or system is operating satisfactorily in detail and in every respect and that the Owner's representative has been instructed in the operation and maintenance.

3.2 COORDINATION

A. Coordinate the mechanical and electrical Work with that of other trades in order that the various components of the systems shall be installed at the proper time, shall fit the available space, and shall allow proper service access to those requiring maintenance, including equipment specified in other Divisions.

B. Remove and relocate items which are installed without regard to proper access as directed by the Consultant, at no additional cost to the Owner.

C. Provide materials with trim to match and fit properly with the types of adjacent ceiling, wall, and floor finishes actually installed. Model numbers in specifications or scheduled on Drawings are not intended to designate the required trim.

D. Provide mechanical equipment with electrical characteristics compatible with that shown on Electrical Drawings and described in electrical Division of the specifications.

E. Prior to the fabrication of ductwork or the installation of devices in the ceilings, review the Drawings to ascertain that the locations of devices in the ceilings create a pattern which is compatible with the reflected ceiling plan and the spacings of the various ceiling mounted devices.

3.3 DRAWINGS

A. The Contract Drawings are schematic in nature, but indicate how the various components are integrated with other parts of the building. Determine exact locations by job measurement, by checking the requirements of other trades, and by review of Contract Documents.

B. The Drawings indicate general routing of the various parts of the systems, but do not indicate all sizes, fittings, offsets, and runouts which are required. Provide correct sizes, fittings, offsets, and runouts required to fit the system into spaces allocated to them. Locate all light fixtures, vents, and supply grilles to conform to the ceiling grid system. Examine the Drawings to become familiar with this requirement.

C. In certain instances, the Architect may require relocation of outlets and switches. Where relocation is within 3 feet of location shown on Drawings, and when Contractor is informed of necessary relocation before Work is begun on this portion of the job, no extra compensation will be allowed.

END OF SECTION

SECTION 01 31 19 - PROJECT MEETINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for project meetings including but not limited to:
   1. Pre-Construction Conference.
   2. Pre-Installation Conferences.
   3. Coordination Meetings.
   4. Progress Meetings.

B. Construction schedules are specified in another Division-1 Section.

1.3 PRE-CONSTRUCTION CONFERENCE

A. Schedule a pre-construction conference and organizational meeting at the Project site or other convenient location no later than 15 days after execution of the Agreement and prior to commencement of construction activities. Conduct the meeting to review responsibilities and personnel assignments.

B. Attendees: The Owner, Architect and their consultants, the Contractor and its superintendent, major subcontractors, manufacturers, suppliers and other concerned parties shall each be represented at the conference by persons familiar with and authorized to conclude matters relating to the Work.

C. Agenda: Discuss items of significance that could affect progress including such topics as:
   1. Tentative construction schedule.
   2. Critical Work sequencing.
   3. Designation of responsible personnel.
   4. Procedures for processing field decisions and Change Orders.
   5. Procedures for processing Applications for Payment.
   6. Distribution of Contract Documents.
   7. Submittal of Shop Drawings, Product Data and Samples.
   8. Preparation of record documents.
   9. Use of the premises.
   10. Office, Work and storage areas.
   11. Equipment deliveries and priorities.
   12. Safety procedures.
   13. First aid.
   14. Security.
   15. Housekeeping.
   16. Working hours.

1.4 PRE-INSTALLATION CONFERENCES

A. Conduct a pre-installation conference at the site before each construction activity that requires coordination with other construction. The 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 the Architect of scheduled meeting dates.

B. Review the progress of other construction activities and preparations for the particular activity under consideration at each pre-installation conference, including requirements for:
   1. Contract Documents.
   2. Options.
   3. Related Change Orders.
   4. Purchases
   5. Deliveries.
   6. Shop Drawings, Product Data and quality control Samples.
   7. Possible conflicts.
   8. Compatibility problems.
   9. Time schedules.
   10. Weather limitations.
   11. Manufacturer's recommendations.
   12. Compatibility of materials.
   13. Acceptability of substrates.
   14. Temporary facilities.
   15. Space and access limitations.
   16. Governing regulations.
   17. Safety.
   18. Inspection and testing requirements.
   19. Required performance results.
   20. Recording requirements.
   21. Protection.

C. Record significant discussions and agreements and disagreements of each conference, along with the approved schedule. Distribute the record of the meeting to everyone concerned, promptly, including the Owner and Architect.

D. Do not proceed if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of Work and reconvene the conference at the earliest feasible date.

1.5 COORDINATION MEETINGS

A. Conduct Project coordination meetings at regularly scheduled times convenient for all parties involved. Project coordination meetings are in addition to specific meetings held for other purposes, such as regular progress meetings and special pre-installation meetings.

B. Request representation at each meeting by every party currently involved in coordination or planning for the construction activities involved.

C. Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

1.6 PROGRESS MEETINGS

A. Architect will conduct progress meetings at the Project sites once a week, or biweekly as the stage of work dictates. Notify the Owner and Architect of appropriate meeting dates. Coordinate dates of meetings with preparation of the payment request.
B. Attendees: In addition to representatives of the Owner and Architect, each subcontractor, supplier or other entity concerned with current progress or involved in planning, coordination or performance

of future activities shall be represented at these meetings by persons familiar with the Project and authorized to conclude matters relating to progress.

C. Agenda: Review and correct or approve minutes of the previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to the current status of the Project.

D. Contractor's Construction Schedule: Review progress since the last meeting. Determine where each activity is in relation to the Contractor's Construction Schedule, whether on time or ahead or behind 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 the present and future needs of each entity present, including such items as:
    a. Interface requirements.
    b. Time.
    c. Sequences.
    d. Deliveries.
    e. Off-site fabrication problems.
    f. Access.
    g. Site utilization.
    h. Temporary facilities and services.
    i. Hours of Work.
    j. Hazards and risks.
    k. Housekeeping.
    l. Quality and Work standards.
    m. Change Orders.
    n. Documentation of information for payment requests.

E. Reporting: No later than 3 days after each progress meeting date, the contractor shall distribute copies of minutes of the meeting to each party present and to other parties who should have been present. Include a brief summary, in narrative form, of progress since the previous meeting and report.

1. Schedule Updating: Revise the construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue the revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 01 32 00 - NOTIFICATION OF ARCHITECT REQUIREMENTS

PART 1 - GENERAL

1.1 REQUIREMENTS

A. In general, the Contractor shall notify the Architect whenever there is need of clarification of interpretation of the Contract Documents.

B. The Contractor shall notify the Architect 48 hours in advance of certain stages of construction. The project superintendent shall notify the Owner's Representative on an ongoing basis of ongoing work. These stages shall include, but not necessarily be limited to the following:

1. Division 2 – Demolition of any existing facilities or site features.

2. Division 3.
   a. Excavation of grade beams.
   b. Installation of concrete underlayment, underslab vapor barriers, water proofing.
   c. Installation of void boxes under concrete slab.
   d. Installation of reinforcing and formwork
   e. Placing of concrete.

3. Division 4
   a. Placing of masonry, grout, and reinforcement
   b. Block, brick, and stone placement, glass unit masonry, masonry cleaning.

4. Division 5
   a. Erection of structural steel, open web steel joists, and steel deck.
   b. Miscellaneous metals, ladders, brackets, pipe rails, etc.

5. Division 6 - Finish Carpentry and Millwork.
   a. Installation of Learning Stair.
   b. Installation of sliding wood panels

6. Division 7
   a. Installation of waterproofing, vapor barriers, flashing and sheet metal.
   b. Installation of roofing system(s) and associated work.
   c. Concealment of insulation.
   d. Application of fireproofing.
   e. Installation of firestopping and firesafing.
   f. Installation of building and glazing sealants.

7. Division 8
   a. Installation of doors, frames, windows, and storefronts.
   b. Installation of rolling and coiling doors and grilles.
   c. Installation of finish hardware.
   d. Installation of glazing and glazed systems.

8. Division 9
   a. Installation of plaster and gypsum board products.
   b. Installation of tile, flooring, and pavers.

c. Installation of acoustical ceiling (grid and panels).
d. Installation of resilient flooring and base.
e. Painting and staining (each coat).

9. Division 10
   a. Installation of specialty items, markerboards, display cases, projection screens, signage and graphics, canopies.
   b. Installation of operable walls and folding partitions.
   c. Installation of toilet accessories.

10. Division 11
   a. Installation of appliances.
   b. Installation of Stage Equipment.

11. Division 14 – Installation of elevators.

12. Division 21
   a. Installation of sprinkler piping.
   b. Installation of sprinkler heads.

13. Divisions 22, 23 and 26
   a. Completion of roughing-in of plumbing, heating, air conditioning and electrical work (prior to concealment).
   b. Any testing specified for mechanical, electrical and plumbing systems.
   c. Inspection and testing of underground utilities.

14. Division 22 - Installation of plumbing fixtures.

15. Division 23 - Installation of heating, ventilating and air conditioning.

16. Division 26 - Installation of all electrical fixtures.

17. Division 31
   a. Site clearing and stripping of top soil.
   b. Excavation for building foundation.
   c. Placing and compaction of each lift of select fill material.
   d. Drilling of foundation piers.
   e. Covering of underground utilities.
   f. Site grading.

18. Division 32
   a. Stabilization of paving subgrades.
   b. Installation of concrete paving.
   c. Installation of decorative metal fencing.
   d. Installation of topsoil.
   e. Installation of landscaping.

PARTS 2 and 3 - Not Used

END OF SECTION

SECTION 01 33 00 - SUBMITTALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this Section.

B. Other Related Sections:
   1. 01 30 10 – Mechanical and Electrical Coordination.
   2. 01 33 10 – BIM Coordination Process.

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for submittals required for performance of the Work, including:
   1. Contractor's construction schedule.
   2. Submittal schedule.
   3. Daily construction reports.
   4. Shop Drawings.
   5. Product Data.
   6. Samples.
   7. Requests for Interpretation.
   8. Environmental and Health Certificates or labels for certain materials as required.

B. Administrative Submittals: Refer to other Division-1 Sections and other Contract Documents for requirements for administrative submittals. Such submittals include, but are not limited to:
   1. Permits.
   2. Applications for payment.
   3. Performance and payment bonds.
   4. Insurance certificates.
   5. List of Subcontractors.

C. The Schedule of Values submittal is included in Section "Applications for Payment."

D. Inspection and test reports are included in Section "Quality Control Services."

1.3 SUBMITTAL PROCEDURES

A. General: Electronic copies of CAD Drawings of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals only after receipt of acceptable waiver from Contractor.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.

   1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals and related activities that require sequential activity.

   2. Coordinate transmittal of different types of submittals for related elements of the Work so processing will not be delayed by the need to review submittals concurrently for coordination.
      a. The Architect reserves the right to withhold action on a submittal requiring

coordination with other submittals until related submittals are received.

3. Processing: Allow sufficient review time so that installation will not be delayed as a result of the time required to process submittals, including time for re-submittals.

4. Allow two weeks for initial review. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. The Architect will promptly advise the Contractor when a submittal being processed must be delayed for coordination.
   a. If an intermediate submittal is necessary, process the same as the initial submittal.

5. Allow two weeks for reprocessing each submittal.
   a. No extension of Contract Time will be authorized because of failure to transmit submittals to the Architect sufficiently in advance of the Work to permit processing.

C. Submittal Preparation: Place a permanent label or title block on each submittal for identification. Indicate the name of the entity that prepared each submittal on the label or title block.

1. Prior to forwarding to Architect, include Contractor's stamp on transmittal, each shop drawing sheet, and each bound set of data indicating Contractor's review and acceptance of submittal. Contractor's notations regarding exceptions, requirements, or deviations from Project requirements are to be clearly indicated.

2. Do not provide multiple submittals under one transmittal. Provide separate transmittal for each item.

3. Include the following information on the transmittal and submittal for processing and recording action taken.
   a. Listing of the product(s) or system(s) b or
   b. Number of the related specification section plus sequential number of the particular submittal (for instance: **05 21 00 -1** for initial submittal of Steel Joists). Verify numbering system with Architect.
   c. Project name.
   d. Date.
   e. Name of Architect.
   f. Name of Contractor.
   g. Name of submitting subcontractor or supplier.

4. Title block on shop drawings shall include the following:
   a. Project name.
   b. Date.
   c. Name of Contractor.
   d. Name and contact number of subcontractor or supplier as appropriate.
   h. Name or initials of person producing the shop drawings.

5. Submittals rejected or returned to the sender for additional information are not to be forwarded to the Architect. Forwarding a submittal to the Architect indicates Contractor's acceptance of the submittal as meeting Project requirements.

D. Electronic (PDF) Submittals are to be provided in lieu of hard-copies. Architect will utilize file transfer protocol "Project mates" to receive, transfer, and manage submittals routed from Contractor to Architect and associated Consultants.
   1. Contractor will require purchase of special software to interface with "Projectmates".

E. Submittal Transmittal: Package each submittal appropriately for transmittal and handling. Transmit each submittal from Contractor to Architect using electronic transmittal form.

Submittals received from sources other than the Contractor will be returned or discarded without action.

1. Record on the transmittal Record relevant information and requests for additional information.
2. Clearly and conspicuously indicate on transmittal and shop drawings any deviations from Contract Document requirements, including a non-specified product or manufacturer, any variations, or limitations. Architect's review and acceptance of submittals is not binding where such deviations are not CLEARLY NOTED.
3. Include Contractor's certification of review that submitted product(s) complies with Contract Document requirements except as CLEARLY NOTED.

F. Owner will have access to viewing and commenting on submittals concurrently with A/E, and the Architect will incorporate any Owner comments prior to return of submittals.

1.4 SHOP DRAWINGS AND COORDINATION DRAWINGS

A. Submit newly prepared information, drawn to accurate scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to the Project is not considered Shop Drawings.

B. Shop Drawings include fabrication and installation drawings, setting diagrams, schedules, patterns, templates and similar drawings. Include the following information:

1. Dimensions.
2. Identification of products and materials included.
3. Compliance with specified standards.
4. Notation of coordination requirements.
5. Notation of dimensions established by field measurement.

C. Provide digital copies of shop drawings unless A/E specifically requests hard copy drawings for a particular submittal.

1. Sheet Size: Except for templates, patterns and similar full-size Drawings, submit Shop Drawings on sheets at least 8-1/2" x 11" but no larger than 36" x 48".
2. Number of Copies: Submit three black-line prints for the Architect's or Architect's Consultant's review; one print will be returned with comments, or scanned and returned through Architect's digital file transfer protocol.
3. Contractor shall make copies necessary for his own use, for field copies, and copies of reviewed submittals to be included in maintenance manuals

D. Steel Shop Drawings (Division 5): To expedite the Architect's and Engineer's review of the structural steel Shop Drawings, submit Shop Drawings for items specified in the following sections separately from those of Section 05 12 00 - Structural Steel Framing, even when furnished by the same fabricator:

1. Section 05 50 00 - Metal Fabrications.
2. Section 05 51 00 - Metal Stairs.
3. Section 05 52 00 - Metal Railings
4. Section 05 53 00 - Metal Gratings.

E. Coordination drawings are a special type of Shop Drawing that show the relationship and integration of different construction elements that require careful coordination during fabrication or installation to fit in the space provided or function as intended.

1. Preparation of coordination Drawings is specified in other sections of the Project specifications and may include components previously shown in detail on Shop Drawings or Product Data.
2. Submit coordination Drawings for integration of different construction elements. Show sequences and relationships of separate components to avoid conflicts in use of space.

1.5 PRODUCT DATA

A. Collect Product Data into a single submittal for each element of construction or system. Product Data includes printed information such as manufacturer's installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams and performance curves. Where Product Data must be specially prepared because standard printed data is not suitable for use, submit as "Shop Drawings."

B. Mark each copy to show applicable choices and options. Where printed Product Data includes information on several products, some of which are not required, mark copies to indicate the applicable information. Include the following information:

1. Manufacturer's printed recommendations.
2. Compliance with recognized trade association standards.
3. Compliance with recognized testing agency standards.
4. Application of testing agency labels and seals.
5. Notation of dimensions verified or requiring verification by field measurement.
6. Notation of coordination requirements.

C. Do not submit Product Data until compliance with requirements of the Contract Documents has been confirmed.

D. Preliminary Submittal: Submit a preliminary single copy of Product Data where selection of options is required. Do not submit manufacturer’s pamphlets or catalogs without the particular items for consideration CLEARLY indicated.

E. Number of Copies: Provide digital copies of Product Data unless A/E specifically requests hard copies for a particular submittal:

1. Submit three copies for the Architect's or Consultant’s review; one copy will be returned with comments, or scanned and returned through Architect’s digital file transfer protocol.
2. Contractor shall make copies necessary for his own use, for field copies, and copies of reviewed Product Data to be included in maintenance manuals.

F. Field Copies: Following receipt of reviewed and accepted submittal from Architect, print and file copy of reviewed submittal in the Project meeting room and field office. Field copy shall include all review markings.
1. Do not proceed with installation until a copy of the final Product Data submittal is in the installer's possession.

1.6 SAMPLES

A. Submit full-size, fully fabricated Samples cured and finished as specified and physically identical with the material or product proposed. Samples include partial sections of manufactured or fabricated components, cuts or containers of materials, color range sets, and swatches showing color, texture and pattern.

1. Include transmittal with information as identified above in Submittal Procedures. Number product on the transmittal per the approved numbering system. In many cases the

sample will be retained by the Architect with only the transmittal returned with comments.

2. Mount, display, or package Samples in the manner specified to facilitate review of qualities indicated. Prepare Samples to match the Architect's Sample. Include the following:
   a. Generic description of the Sample.
   b. Sample source.
   c. Product name or name of manufacturer.
   d. Compliance with recognized standards.
3. Submit Samples for review of kind, color, pattern, and texture, for a final check of these characteristics with other elements, and for a comparison of these characteristics between the final submittal and the actual component as delivered and installed.
4. Where variation in color, pattern, texture or other characteristics are inherent in the material or product represented, submit multiple units (not less than 3), that show approximate limits of the variations.
5. Refer to other Specification Sections for requirements for Samples that illustrate workmanship, fabrication techniques, details of assembly, connections, operation and similar construction characteristics.
6. Refer to other Sections for Samples to be returned to the Contractor for incorporation in the Work. Such Samples must be undamaged at time of use. On the transmittal, indicate special requests regarding disposition of Sample submittals.

B. Preliminary samples: Where Samples are for initial selection of color, pattern, texture or similar characteristics from a range of standard choices, submit a full set of choices for the material or product.

1. Preliminary samples will be reviewed and may be returned with the Architect's mark indicating initial selection.

2. Maintain approved samples, if returned, at the Project site, for quality comparisons throughout the course of construction.

3. Unless noncompliance with Contract Document provisions is observed, the initial submittal may also serve as the final sample.

C. Distribution of Samples: Distribute additional sets of approved samples to subcontractors, manufacturers, fabricators, suppliers, installers, and others as required for performance of the Work.

1. Field Samples or “mockups” specified in individual Sections are special types of Samples. Field Samples are full-size mockups erected, installed, or applied on site to illustrate finishes, coatings, or quality of installation, and to establish the standard by which the Work will be judged.

2. Comply with submittal requirements to the fullest extent possible. Process transmittal forms to provide a record of activity
   .
3. As part of Closeout Documents, Contractor shall provide a binder with samples of all materials included in Completed Work. Samples shall be separated by Specification Section.

1.7 SUBMITTAL SCHEDULE

A. After development and acceptance of the Contractor's construction schedule. Architect and Contractor will work in tandem to prepare a complete schedule of submittals. Submit the

schedule within 10 days of the date required for establishment of the Contractor's construction schedule.

1. Coordinate submittal schedule with the list of subcontracts, schedule of values and the list of products as well as the Contractor's construction schedule.
2. Prepare the schedule in chronological order; include submittals required during the first 90 days of construction. Provide the following information:
   a. Scheduled date for delivery of each submittal to the Architect.
   b. Submittal category.
   c. Name of subcontractor.
   d. Description of the part of the Work covered.
   e. Anticipated date for return of Architect’s reviewed copy.

B. Field Copies: Following receipt of reviewed and accepted submittal from Architect, print and file copy of reviewed submittal in the Project meeting room and field office. Field copy shall include all review markings.

1.8 ARCHITECT'S REVIEW OF SUBMITTALS

A. Except for submittals for record, information or similar purposes, where action and return is required or requested, the Architect will review each architectural submittal, mark to indicate action taken, and return promptly.
   1. Compliance with specified characteristics is the Contractor's responsibility.

B. Action Stamp: The Architect will stamp each submittal with a uniform, self-explanatory action stamp. The stamp will be appropriately marked, as follows, to indicate the action taken:

C. Final Release: Where submittals are marked "No Exceptions," that part of the Work covered by the submittal may proceed provided it complies with requirements of the Contract Documents; final acceptance will depend upon that compliance.

D. Final-But-Restricted Release: When submittals are marked "Exceptions Noted" or "Make Corrections Noted", that part of the Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents; final acceptance will depend on that compliance.

E. Returned for Resubmittal: When submittal is marked "Revise and Resubmit", do not proceed with that part of the Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal in accordance with the notations; resubmit without delay. Repeat if necessary to obtain a different action mark.

F. Where subcontractor or supplier elects to make corrections based on notations by the Contractor, Architect, or consultants and the submittal has NOT been marked "Revise and Resubmit”, do not copy the Architect with revised drawing unless specifically corrected.

G. Do not permit submittals marked "Revise and Resubmit" to be used at the Project site, or elsewhere where Work is in progress

1.9 CONTRACTOR'S CONSTRUCTION SCHEDULE

B. Bar-Chart Schedule: Prepare a fully developed, horizontal bar-chart type Contractor's construction schedule. Submit within 30 days of the date established for "Commencement of the Work" or before initial application of payment.
   1. Provide a separate time bar for each significant construction activity. Provide a continuous vertical line to identify the first working day of each week. Use the same

breakdown of units of the Work as indicated in the "Schedule of Values."
2. Prepare the schedule on a sheet, or series of sheets, of stable transparency, or other reproducible media, of sufficient width to show data for the entire construction period.
3. Secure time commitments for performing critical elements of the Work from parties involved. Coordinate each element on the schedule with other construction activities; include minor elements involved in the sequence of the Work. Show each activity in proper sequence. Indicate graphically sequences necessary for completion of related portions of the Work.
4. Coordinate the Contractor's construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests and other schedules.
5. Indicate completion in advance of the date established for Substantial Completion. Indicate Substantial Completion on the schedule to allow time for the Architect's procedures necessary for certification of Substantial Completion.

C. Work Stages: Indicate important stages of construction for each major portion of the Work, including testing and installation.

D. Distribution: Following response to the initial submittal, print and distribute copies to the Architect, Owner, and other parties required to comply with scheduled dates. Post copies in the Project meeting room and temporary field office.
1. When revisions are made, distribute 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 construction activities.

E. Schedule Updating: Revise the schedule after each meeting or activity, where revisions have been recognized or made. Issue the updated schedule concurrently with report of each meeting.

1.10 DAILY CONSTRUCTION REPORTS

A. Prepare a daily construction report, recording the following information concerning events at the site; make report available to the Architect and Owner via “Projectmates”
1. List of subcontractors at the site.
2. Approximate count of personnel at the site.
3. Weather-related conditions at the actual site including temperature, precipitation, muddy or wet site conditions. No claims for additional weather days can be made without daily weather entries in the log.
4. Accidents and unusual events.
5. Meetings and significant decisions.
6. Stoppages, delays, shortages, losses.
7. Orders and requests of governing authorities.
8. Services connected, disconnected.
9. Equipment or system tests and start-ups.
10. Partial Completions, occupancies.
11. Substantial Completions authorized.

1.11 REQUESTS FOR INTERPRETATION - All contractor requests for interpretation pertaining to all aspects of the construction documents and this Project shall be submitted on “Projectmates”

1.12 Environmental and Health Certifications or Labels (for example: Cradle to Cradle, EPD, HPD, and other certifications and labels): Furnish copies of documents showing proof of certification or label as indicated on the Project’s Interior and/or Exterior Finish Schedule. Submit the information with the other Submittal Data for Basis-of-Design products, equal products by specified manufacturers, and proposed substitution products.

A. Proposed substitutions shall comply with the following: The Project's Interior and/or Exterior Finish Schedule, or Color Schedule, may be labelled in the drawings as something other than the "Interior Finish Schedule" or "Exterior Finish Schedule".

B. For a product to be used in lieu of the Basis-of-Design product listed in the specs or on the Interior Finish Schedule, a proposed as-equal product supplied by manufacturers listed in the specifications that is not the Basis-of-Design product, the proposed comparable product shall have a certification or label which is equal to, or better than the Basis-of-Design product.

C. A proposed as-equal product to be used in lieu of the Basis-of-Design product listed in the Specifications or on the Interior Finish Schedule, a product supplied by manufacturers not listed in the specifications or the Interior Finish Schedule, the proposed comparable product shall have a certification or label which is equal to, or better than the Basis-of-Design product.

D. If a question about which certification or label is better than or exceeds the indicated certification, contact the project's Architect for direction.

PART 2 - PRODUCTS (Not Applicable).

PART 3 - EXECUTION (Not Applicable).

END OF SECTION – Plus Attached RFI Form

SEE ATTACHED RFI FORM

REQUEST FOR INTERPRETATION
(R.F.I.)

PROJECT: _____

CONTRACTOR: _____

ARCHITECT: STANTEC

THIS IS A FIELD AND/OR OFFICE REQUEST FOR INTERPRETATION TO SUPPLEMENT THE DESIGN DATA DEPICTED ON THE DRAWINGS OR IN THE SPECIFICATIONS. CHANGES TO THE CONTRACT DOCUMENTS, THE CONTRACT SUM, OR THE TIME FOR CONTRACT PERFORMANCE THAT MAY RESULT FROM THE REPLY TO THIS RFI WILL BE PROCESSED IN ACCORDANCE WITH THE CHANGES CLAUSE OF THE CONTRACT, IF APPROPRIATE.

QUESTION:

Submitted by: _____

Drawing/Specification: _____

PROPOSED OR SUGGESTED SOLUTION:

Copied to:

_____ _____ **Date:** _____

_____ _____

_____ _____ **R.F.I. No.:** _____

SECTION 01 33 10 BIM COORDINATION PROCESS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to the Section.

B. Other Related Sections:
   1. 01 30 10 – Mechanical and Electrical Coordination.
   2. 01 33 00 – Submittal Procedures.

C. The requirements of the General Conditions and Supplementary Conditions apply to the work of this Section.

1.2 MODEL REQUIREMENTS

B. BIM Execution/ Implementation Plan shall identify how the data is to be managed and interoperated (data storage, sharing, viewing, quality control parameters, and updating, as necessary) among all Contractor team members.

C. Mechanical: The mechanical systems Model may vary in level of detail for individual elements, but at a minimum must include all features that would be included on a quarter-inch (1/4”=1’0”) scaled drawing.

   1. HVAC- All necessary heating, ventilating, air-conditioning, and specialty equipment, including air distribution ducts for supply, return, and ventilation and exhaust ducts, including control system, registers, diffusers, grills, and hydronic baseboards with necessary intelligence to produce accurate drawings and schedules.

   2. Mechanical Piping: All necessary piping and fixture layouts, and related equipment, including necessary intelligence to produce accurate drawings and schedules. All piping larger than 1.5” diameter shall be modeled.

D. Plumbing: All necessary plumbing piping and fixture layouts, floor and area drains, and related equipment, including necessary intelligence to produce accurate drawings and schedules. All piping larger than 1.5” diameter shall be modeled.

E. Electrical/Telecommunications: The electrical systems Model may vary in level of detail for individual elements, but at a minimum must include all features that would be included on a quarter-inch (1/4”=1’0”) scaled drawing.

   1. All necessary interior electrical components (i.e., receptacles, special and general purpose power receptacles, lighting fixtures, panel boards and control systems), including necessary intelligence to produce accurate drawings and schedules.

   2. Cable tray routing shall be modeled without detail of cable contents. Electrical conduit larger than 1.5” diameter shall be modeled.

F. Fire Protection: The fire protection system Model may vary in level of detail for individual elements, but at a minimum must include all features that would be included on a quarter-inch (1/4”=1’0”) scaled drawing.

1. Fire Protection System- All relevant fire protection components (i.e., branch piping, sprinkler heads, fittings, drains, pumps, tanks, sensors, control panels) with necessary intelligence to produce accurate drawings and schedules. All fire protection piping, regardless of size, shall be modeled.

2. Fire Alarms- Fire alarm/mass notification devices and detection system shall be indicated with necessary intelligence to produce accurate plans depicting the system.

G. Equipment Clearances: All Mechanical, Electrical, and Plumbing equipment clearances shall be modeled for use in spatial coordination and maintenance access requirements.

H. As-Builts BIM Model: The final Model shall include Architectural, Structural, Mechanical, Electrical, Plumbing and Fire protection systems.

1. The model shall include detailed and accurate representations of all equipment as installed.

2. Provide the Model files in interoperable file formats (AutoCAD or Navisworks) per Implementation Plan requirements.

I. Quality Control: Visual review to ensure the design intent has been followed and that the As-Built Model set has no unintended, undefined, incorrectly defined or duplicated elements.

1.3 COORDINATION PROCESS

A. Construction Manager shall take the lead in coordinating the Mechanical, Electrical, Plumbing, and Fire Protection systems within the Project.

B. The Construction Manager shall coordinate a three-dimensional (3D) model of the building which includes the Mechanical, Electrical, Plumbing, and Fire Protection systems.

1. The Electrical, Plumbing, and Fire Protection Sub-Contractors shall prepare their work and generate 3D models that will be given to the Construction manager for spatial coordination.

2. The Sub-Contractors will be provided with the Architecture and Structure models that were used to generate the Contract Documents, and these files may be used for backgrounds.

3. The Sub-Contractors shall replace the MEP systems originally drawn in the Contract Documents with the actual shop drawing models. Submitting the contract drawings as coordination drawings will not be acceptable.

C. The model shall include properly sized, detailed, and accurate representations of all equipment to be installed based upon the reviewed equipment submittals.

D. The Construction Manager shall organize a 3D coordination meeting with all appropriate Sub-Contractors present to review the model and discuss coordination of the installation of the building systems in iterations.

E. The Sub-Contractors shall coordinate to resolve identified spatial conflicts. In accordance with the coordinated and agreed actions, each project team member shall make the appropriate adjustment to their respective model.

F. Sequence of Coordination: Below is hierarchy of model elements and the sequencing by which the models shall be coordinated:
   1. Structure model with Architecture model.
   2. Mechanical model with coordinated Structure and Architecture model.
   3. Electrical, Plumbing and Fire Sprinkler models with coordinated Mechanical, structure and Architecture Models.

G. The Sub-Contractors shall not install any item until the coordination has been completed and reviewed by the Construction Manager, Owner, and A/E Team.

I. By submitting shop drawings for the project, the submitting Sub-Contractor indicates that all necessary coordination with other trades has been completed and that the systems, products and equipment submitted can be installed in the building without conflict and will operate as specified and intended.

END OF SECTION

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for quality control services.

B. Quality control services include inspections and tests and related actions including reports, performed by independent agencies, governing authorities, and the Contractor. They do not include Contract enforcement activities performed by the Architect.

C. Inspection and testing services are required to verify compliance with requirements specified or indicated. These services do not relieve the Contractor of responsibility for compliance with Contract Document requirements.

D. Requirements of this Section relate to customized fabrication and installation procedures, not production of standard.

1. Specific quality control requirements for individual construction activities are specified in the Sections that specify those activities. Those requirements, including inspections and tests, cover production of standard products as well as customized fabrication and installation procedures.
2. Inspections, test and related actions specified are not intended to limit the Contractor's quality control procedures that facilitate compliance with Contract Document requirements.
3. Requirements for the Contractor to provide quality control services required by the Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

1.3 RESPONSIBILITIES

A. Contractor Responsibilities: The Contractor shall provide inspections, tests and similar quality control services specified in individual Specification Sections and required by governing authorities, except where they are specifically indicated to be the Owner's responsibility, or are provided by another identified entity; these services include those specified to be performed by an independent agency and not by the Contractor. Costs for these services shall be included in the Contract Sum.

1. The Owner will engage and pay for the services of an independent agency to perform certain inspections and tests as specified in PART 3 - EXECUTION, QUALITY CONTROL, QUALITY CONTROL TESTING DURING CONSTRUCTION or FIELD QUALITY CONTROL.
    a. Where the Owner has engaged a testing agency or other entity for testing and inspection of a part of the Work, and the Contractor is also required to engage an entity for the same or related element, the Contractor shall not employ the entity engaged by the Owner, unless otherwise agreed in writing with the Owner.

2. Retesting: The Contractor is responsible for retesting where results of required inspections, tests or similar services prove unsatisfactory and do not indicate compliance

with Contract Document requirements, regardless of whether the original test was the Contractor's responsibility.

a. Cost of retesting construction revised or replaced by the Contractor is the Contractor's responsibility, where required tests were performed on original construction.

3. Associated Services: The Contractor shall cooperate with agencies performing required inspections, tests and similar services and provide reasonable auxiliary services as requested. Notify the agency sufficiently in advance of operations to permit assignment of personnel. Auxiliary services required include but are not limited to:
   a. Providing access to the Work and furnishing incidental labor and facilities necessary to facilitate inspections and tests.
   b. Taking adequate quantities of representative samples of materials that require testing or assisting the agency in taking samples.
   c. Providing facilities for storage and curing of test samples, and delivery of samples to testing laboratories.
   d. Providing the agency with a preliminary design mix proposed for use for materials mixes that require control by the testing agency.
   e. Security and protection of samples and test equipment at the Project site.

B. Owner Responsibilities: The Owner will provide inspections, tests and similar quality control services specified to be performed by independent agencies and not by the Contractor, except where they are specifically indicated as the Contractor's responsibility or are provided by another identified entity. Costs paid by the Owner for these services are not included in the Contract Sum unless an Allowance sum is established specifically for this purpose.

1. The Owner will employ and pay for the services of an independent agency, testing laboratory or other qualified firm to perform services which are the Owner's responsibility.

C. Duties of the Testing Agency: The independent testing agency engaged to perform inspections, sampling and testing of materials and construction specified in individual Specification Sections shall cooperate with the Architect and Contractor in performance of its duties, and shall provide qualified personnel to perform required inspections and tests.

1. The agency shall notify the Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. The agency is not authorized to release, revoke, alter or enlarge requirements of the Contract Documents, or approve or accept any portion of the Work.
3. The agency shall not perform any duties of the Contractor.

D. Coordination: The Contractor and each agency engaged to perform inspections, tests and similar services shall coordinate the sequence of activities to accommodate required services with a minimum of delay. Additionally, Contractor and each agency shall coordinate activities to avoid the necessity of removing and replacing construction to accommodate inspections and tests.

1. The Contractor is responsible for scheduling times for inspections, tests, taking samples and similar activities.

1.4 SUBMITTALS

A. The independent testing agency shall submit a certified written report of each inspection, test or similar service, to the Architect, in duplicate, unless the Contractor is responsible for the service. If the Contractor is responsible for the service, submit a certified written report of each inspection, test or similar service through the Contractor, in duplicate.

B. Submit additional copies of each written report directly to the governing authority, when the authority so directs.

C. Report Data: Written reports of each inspection, test or similar service shall include, but not be limited to:
   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 the inspection or test.
   6. Designation of the Work and test method.
   7. Identification of product and Specification Section.
   8. Complete inspection or test data.
   9. Test results and an interpretation of test results.
   10. Ambient conditions at the time of sample-taking and testing.
   11. Comments or professional opinion as to whether inspected or tested Work complies with Contract Document requirements.
   12. Name and signature of laboratory inspector.
   13. Recommendations on retesting.

1.5 QUALITY ASSURANCE

A. Qualification for Service Agencies: Engage inspection and testing service agencies, including independent testing laboratories, which are prequalified as complying with "Recommended Requirements for Independent Laboratory Qualification" by the American Council of Independent Laboratories, and which specialize in the types of inspections and tests to be performed.
   1. Each independent inspection and testing agency engaged on the Project shall be authorized by authorities having jurisdiction to operate in the State in which the Project is located.

PART 2 - PRODUCTS (Not Applicable).

PART 3 - EXECUTION

3.1 REPAIR AND PROTECTION

A. General: Upon completion of inspection, testing, sample-taking and similar services, repair damaged construction and restore substrates and finishes to eliminate deficiencies, including deficiencies in visual qualities of exposed finishes. Comply with Contract Document requirements for "Cutting and Patching."

B. Protect construction exposed by or for quality control service activities, and protect repaired construction.

C. Repair and protection is the Contractor's responsibility, regardless of the assignment of responsibility for inspection, testing or similar services.

END OF SECTION

SECTION 01 42 19 - REFERENCE STANDARDS AND DEFINITIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. Indicated: The term indicated refers to graphic representations, notes, or schedules on the Drawings, or other Paragraphs or Schedules in the Specifications, and similar requirements in the Contract Documents. Terms such as shown, noted, scheduled, and specified are used to help the reader locate the reference. There is no limitation on location.

C. Directed: Terms such as directed, requested, authorized, selected, approved, required, and permitted mean directed by the Architect, requested by the Architect, and similar phrases.

D. Approved: The term approved, when used in conjunction with the Architect's action on the Contractor's submittals, applications, and requests, is limited to the Architect's duties and responsibilities as stated in the Conditions of the Contract.

E. Regulations: The term regulations includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.

F. Furnish: The term furnish means supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. Install: The term install describes operations at the Project site including the actual unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

H. Provide: The term provide means furnish and install, complete and ready for the intended use.

I. Installer: An Installer is the Contractor or another entity engaged by the Contractor, either as an employee, subcontractor, or contractor of lower tier, to perform a particular construction activity, including installation, erection, application, and similar operations. Installers are required to be experienced in the operations they are engaged to perform.

   1. The term experienced, when used with the term Installer, means having a minimum of five previous projects similar in size and scope to this Project, being familiar with the special requirements indicated, and having complied with requirements of the authority having jurisdiction.

J. Trades: Using terms such as carpentry is not intended to imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as carpenter. It also does not imply that requirements specified apply exclusively to tradespersons of the corresponding generic name.

K. Assigning Specialists: Certain Sections of the Specifications require that specific construction activities shall be performed by specialists who are recognized experts in those operations.

The specialists must be engaged for those activities, and their assignments are requirements over which the Contractor has no choice or option. However, the ultimate responsibility for fulfilling Contract requirements remains with the Contractor.

1. This requirement shall not be interpreted to conflict with enforcing building codes and similar regulations governing the Work. It is also not intended to interfere with local trade union jurisdictional settlements and similar conventions.

L. Project site is the space available to the Contractor for performing construction activities either exclusively or in conjunction with others performing other work as part of the Project. The extent of the Project site is shown on the Drawings and may or may not be identical with the description of the land on which the Project is to be built.

M. Testing Agencies: A testing agency is an independent entity engaged to perform specific inspections or tests, either at the Project site or elsewhere and to report and interpret results of those inspections or tests.

1.3 SPECIFICATION FORMAT AND CONTENT EXPLANATION

A. Specification Format: These Specifications are organized into Divisions and Sections based on the Construction Specifications Institute's MASTERFORMAT numbering system.

1. Text Subordination: Portions of the Specification may be subordinated to other portions in the following manner:
   a. Certain Sections may be subordinate to other Sections or parts of other Sections. When that occurs, the degree of subordination is described in those Sections.
   b. Paragraphs and lines of text are subordinate to article titles.
   c. Paragraphs and lines of text that are indented from the left hand margin are subordinate to the preceding text that is either not indented or indented by a lesser amount.

2. Underscoring, Bold Letters and Bold Numbers are used strictly to assist the reader in scanning for key words. No emphasis or relative importance is intended for text where underscoring, bold letters and bold numbers are used.

B. Specification Content: This Specification uses certain conventions regarding the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations or circumstances. These conventions are explained as follows:

C. Abbreviated Language: Language used in Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words that are 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.

D. Imperative and streamlined language is used generally 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 responsibilities that must be fulfilled indirectly by the Contractor, or by others when so noted.

1. The words "shall be" are implied wherever a colon (:) is used within a sentence or phrase.

1.4 INDUSTRY STANDARDS

A. Applicability of Standards: Except where 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 the standards in effect as of the date of the Contract Documents.

C. Conflicting Requirements: Where compliance with two or more standards is specified and where the standards may establish different or conflicting requirements for minimum quantities or quality levels, refer requirements that are different but apparently equal and other uncertainties to the Architect for a decision before proceeding.

D. 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 the requirements. Refer uncertainties to the Architect for a decision before proceeding.

E. Copies of Standards: Each entity engaged in construction on the Project is required to 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, the Contractor shall obtain copies directly from the publication source.
2. The Architect reserves the right to require the Contractor to submit copies of standards as necessary for enforcement of requirements.

F. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. Where such acronyms or abbreviations are used in the Specifications or other Contract Documents, they mean the recognized name of the trade association, standards-generating organization, authority having jurisdiction, or other entity applicable to the context of the Text provision. Refer to the "Encyclopedia of Associations," published by Gale Research Co., available in most libraries.

G. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. The following acronyms or abbreviations, as referenced in Contract Documents, are defined to mean the associated names. Names and addresses are subject to change and are believed, but not ensured, to be accurate and up to date as of the date of Contract Documents.

AA	Aluminum Association 900 19th St., NW, Suite 300 Washington, DC 20006	www.aluminum.org (202) 862-5100
AABC	Associated Air Balance Council 1518 K St., NW Washington, DC 20005	www.aabchq.com (202) 737-0202
AAMA	American Architectural Manufacturers Assoc. 1540 E. Dundee Road, Suite 310 Palatine, IL 60067	www.aamanet.org (847) 303-5664

AAN	American Association of Nurserymen 1250 I St., NW, Suite 500 Washington, DC 20005	(see ANLA) (202) 789-2900
AASHTO	American Association of State Highway and Transportation Officials 444 North Capitol St., Suite 249 Washington, DC 20001	www.aashto.org (202) 624-5800
AATCC	American Association of Textile Chemists and Colorists P.O. Box 12215 One Davis Dr. Research Triangle Park, NC 27709-2215	www.aatcc.org (919) 549-8141
ABMA	American Bearing Manufacturers Assoc. 1200 19th St., Suite 300 Washington, DC 20036	www.abma-dc.org (202) 367-1155
ABMA	American Boiler Manufacturers Association 950 North Glebe Rd., Suite 160 Arlington, VA 22203	www.abma.com (703) 522-7350
ACI	American Concrete Institute P.O. Box 19150 Detroit, MI 48219	www.aci-int.org (248) 848-3700
ACIL	American Council of Independent Laboratories 1629 K St., NW Washington, DC 20006	www.acil.org (202) 887-5872
ACPA	American Concrete Pipe Association 8618 Westwood Center Dr., Suite 105 Vienna, VA 22182	www.concrete-pipe.org (972) 506-7216
ADC	Air Diffusion Council 11 South LaSalle St., Suite 1400 Chicago, IL 60603	www.flexibleduct.org (312) 201-0101
AFBMA	Anti-Friction Bearing Manufacturers Assoc. (Now ABMA)	
AFPA	American Forest and Paper Association 1111 19th St., NW, Suite 800 Washington, DC 20036	(See AF&PA) (202) 463-2700
AF&PA	American Forest & Paper Association	www.afandpa.org
AGA	American Gas Assoc. 1515 Wilson Blvd. Arlington, VA 22209	www.aga.org (202) 824-7000

AGC	Associated General Contractors of America	www.agc.org (703) 548-3118
AHA	American Hardboard Assoc. 1210 W. Northwest Highway Palatine, IL 60067	www.ahardbd.org (847) 934-8800
AHAM	Association of Home Appliance Manufacturers 20 N. Wacker Dr., Suite 1500 Chicago, IL 60606	www.aham.org (202) 872-5955
AI	Asphalt Institute Research Park Dr. P.O. Box 14052 Lexington, KY 40512-4052	www.asphaltinstitute.org (859) 288-4960
AIA	The American Institute of Architects 1735 New York Ave., NW Washington, DC 20006	www.e-architect.com (202) 626-7300
AIA	American Insurance Assoc. 1130 Connecticut Ave., NW, Suite 1000 Washington, DC 20036	www.aiadc.org (202) 828-7100
AIHA	American Industrial Hygiene Assoc. 2700 Prosperit Ave., Suite 250 Fairfax, VA 22031	www.aiha.org (703) 849-8888
AISC	American Institute of Steel Construction One East Wacker Dr., Suite 3100 Chicago, IL 60601-2001	www.aisc.org (800) 644-2400 (312) 670-2400
AISI	American Iron and Steel Institute 1101 17th St., NW Washington, DC 20036-4700	www.steel.org (202) 452-7100
AITC	American Institute of Timber Construction 7012 S. Revere Pkwy, Suite 140 Englewood, CO 80112	www.aitc-glulam.org (303) 792-9559
ALA	American Laminators Association 419 Norton Building Seattle, WA 98104-1584	(See LMA) (206) 622-0666
ALI	Associated Laboratories, Inc. c/o HOH Chemicals 500 S. Vermont St. Palatine, IL 60067	www.associatedlabs.org (800) 685-0026
ALSC	American Lumber Standards Committee P.O. Box 210 Germantown, MD 20875	www.alsc.org (301) 972-1700

AMCA	Air Movement and Control Assoc. 30 W. University Dr. Arlington Heights, IL 60004-1893	www.amca.org (847) 394-0150
ANLA	American Nursery & Landscape Association (Formerly: AAN – American Association of Nurserymen)	www.amac.org (202) 789-2900
ANSI	American National Standards Institute 11 West 42nd St., 13th Floor New York, NY 10036	www.ansi.org (202) 293-8020
AOAC	AOAC International 2200 Wilson Blvd., Suite 400 Arlington, VA 22201-3301	www.aoac.org (703) 522-3032
AOSA	Association of Official Seed Analysts 201 N. 8th St., Suite 400 P.O. Box 81152 Lincoln, NE 68501-1151	www.aosaseed.com (402) 476-3852
APA	APA-The Engineered Wood Association (Formerly American Plywood Assoc.) P.O. Box 11700 Tacoma, WA 98411	www.apawood.org (253) 565-6600
API	American Petroleum Institute 1220 L St., NW Washington, DC 20005	www.api.org (202) 682-8000
ARI	Air-Conditioning and Refrigeration Institute 4301 Fairfax Dr., Suite 425 Arlington, VA 22203	www.ari.org (703) 524-8800
ARMA	Asphalt Roofing Manufacturers Assoc. Public Information Department 1156 – 15th Street, N.W., Suite 900 Washington, DC 20005	www.asphaltroofing.org (202) 207-0917
ASA	Acoustical Society of America Suite 1NO1 2 Huntington Quadrangle Melville, NY 11747 – 4502	http://asa.aip.org (516) 576-2360
ASC	Adhesive and Sealant Council 7974 Old Georgetown Road, Suite 500 Bethesda, Maryland 20814	www.ascouncil.org (301) 986-9700
ASCA	Architectural Spray Coaters Association 895 Doncaster Drive Paulsboro, NJ 08066	www.ascassoc.com (856) 848-6120
ASCE	American Society of Civil Engineers 345 East 47th St.	www.asce.org (703) 295-6300

	New York, NY 10017-2398	(800) 548-2723
ASHE	American Society for Healthcare Engineering	www.ashe.org
	One North Franklin, 28th Floor	(312) 422-3800
	Chicago, IL 60606	(800) AHA-2626
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers	www.ashrae.org
	1791 Tullie Circle, NE	(404) 636-8400
	Atlanta, GA 30329-2305	(800) 527-4723
ASME	American Society of Mechanical Engineers International	www.asme.org
	345 East 47th St.	(800) 843-2763
	New York, NY 10017	(212) 591-7722
ASPA	American Sod Producers Assoc.	(Now TPI)
ASPE	American Society of Plumbing Engineers	www.aspe.org
	8614 Catalpa Avenue, Suite 1007	
	Chicago, IL 60656-1116	(773) 693-2773
ASSE	American Society of Sanitary Engineering	www.asse-plumbing.org
	P.O. Box 40362	
	Bay Village, OH 44140	(440) 835-3040
ASTM	American Society for Testing and Materials	www.astm.org
	100 Barr Harbor Dr.	
	West Conshohocken, PA 19428	(610) 832-9585
	ATIS Alliance for Telecommunications Industry Solutions	www.atis.org
	1200 G St., NW, Suite 500	
	Washington, DC 20005	(202) 628-6380
AWCMA	American Window Covering Manufacturers Assoc.	(Now WCMA)
AWI	Architectural Woodwork Institute	www.awinet.org
	P.O. Box 1550	
	13924 Braddock Rd., No. 100	(800) 449-8811
	Centerville, VA 22020	(703) 733-0600
AWPA	American Wood Preservers' Assoc.	www.awpa.com
	P.O. Box 286	
	Woodstock, MD 21163-0286	(817) 326-6300
AWPB	American Wood Preservers' Bureau (This organization is now defunct.)	
AWS	American Welding Society	www.aws.org
	550 LeJeune Rd., NW	(800) 443-9353
	Miami, FL 33126	(305) 443-9353

AWWA	American Water Works Assoc. 6666 W. Quincy Ave. Denver, CO 80235	www.awwa.org (800) 926-7337 (303) 794-7711
BANC	Brick Association of North Carolina P.O. Box 13290 Greensboro, NC 27415-3290	 (910) 273-5566
BHMA	Builders Hardware Manufacturers Assoc. 355 Lexington Ave., 17th Floor New York, NY 10017-6603	www.buildershardware.com (212) 297-2122
BIA	Brick Institute of America 11490 Commerce Park Dr. Reston, VA 22091-1525	www.bia.org (703) 620-0010
BIFMA	The Business and Institutional Furniture Manufacturer's Association International 2680 Horizon Dr., SE, Suite A1 Grand Rapids, MI 49546-7500	www.bifma.com (616) 285-3963
CAGI	Compressed Air and Gas Institute c/o Thomas Associates, Inc. 1300 Sumner Ave. Cleveland, OH 44115-2851	www.cagi.org (216) 241-7333
CAUS	Color Association of the United States 315 West 39th Street, Studio 507 New York, NY 10018	www.colorassociation.com (212) 947-7774
CBM	Certified Ballast Manufacturers Assoc. 1422 Euclid Ave., Suite 402 Cleveland, OH 44115-2851	 (216) 241-0711
CCC	Carpet Cushion Council P.O. Box 546 Riverside, CT 06878	www.carpetcushion.org (203) 637-1312
CCFSS	Center for Cold-formed Steel Structures	www.umr.edu/~ccfss (573) 341-4471
CDA	Copper Development Association Inc. 260 Madison Av., 16th Floor New York, NY 10016	www.copper.org (212) 251-7200 (800) 232-3282
CFFA	Chemical Fabrics & Film Association, Inc. c/o Thomas Associates, Inc. 1300 Sumner Ave. Cleveland, OH 44115-2851	www.chemicalfabricsandfilm.com (216) 241-7333
CGA	Compressed Gas Assoc. 1725 Jefferson Davis Highway, Suite 1004 Arlington, VA 22202-4100	www.cganet.com (703) 412-0900

CGSB	Canadian General Standards Board	www.pwgsc.gc.ca/cgsb (819) 956-0425
CIMA	Cellulose Insulation Manufacturers Association	www.cellulose.org (888) 881-2462
CISCA	Ceiling and Interior Systems Construction Assoc. 579 W. North Ave., Suite 301 Elmhurst, IL 60126	www.cisca.org (630) 584-1919
CISPI	Cast Iron Soil Pipe Institute 5959 Shallowford Rd., Suite 419 Chattanooga, TN 37421	www.cispi.org (423) 892-0137
CLFMI	Chain Link Fence Manufacturers Institute 1776 Massachusetts Ave., NW, Suite 500 Washington, DC 20036	www.chainlinkinfo.org (301) 569-2583
CPA	Composite Panel Association (Formerly: National Particleboard Association)	www.pbmdf.com (301) 670-0604
CPPA	Corrugated Polyethylene Pipe Association	www.cppa-info.org (800) 510-2772
CRI	Carpet and Rug Institute P.O. Box 2048 Dalton, GA 30722-2048	www.carpet-rug.com (800) 882-8846 (706) 278-3176
CRSI	Concrete Reinforcing Steel Institute 933 N. Plum Grove Rd. Schaumburg, IL 60173-4758	www.crsi.org (847) 517-1200
CSA	CSA International (Formerly: IAS – International Approval Services)	www.csa-international.org (416) 747-4000
CSI	Construction Specifications Institute	www.csinet.org (800) 689-2900
CTI	Cooling Technology Institute (Formerly: Cooling Tower Institute)	www.cti.org (281) 583-4087
CTIOA	Ceramic Tile Institute of America 12061 West Jefferson Blvd. Culver City, CA 90230 – 6219	www.ctia.org (310) 574-7800
DHI	Door and Hardware Institute 14170 Newbrook Dr. Chantilly, VA 22021-2223	www.dhi.org (703) 222-2010
DIPRA	Ductile Iron Pipe Research Assoc. 245 Riverchase Parkway East, Suite O Birmingham, AL 35244	www.dipra.com (205) 402-8700
DLPA	Decorative Laminate Products Assoc.	

	13924 Braddock Rd. Centreville, VA 22020	(800) 684-3572
ECSA	Exchange Carriers Standards Assoc. (Now ATIS)	
EIA/TIA	Electronic Industries Alliance/Telecommunications Industry 2001 Pennsylvania Ave., NW Washington, DC 20006-1813	www.eia.org (703) 907-7500
EIMA	EIFS Industry Manufacturers Assoc. 2759 State Road 580, Suite 112 Clearwater, FL 34621	www.eifsfacts.com (800) 294-3462 (770) 968-7945
EJMA	Expansion Joint Manufacturers Assoc. 25 N. Broadway Tarrytown, NY 10591	www.ejma.org (914) 332-0040
ETL	ETL SEMKO Testing Laboratories, Inc. 420 North Dorothy Drive Richardson, Texas 75081	www.etlsemko.com (972) 238-5591
FCI	Fluid Controls Institute c/o Thomas Associates, Inc. 1300 Sumner Ave. Cleveland, OH 44115-2851	www.fluidcontrolsinstitute.org (216) 241-7333
FCICA	Floor Covering Installation Contractors Assoc. (Formerly Floor Covering Installation Board) P.O. Box 948 Dalton, GA 30722-0948	 (706) 226-5488
FGMA	Flat Glass Marketing Assoc. (Now GANA)	
FM	Factory Mutual 1151 Boston-Providence Turnpike P.O. Box 9102 Norwood, MA 02062	(See FMG) (617) 762-4300
FMG	FM Global (Formerly: FM – Factory Mutual System)	www.fmglobal.com (401) 275-3000
FTI	Facing Tile Institute P.O. Box 8880 Canton, OH 44711	 (216) 488-1211
GA	Gypsum Association 810 First St., NE, Suite 510 Washington, DC 20002	www.gypsum.org (202) 289-5440
GANA	Glass Association of North America (Formerly: FGMA – Flat glass Marketing Association)	www.glasswebsite.com/gana

	3310 SW Harrison St. Topeka, KS 66611-2279	 (785) 271-0208
GRI	Geosynthetic Research Institute	www.drexel.edu/gana (215) 895-2343
GTA	Glass Tempering Division of Glass Association of North America	(See GANA)
HEI	Heat Exchange Institute 1300 Sumner Ave. Cleveland, OH 44115-2851	www.heatexchange.org (216) 241-7333
HI	Hydraulic Institute 9 Sylvan Way Parsippany, NJ 07054-3802	www.pumps.org (888) 786-7744 (973) 267-9700
HI	Hydronics Institute P.O. Box 218 35 Russo Place Berkeley Heights, NJ 07922	www.gamanet.org (908) 464-8200
HMA	Hardwood Manufacturers Assoc. 400 Penn Center Blvd. Pittsburgh, PA 15235	www.hardwood.org (412) 829-0770
HPVA	Hardwood Plywood and Veneer Assoc. 1825 Michael Farraday Dr. P.O. Box 2789 Reston, VA 22090-0789	www.hpva.org (703) 435-2900
HPW	H.P. White Laboratory, Inc.	www.hpwhite.com (410) 838-6550
IBD	Institute of Business Designers 341 Merchandise Mart Chicago, IL 60654	 (312) 467-1950
ICEA	Insulated Cable Engineers Association, Inc. P.O. Box 440 South Yarmouth, MA 02664	www.icea.net (508) 394-4424
ICRI	International Concrete Repair Institute (The)	www.icri.org (703) 450-0116
IEC	International Electrotechnical Commission (Available from ANSI) 11 West 42nd St., 13th Floor New York, NY 10036	www.iec.ch 41-22-919-02-11 (212) 642-4900
IEEE	Institute of Electrical and Electronic Engineers 345 E. 47th St. New York, NY 10017	www.ieee.org (212) 419-7900
IESNA	Illuminating Engineering Society of North	www.iesna.org

	America 120 Wall St., Floor 17 New York, NY 10005-4001	 (212) 248-5000
IGCC	Insulating Glass Certification Council c/o ETL Testing Laboratories, Inc. P.O. Box 2040 Route 11, Industrial Park Cortland, NY 13045	www.igcc.org (315) 646-2234
ILI	Indiana Limestone Institute of America Stone City Bank Building, Suite 400 Bedford, IN 47421	www.iliai.com (812) 275-4426
IMSA	International Municipal Signal Assoc. 165 E. Union St. Newark, NY 14513 – 0539	www.imsafety.org (315) 331-2182
IRI	Industrial Risk Insurers P.O. Box 5010 85 Woodland St. Hartford, CT 06102-5010	www.industrialrisk.com (800) 243-8308 (860) 520-7300
ISA	Instrument Society of America P.O. Box 12277 67 Alexander Dr. Research Triangle Park, NC 27709	www.isa.org (919) 549-8411
ITS	Intertek Testing Services	www.itsglobal.com (800) 345-3851
KCMA	Kitchen Cabinet Manufacturers Assoc. 1899 Preston White Dr. Reston, VA 22091-4326	www.kcma.org (703) 264-1690
LGSI	Light Gage Structural Institute P.O. Box 866301 Plano, TX 75086-6301	www.loseke.com (972) 370-0967
LIA	Lead Industries Association, Inc. 295 Madison Ave. New York, NY 10017	www.leadinfo.com (212) 578-4750
LMA	Laminating Materials Association (Formerly: ALA – American Laminators Association)	www.lma.org (201) 664-2700
LPI	Lightning Protection Institute 3365 N. Arlington Heights Rd., Suite J Arlington Heights, IL 60004	www.lightning.org (847) 577-7200 (800) 488-6864
LSGA	Laminated Safety Glass Association	(See GANA)
MBMA	Metal Building Manufacturer's Assoc. c/o Thomas Associates, Inc. 1300 Sumner Ave.	www.mbma.com

	Cleveland, OH 44115-2851	(216) 241-7333
MCA	Metal Construction Association	www.metalconstruction.org (312) 201-0193
MCAA	Mechanical Contractors Association of America 1385 Piccard Dr. Rockville, MD 20850-4329	www.mcaa.org (301) 869-5800
MFMA	Maple Flooring Manufacturers Assoc. 60 Revere Dr., Suite 500 Northbrook, IL 60062	www.maplefloor.org (847) 480-9138
MFMA	Metal Framing Manufacturers Association (312) 644-6610	www.sba.com
MGPHO	Medical Gas Professional Healthcare Organization, Inc	www.mgpho.org (877) 238-5157
MHIA	Material Handling Industry of America	www.mhia.org (800) 345-1815
MIA	Marble Institute of America 30 Eden Alley, Suite 201 Columbus, OH 43215	www.marble-institute.com (614) 228-6194
MIA	Masonry Institute of America 386 Beech Avenue, Suite #4 Tarrence, CA 90501	www.masonryinstitute.org (310) 328-4400
ML/SFA	Metal Lath/Steel Framing Assoc. (A Division of the NAAMM) 11 South LaSalle St., Suite 1400 Chicago, IL 60603	(See SSMA) (312) 201-0101
MSS	Manufacturers Standardization Society of the Valve and Fittings Industry 127 Park St., NE Vienna, VA 22180-4602	www.mss-hq.com (703) 281-6613
NAA	Tree Care Industry Association (formerly National Arborist Assoc.) 3 Perimeter Road, Unit 1 Manchester, NH 03103	www.natlab.com (800) 733-2622
NAAMM	National Association of Architectural Metal Manufacturers 11 South LaSalle St., Suite 1400 Chicago, IL 60603	www.naamm.org (312) 332-0405
NAAMM	North American Association of Mirror Manufacturers	(See GANA)
NAIMA	North American Insulation Manufacturers Assoc.	www.naima.org

	44 Canal Center Plaza, Suite 310 Alexandria, VA 22314	(703) 684-0084
NAMI	National Accreditaion and Management Institute, Inc.	(304) 258-5100
NAPA	National Asphalt Pavement Assoc. NAPA Building 5100 Forbes Blvd. Lanham, MD 20706-4413	www.hotmix.com (888) HOT-MIXX
NAPF	National Association of Plastic Fabricators (Now DLPA)	
NAPM	National Association of Photographic Manufacturers	(See PIMA)
NBGQA	National Building Granite Quarries Assoc., Inc. c/o Rock of Ages 369 N. State St. Concord, NH 03301	www.nbgqa.com (800) 557-2848 (603) 225-8397
NBHA	National Builders Hardware Assoc.	(Now DHI)
NCMA	National Concrete Masonry Assoc. 2302 Horse Pen Rd. Herndon, VA 22071-3499	www.ncma.org (703) 713-1900
NCPI	National Clay Pipe Institute P.O. Box 759 253-80 Center St. Lake Geneva, WI 53147	www.ncpi.org (414) 248-9094
NCRPM	National Council on Radiation Protection and Measurements 7910 Woodmont Ave., Suite 400 Bethesda, MD 20814 - 3095	www.ncrp.com (301) 657-2652
NCSPA	National Corrugated Steel Pipe Association 13140 Coit Road, Suite 320 LB120 Dallas, Texas 75240	www.ncspa.org (972) 850-1907
NCTA	National Cable Television Association	www.ncta.com (202) 775-3669
NEBB	National Environmental Balancing Bureau	www.nebb.org (301) 977-3698
NEC	National Electrical Code (Available from NFPA)	
NECA	National Electrical Contractors Assoc. 3 Bethesda Metro Center, Suite 1100 Bethesda, MD 20814-5372	www.necanet.org (301) 657-3110
NEII	National Elevator Industry, Inc.	www.neii.org

	1677 County Road 64 P.O. Box 838 Salem, New York 12865 - 0838	 (518) 854-3100
NELMA	Northeastern Lumber Manufacturers Assoc. 272 Tuttle Rd. P.O. Box 87A Cumberland Center, ME 04021	www.nelma.org (207) 829-6901
NEMA	National Electrical Manufacturers Assoc. 2101 L St., NW, Suite 300 Washington, DC 20037	www.nema.org (703) 841-3200
NETA	International Electrical Testing Assoc. P.O. Box 687 Morrison, CO 80465-1526	www.netaworld.org (303) 697-8441
NFPA	National Fire Protection Assoc. One Batterymarch Park P.O. Box 9101 Quincy, MA 02269-9101	www.nfpa.org (617) 770-3000 (800) 344-3555
NFPA	National Forest Products Assoc.	(Now AF&PA)
NFRC	National Fenestration Rating Council	www.nfrc.org (301) 589-6372
NGA	National Glass Association	www.glass.org (703) 442-4890
NHLA	National Hardwood Lumber Assoc. P.O. Box 34518 Memphis, TN 38184-0518	www.natlhardwood.org (800) 933-0318 (901) 377-1818
NKCA	National Kitchen Cabinet Assoc.	(Now KCMA)
NLGA	National Lumber Grades Authority 103-4400 Dominion St. Burnaby, BC V5G 4G3 CANADA	www.nlga.org (604) 524-2393
NOFMA	National Oak Flooring Manufacturers Assoc. P.O. Box 3009 Memphis, TN 38173-0009	www.nofma.org (901) 526-5016
NPA	National Particleboard Assoc. 18928 Premiere Ct. Gaithersburg, MD 20879-1569	(See CPA) (301) 670-0604
NPCA	National Paint and Coatings Assoc. 1500 Rhode Island Ave., NW Washington, DC 20005	www.paint.org (202) 462-6272
NRCA	National Roofing Contractors Assoc.	www.nrca.net

	O'Hare International Center 10255 W. Higgins Rd., Suite 600 Rosemont, IL 60018-5607	 (800) 323-9545 (847) 299-9070
NRMCA	National Ready Mixed Concrete Association	www.nrmca.org (888) 846-7622
NSA	National Stone Association	www.aggregates.org (800) 342-1415
NSF	NSF International (Formerly National Sanitation Foundation) 3475 Plymouth Rd. Ann Arbor, MI 48113-0140	www.nsf.org (800) 673-6275
NSSEA	National School Supply and Equipment Assoc. Assoc. 8300 Colesville Rd., Stc. 250 Silver Spring, MD 20910	(734) 769-8010 (301) 495-0240
NTMA	National Terrazzo and Mosaic Assoc. 3166 Des Plaines Ave., Suite 132 Des Plaines, IL 60018	www.ntma.com (800) 323-9736
NWMA	National Woodwork Manufacturers Assoc.	(Now NWWDA) (703) 779-1022
NWWDA	National Wood Window and Door Assoc. 1400 E. Touhy Ave., #G54 Des Plaines, IL 60018	(See WCMA) (708) 299-5200 (800) 223-2301
PATMI	Power Actuated Tool Manufacturers' Institute, Inc. 1603 Boone's Lick Road St. Charles, MO 63301	www.patmi.org (636) 947-6610
PCA	Portland Cement Assoc. 5420 Old Orchard Rd. Skokie, IL 60077-1083	www.portcement.org (847) 966-6200
PCI	Precast/Prestressed Concrete Institute 175 W. Jackson Blvd. Chicago, IL 60604	www.pci.org (312) 786-0300
PDCA	Painting and Decorating Contractors of America	www.pdca.com (800) 332-7322
PDI	Plumbing and Drainage Institute c/o Sol Baker 1106 W. 77th St., South Dr. Indianapolis, IN 46260	www.pdionline.org (800) 589-8956 (508) 230-3516
PEI	Porcelain Enamel Institute 3700 Mansell Road, Suite 220	www.porcelainenamel.com

	Alpharetta, Georgia 30022	(770) 281-8980
PGI	PVC Geomembrane Institute 205 North Mathews Avenue Urbana, Illinois 61801	//pgi-tp.ce.uiuc.edu (217) 333-3929
PIMA	Photographic & Imaging Manufacturers Association (Formerly: NAPM – National association of Photographic Manufacturers)	www.pima.net (914) 698-7603
PIMA	Polyisocyanurate Insulation Manufacturers Association 515 King Street, Suite 420 Alexandria, Virginia 22314	www.pima.org (703) 684-1136
RCSC	Research Council on Structural Connections	www.boltcouncil.org (800) 644-2400
RFCI	Resilient Floor Covering Institute 401 East Jefferson Street, Suite 102 Rockville, MD 20850	www.rfci.com (301) 340-8580
RIS	Redwood Inspection Service 405 Enfrente Dr., Suite 200 Novato, CA 94949	www.calredwood.org (415) 382-0662
RMA	Rubber Manufacturers Assoc. 1400 K St., NW Washington, DC 20005	www.rma.org (800) 220-7620 (202) 682-4800
SAE	SAE International 400 Commonwealth Dr. Warrendale, PA 15096-0001	www.sae.org (724) 776-4841
SDI	Steel Deck Institute P.O. Box 9506 Canton, OH 44711	www.sdi.org (847) 462-1930
SDI	Steel Door Institute 30200 Detroit Rd. Cleveland, OH 44145-1967	www.steeldoor.org (440) 889-0010
SEFA	Scientific Equipment and Furniture Assoc. 1028 Duchess Dr. McLean, VA 22102	www.sefalabfurn.com (843) 689-6878
SGCC	Safety Glazing Certification Council c/o ETL Testing Laboratories U.S. Route 11, Industrial Park Cortland, NY 13045	www.sgcc.org (315) 646-2234
SHLMA	Southern Hardwood Lumber Manufacturers Assoc. (Now HMA)	

SIGMA	Sealed Insulating Glass Manufacturers Assoc. 401 N. Michigan Ave. Chicago, IL 60611	www.sigmaonline.org/aigma (312) 644-6610
SJI	Steel Joist Institute 1205 48th Avenue North, Suite A Myrtle Beach, SC 29577-5424	www.steeljoist.org (803) 449-0487
SMA	Screen Manufacturers Assoc. 2850 South Ocean Boulevard, #114 Palm Beach, Florida 33480 - 6205	www.smacentral.org (561) 533-0991
SMACNA	Sheet Metal and Air Conditioning Contractors' National Assoc. 4201 Lafayette Center Dr. Chantilly, VA 22022-1230	www.smacna.org (703) 803-2980
SPFA	Spray Polyurethane Foam Alliance	www.sprayfoam.org (800) 523-6154
SPI	The Society of the Plastics Industry	www.plasticsindustry.org ((202) 974-5200
SPIB	Southern Pine Inspection Bureau 4709 Scenic Highway Pensacola, FL 32504-9094	www.spib.org (850) 434-2611
SPRI	SPRI (Formerly Single Ply Roofing Institute) 175 Highland Ave. Needham, MA 02194	www.spri.org (781) 444-0242
SSIUS	Specialty Steel Industry of North America 3050 K St., NW Washington, DC 20007	www.ssina.com (800) 982-0355 (202) 342-8630
SSMA	Steel Stud Manufacturers Association (Formerly: ML/SFA – Metal Lath/Steel Framing Association)	www.ssma.com (312) 456-5590
SSPC	SSCP: The Society for Protective Coatings	www.sspc.org (800) 837-8303
SSPC	Steel Structures Painting Council (The Society for Protective Coatings) 40 24th Street, 6th Floor Pittsburgh, PA 15222 - 4656	www.sspc.org (412) 281-2331
SSPMA	Sump and Sewage Pump Manufacturers Assoc. P.O. Box 647 Northbrook, IL 60065-0647	www.sspma.org (708) 559-9233
STI	Steel Tank Institute 570 Oakwood Rd. Lake Zurich, IL 60047	www.steeltank.com (847) 438-8265

SWI	Steel Window Institute c/o Thomas Associates, Inc. 1300 Sumner Ave. Cleveland, OH 44115-2851	www.steelwindows.com (216) 241-7333
SWPA	Submersible Wastewater Pump Assoc. 1866 Sheridan Road, Suite 201 Highland Park, IL 60035-2545	www.swpa.org (847) 681-1868
SWRI	Sealant, Waterproofing, and Restoration Institute	www.swrionline.org (816)472-7974
TCA	Tile Council of America 511 Westinghouse Rd. Pendleton, SC 29670 P.O. Box 1787 Clemson, SC 29633	www.tileusa.com (864) 646-8453
TIA/EIA	Telecommunications Industry Association/ Electronic Industries Alliance	www.tiaonline.org (703) 907-7700
TIMA	Thermal Insulation Manufacturers Assoc. (Now NAIMA)	
TPI	Truss Plate Institute 583 D'Onofrio Dr., Suite 200 Madison, WI 53719	www.tpinst.org (608) 833-5900
TPI	Turfgrass Producers International (Formerly American Sod Producers Assoc.) 1855-A Hicks Rd. Rolling Meadows, IL 60008	www.turfgrasssod.org (847) 705-9898 (800) 405-8873
UFAC	Upholstered Furniture Action Council	www.ufac.org (336) 885-5065
UL	Underwriters Laboratories 333 Pfingsten Rd. Northbrook, IL 60062-2096	www.ul.com (800) 704-4050 (847) 272-8800
UNI	Uni-Bel PVC Pipe Assoc. 2655 Villa Creek Dr., Suite 155 Dallas, TX 75234	www.uni-bell.org (972) 243-3902
USITT	United States Institute for Theatre Technology, Inc.	www.culturenet.ca/usitt (800) 938-7488
USP	U.S. Pharmacopeia (Formerly U.S. Pharmacopoeial Convention) 12601 Twinbrook Pkwy Rockville, MD 20852	www.usp.org (800) 822-8772 (301) 881-0666
WA	Wallcoverings Assoc. 401 N. Michigan Ave.	www.wallcoverings.org

	Chicago, IL 60611-4267	(312) 644-6618
WASTEC	Waste Equipment Technology Association	www.wastec.org (800) 424-2869
WCLIB	West Coast Lumber Inspection Bureau P.O. Box 23145 Portland, OR 97281	www.wclib.org (800) 283-1486 (503) 639-0651
WCMA	Wood Components Manufacturer's Association 1000 Johnson Ferry Road, Suite A-130 Marrietta, Georgia 30068	www.woodcomponents.org (770) 565-6660
WCMA	Window Covering Manufacturers Assoc. 355 Lexington Ave., 17th Floor New York, NY 10017	www.windowcoverings.org (800) 506-4653 (212) 661-4261
WIC	Woodwork Institute of California 3164 Industrial Blvd. P.O. Box 980247 West Sacramento, CA 95798-0247	www.wicnet.org (916) 372-9943
WMMPA	Wood Molding & Millwork Producers Assoc. P.O. Box 25278 Portland, OR 97225	www.wmmpa.com (800)550-7889 (530) 661-9591
WRI	Wire Reinforcement Institute 942 Main Street, Suite 300 Hartford, CT 06103	www.wirereinforcementinstitute.org (800) 552-4974
WSC	Water Systems Council 1101 30th Street N.W., Suite 500 Washington, D.C. 20007	www.watersystemscouncil.org (202) 625-4387
WSFI	Wood and Synthetic Flooring Institute (Now MFMA)	
WWCCA	Western Wall and Ceiling Contractors' Assoc. (Formerly Western Lath, Plaster, Drywall Industries Assoc.) 2286 North State College Boulevard Fullerton, CA 92831	www.wwcca.org (800) 903-WALL
WWPA	Western Wood Products Assoc. Yeon Building 522 SW 5th Ave. Portland, OR 97204-2122	www.wwpa.org (503) 224-3930
WWPA	Woven Wire Products Assoc. 1641 East Higgins Lake Drive Roscommon, MI 48653	www.wovenwire.org (517) 821-6621

H. Federal Government Agencies: Names and titles of Federal Government standards- or specification-producing agencies are often abbreviated. The following abbreviations and acronyms referenced in the Contract Documents indicate names of standards- or specification-producing agencies of the Federal Government. Names and addresses are subject to change

and are believed, but are not assured, to be accurate and up-to-date as of the date of the Contract Documents.

CE	Corps of Engineers (U.S. Department of the Army) Chief of Engineers General Information Referral 20 Massachusetts Ave., NW Washington, DC 20314	www.usace.army.mil (202) 761-0660
CFR	Code of Federal Regulations (Available from the Government Printing Office) 732 N. Capitol St., NW Washington, DC 20401 (Material is usually published first in the "Federal Register.")	www.gpoaccess.gov (202) 512-0000
CPSC	Consumer Product Safety Commission East West Towers 4330 East-West Hwy Bethesda, MD 20814	www.cpsc.gov (800) 638-2772
CS	Commercial Standard (U.S. Department of Commerce) Government Printing Office Washington, DC 20402	www.commerce.gov (202) 512-0000
DOC	Department of Commerce 14th St. and Constitution Ave., NW Washington, DC 20230	www.doc.gov (202) 482-2000
DOT	Department of Transportation 400 Seventh St., SW Washington, DC 20590	www.dot.gov (202) 366-4000
EPA	Environmental Protection Agency 401 M St., SW Washington, DC 20460	www.epa.gov (202) 260-2090
FAA	Federal Aviation Administration (U.S. Department of Transportation) 800 Independence Ave., SW Washington, DC 20591	www.faa.gov (202) 366-4000
FCC	Federal Communications Commission 1919 M St., NW Washington, DC 20554	www.fcc.gov (202) 418-0190
FDA	Food and Drug Administration 5600 Fishers Lane Rockville, MD 20857 (888) 463-6332	www.fda.gov
FHA	Federal Housing Administration (U.S. Department of Housing and Urban	www.hud.gov

	Development) 451 Seventh St., SW Washington, DC 20410	 (202) 708-1112
FS	Federal Specification Unit (Available from GSA) 470 East L'Enfant Plaza, SW, Suite 8100 Washington, DC 20407	 (202) 755-0325
GSA	General Services Administration F St. and 18th St., NW Washington, DC 20405	www.gsa.gov (202) 708-5082
HUD	Department of Housing and Urban Development	www.hud.gov (202) 708-1112
LBNL	Lawrence Berkeley National Laboratory	www.lbl.gov (510) 486-5605
MIL	Military Standardization Documents (U.S. Department of Defense) Defense Printing Service 700 Robbins Ave., Building 4D Philadelphia, PA 19111	 (215) 697-2179
NIST	National Institute of Standards and Technology (U.S. Department of Commerce) Building 101, #A1134 Rte. I-270 and Quince Orchard Rd. Gaithersburg, MD 20899	www.nist.gov (301) 975-6478
OSHA	Occupational Safety and Health Administration (U.S. Department of Labor) 200 Constitution Ave., NW Washington, DC 20210	www.osha.gov (202) 693-1999
PS	Product Standard of NBS (U.S. Department of Commerce) Government Printing Office Washington, DC 20402	www.commerce.gov (202) 512-0000
RUS	Rural Utilities Service (See USDA) (Formerly Rural Electrification Administration) (U.S. Department of Agriculture) 14th St. and Independence Ave., SW Washington, DC 20250	 (202) 720-9560
TRB	Transportation Research Board	www.nas.edu/trb (202) 334-2934
USDA	U.S. Department of Agriculture 14th St. and Independence Ave., SW	www.usda.gov

	Washington, DC 20250	(202) 720-2791
USPS	U.S. Postal Service www.usps.com 475 L'Enfant Plaza, SW Washington, DC 20260-0010	(202) 268-2000

I. GOVERNING REGULATIONS/AUTHORITIES

1. The Architect has contacted authorities having jurisdiction where necessary to obtain information necessary for preparation of Contract Documents. Contact authorities having jurisdiction directly for information and decisions having a bearing on the Work.

1.5 SUBMITTALS

A. Permits, Licenses, and Certificates: For the Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, and similar documents, correspondence, and records established in conjunction with compliance with standards and regulations bearing upon performance of the Work.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 01 50 00 - TEMPORARY FACILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies requirements for temporary services and facilities, including utilities, construction and support facilities, security and protection.

B. Temporary utilities which may be required include but are not limited to:

1. Water service and distribution.
2. Temporary electric power and light.
3. Telephone service.
4. Storm and sanitary sewer.

C. Temporary construction and support facilities which may be required include but are not limited to:

1. Temporary heat.
2. Storage sheds.
3. Sanitary facilities, including drinking water.
4. Dewatering facilities and drains.
5. Temporary enclosures.
6. Hoists.
7. Temporary Project identification signs and bulletin boards.
8. Waste disposal services.
9. Rodent and pest control.
10. Construction aids and miscellaneous services and facilities.

D. Security and protection facilities which may be required include but are not limited to:

1. Temporary fire protection.
2. Barricades, warning signs, lights.
3. Sidewalk bridge or enclosure fence for the site.
4. Environmental protection.

1.3 QUALITY ASSURANCE

A. Regulations: Comply with industry standards and applicable laws and regulations if authorities having jurisdiction, including but not limited to:

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.

B. Standards: Comply with NFPA Code 241, "Building Construction and Demolition Operations", ANSI-A10 Series standards for "Safety Requirements for Construction and

Demolition", and NECA Electrical Design Library, "Temporary Electrical Facilities."

1. Refer to "Guidelines for Bid Conditions for Temporary Job Utilities and Services", prepared jointly by AGC and ASC, for industry recommendations.

C. Electrical Service: Comply with NEMA, NECA and UL standards and regulations for temporary electric service. Install service in compliance with National Electric Code (NFPA 70).

D. Inspections: For inspections and tests of temporary facilities required by authorities having jurisdiction, arrange for such inspections or tests before use. Obtain required certifications and permits.

1.4 PROJECT CONDITIONS

A. Temporary Utilities: Inform the Owner of scheduled dates for termination of each temporary utility. At the earliest feasible time, when acceptable to the Owner, change over from use of temporary service to use of the permanent service.

B. Conditions of Use: Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Take necessary fire prevention measures. Do not overload facilities, or permit them to interfere with progress. Do not allow hazardous dangerous or unsanitary conditions, or public nuisances to develop or persist on the site.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Provide new materials; if acceptable to the Architect, undamaged previously used materials in serviceable condition may be used. Provide materials suitable for the use intended.

2.2 EQUIPMENT

A. General: Provide new equipment; if acceptable to the Architect, undamaged, previously used equipment in serviceable condition may be used. Provide equipment suitable for use intended.

B. Water Hoses: Provide 3/4" heavy-duty, abrasion-resistant, flexible rubber hoses 100 ft. long, with pressure rating greater than the maximum pressure of the water distribution system; provide adjustable shut-off nozzles at hose discharge.

C. Electrical Outlets: Provide properly configured NEMA polarized outlets to prevent insertion of 110-120 volt plugs into higher voltage outlets. Provide receptacle outlets equipped with ground-fault circuit interrupters, reset button and pilot light, for connection of power tools and equipment.

D. Electrical Power Cords: Provide grounded extension cords; use "hard-service" cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords, if single lengths will not reach areas where construction activities are in progress.

E. Lamps and Light Fixtures: Provide general service incandescent lamps of wattage required for adequate illumination. Provide guard cages or tempered glass enclosures, where exposed to breakage. Provide exterior fixtures where exposed to moisture.

F. Heating Units: Provide temporary heating units that have been tested and labeled by UL, FM or another recognized trade association related to the type of fuel being consumed.

G. Temporary Offices: Provide prefabricated or mobile units with lockable entrances, operable windows and serviceable finishes. Provide heated and air-conditioned units on foundations adequate for normal loading.

H. Temporary Storage Sheds: Provide prefabricated or mobile units with lockable entrances. Provide heated units on foundations adequate for normal loading.

I. Temporary Toilet Units: Provide self-contained single-occupant toilet units of the chemical, aerated recirculation, or combustion type, properly vented and fully enclosed with a glass fiber reinforced polyester shell or similar nonabsorbent material.

J. First Aid Supplies: Comply with governing regulations.

K. Fire Extinguishers: Provide hand-carried, portable UL-rated, class "A" fire extinguishers for temporary offices and similar spaces. In other locations provide hand-carried, portable, UL-rated, class "ABC" dry chemical extinguishers, or a combination of extinguishers of NFPA recommended classes for the exposures.

1. Comply with NFPA 10 and 241 for classification, extinguishing agent and size required by location and class of fire exposure.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Use qualified personnel for installation of temporary facilities. Locate facilities where they will serve the Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required.

B. Provide each facility ready for use when needed to avoid delay. Maintain and modify as required. 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. General: Engage the appropriate local utility company to install temporary service or connect to existing service. Where the company provides only part of the service, provide the remainder with matching, compatible materials and equipment; comply with the company's recommendations.

1. Arrange with the company and existing users for a time when service can be interrupted, where necessary, to make connections for temporary services.
2. Provide adequate capacity at each stage of construction. Prior to temporary utility availability, provide trucked-in services.

B. Use Charges: Cost or use charges for temporary facilities are not chargeable to the Owner or Architect, and will not be accepted as a basis of claims for a Change Order.

C. Water Service: Install water service and distribution piping of sizes and pressures adequate for construction until permanent water service is in use.

1. Sterilization: Sterilize temporary water piping prior to use.

D. Temporary Electric Power Service: Provide weatherproof, grounded electric power service and distribution system of sufficient size, capacity, and power characteristics during construction period. Include transformers, overload protected disconnects, automatic ground-fault interrupters and main distribution switch gear.

1. Power Distribution System: Install wiring overhead, and rise vertically where least exposed to damage. Where permitted, wiring circuits not exceeding 125 Volts, AC 20 ampere rating, and lighting circuits may be nonmetallic sheathed cable where overhead and exposed for surveillance.

E. Temporary Lighting: Wherever overhead floor or roof deck has been installed, provide temporary lighting with local switching.

1. Install and operate temporary lighting that will fulfill security and protection requirements, without operating the entire system, and will provide adequate illumination for construction operations and traffic conditions.

F. Temporary Telephones: Provide temporary telephone service for use by all personnel engaged in construction activities. Where field offices are required, provide temporary telephone service consisting of a minimum of two separate telephone lines (one line dedicated for facsimile machine) in the field office for use by personnel engaged in construction activities throughout the construction period. Provide internet access for email in the field office.

G. 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 the site in a lawful manner.

1. Filter out excessive amounts of soil, construction debris, chemicals, oils and similar contaminants that might clog sewers or pollute waterways before discharge.
2. Connect temporary sewers to the municipal system as directed by the sewer department officials.
3. Maintain temporary sewers and drainage facilities in a clean, sanitary condition. Following heavy use, restore normal conditions promptly.
4. Provide earthen embankments and similar barriers in and around excavations and subgrade construction, sufficient to prevent flooding by runoff of storm water from heavy rains.

3.3 TEMPORARY CONSTRUCTION AND SUPPORT FACILITIES INSTALLATION

A. If required for completion of the Work, locate field offices, storage sheds, sanitary facilities and other temporary construction and support facilities for easy access.

1. Maintain temporary construction and support facilities until Final Completion. Remove prior to final application for payment. Where temporary construction or facilities interfere with the Owner’s use or occupation of the Work after Substantial Completion, remove, relocate, or modify temporary construction and facilities as required to permit Owner’s use and occupancy.

B. Provide incombustible construction for offices, shops and sheds located within the construction area, or within 30 feet of building lines. Comply with requirements of NFPA

241.

C. Temporary Heat: Provide temporary heat required by construction activities, for curing or drying of completed installations or protection of installed construction from adverse effects of low temperatures or high humidity. Select safe equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce the ambient condition required and minimize consumption of energy.

D. Heating Facilities: Except where use of the permanent system is authorized, provide vented self-contained LP gas or fuel oil heaters with individual space thermostatic control.

1. Use of gasoline-burning space heaters, open flame, or salamander type heating units is prohibited.

E. Field Offices: Provide insulated, weathertight temporary offices of sufficient size to accommodate required office personnel at the Project site. Keep the office clean and orderly for use for small progress meetings. Furnish and equip offices as follows:
1. Furnish with at least two desks and chairs, a 4-drawer file cabinet, plan table and plan rack, a 6-shelf bookcase, conference table and chairs, fax machine, modem with wireless internet access, and printer.
2. Provide work station for Architect’s use while on site including desk and chair. Architect may utilize phone, fax, printer, and internet for work related to this Project.

F. Storage and Fabrication Sheds: Install storage and fabrication sheds, sized, furnished and equipped to accommodate materials and equipment involved, including temporary utility service.

G. Sanitary facilities include temporary toilets, wash facilities and drinking water fixtures. Comply with regulations and health codes for the type, number, location, operation and maintenance of fixtures and facilities. Install where facilities will best service the Project's needs.

1. Provide toilet tissue, paper towels, paper cups and similar disposable materials for each facility. Provide covered waste containers for used material.
2. Toilets: Install self-contained toilet units. Shield toilets to ensure privacy. Use of pit-type privies will not be permitted.
3. Wash Facilities: Install wash facilities supplied with potable water at convenient locations for personnel involved in handling materials that require wash-up for a healthy and sanitary condition. Dispose of drainage properly. Supply cleaning compounds appropriate for each condition.

H. Drinking Water Fixtures: Provide drinking water fountains where required to for compliance with regulations and health codes, including paper supply.

I. Dewatering Facilities and Drains: For temporary drainage and dewatering facilities and operations not directly associated with construction activities included under individual Sections, comply with dewatering requirements of applicable Division-2 Sections. Where feasible, utilize the same facilities. Maintain the site, excavations and construction free of water.

J. Temporary Enclosures: Provide temporary enclosure for protection of construction in progress and completed, from exposure, foul weather, other construction operations and similar activities.

1. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.
2. Install tarpaulins securely, with incombustible wood framing and other materials. Close openings of 25 square feet or less with plywood or similar materials.
3. Close openings through floor or roof decks and horizontal surfaces with load-bearing wood-framed construction.
4. Where temporary wood or plywood enclosure exceeds 100 square feet in area, use UL-labeled fire-retardant treated material for framing and main sheathing.

K. Temporary Lifts and Hoists: Provide facilities for hoisting materials and employees. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

L. Project Identification and Temporary Signs: Display no signs without approval of the Architect. Do not permit installation of unauthorized signs.

1. Project Identification Signs: Engage an experienced sign painter to apply graphics. Comply with the following drawings.
2. Temporary Signs: Prepare signs to provide directional information to construction personnel and visitors.

M. Temporary Exterior Lighting: Install exterior yard and sign lights so that signs are visible when Work is being performed.

N. Collection and Disposal of Waste: Collect waste from construction areas and elsewhere daily. Comply with requirements of NFPA 241 for removal of combustible waste material and debris. Enforce requirements strictly. Do not hold materials more than 7 days during normal weather or 3 days when the temperature is expected to rise above 80 deg F (27 deg C). Handle hazardous, dangerous, or unsanitary waste materials separately from other waste by containerizing properly. Dispose of material in a lawful manner.

O. Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate. Cover finished permanent stairs with a protective covering of plywood or similar material so finishes will be undamaged at the time of acceptance.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Except for use of permanent fire protection as soon as available, do not change over from use of temporary security and protection facilities to permanent facilities until Substantial Completion, or longer as requested by the Architect.

B. Temporary Fire Protection: Until fire protection needs are supplied by permanent facilities, install and maintain temporary fire protection facilities of the types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 10 "Standard for Portable Fire Extinguishers," and NFPA 241 "Standard for Safeguarding Construction, Alterations and Demolition Operations."

1. Locate fire extinguishers where convenient and effective for their intended purpose, but not less than one extinguisher on each floor at or near each usable stairwell.
2. Store combustible materials in containers in fire-safe locations.
3. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire protection facilities, stairways and other access routes for fighting fires. Prohibit smoking in hazardous fire exposure areas.
4. Provide supervision of welding operations, combustion type temporary heating units, and similar sources of fire ignition.

C. Permanent Fire Protection: At the earliest feasible date in each area of the Project, complete installation of the permanent fire protection facility, including connected services, and place into operation and use. Instruct key personnel on use of facilities.

D. Barricades, Warning Signs and Lights: Comply with standards and code requirements for erection of structurally adequate barricades. Paint with appropriate colors, graphics and warning signs to inform personnel and the public of the hazard being protected against. Where appropriate and needed provide lighting, including flashing red or amber lights.

E. Enclosure Fence: When excavation begins, install an enclosure fence with lockable entrance gates. Locate where indicated, or enclose the entire site or the portion determined sufficient to accommodate construction operations. Install in a manner that will prevent people, dogs and other animals from easily entering the site, except by the entrance gates.

1. Provide open-mesh, chain-link fencing with posts set in compacted earth.

F. Security Enclosure and Lockup: Install substantial temporary enclosure of partially completed areas of construction. Provide locking entrances to prevent unauthorized entrance, vandalism, theft and similar violations of security.

G. Storage: Where materials and equipment must be stored, and are of value or attractive for theft, provide a secure lockup. Enforce discipline in connection with the installation and release of material to minimize the opportunity for theft and vandalism.

H. Environmental Protection: Provide protection, operate temporary facilities and conduct construction in ways and by methods that comply with environmental regulations, and minimize the possibility that air, waterways and subsoil might be contaminated or polluted, or that other undesirable effects might result. Avoid use of tools and equipment which produce harmful noise. Restrict use of noise making tools and equipment to hours that will minimize complaints from persons or firms near the site.

3.5 OPERATION, TERMINATION AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. Limit availability of temporary facilities to essential and intended uses to minimize waste and abuse.

B. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage by freezing temperatures and similar elements.

C. Protection: Prevent water filled piping from freezing. Maintain markers for underground lines. Protect from damage during excavation operations.

D. Termination and Removal: Remove each temporary facility when the need has ended, or when 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 the 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 the Contractor. The Owner reserves the right to take possession of Project identification signs.

2. Remove temporary paving that is not intended for or acceptable for integration into permanent paving. Where the area is intended for landscape development, remove soil and aggregate fill that does not comply with requirements for fill or subsoil in the

area. Remove materials contaminated with road oil, asphalt or other petrochemical compounds, and other substances which might impair growth of plant materials or lawns. Repair or replace street paving, curbs and sidewalks at the temporary entrances and elsewhere when used during construction, as required by the governing authority, Architect and or the Owner.

3. At Substantial Completion, clean and renovate permanent facilities that have been used during the construction period, including but not limited to:
   a. Replace air filters.
   b. Replace significantly worn parts and parts that have been subject to unusual operating conditions.
   c. Replace lamps that are burned out or noticeably dimmed by substantial hours of use.

END OF SECTION

SECTION 01 56 39

TEMPORARY TREE AND PLANT PROTECTION

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Work Included:
   1. Protecting of existing trees (Refer also to the drawings).
   2. Protecting of existing utilities.
   3. Protection fencing and planking
   4. Barricading existing trees

1.03 GENERAL PROVISIONS:

A. Trees and areas scheduled for work under this contract shall be identified in the field and indicated on plans and specifications where practical. Where this is not practical, work shall be directed in field by Owner's Representative.

B. Provision for access to the site for heavy equipment will be as directed by Owner's Representative. Equipment shall use prescribed temporary roadways and shall not be allowed in areas other than designated construction areas and designated roadways. Open areas which are altered or disturbed by equipment during the work shall be returned to pre-existing conditions at no additional cost to Owner.

C. Contractor shall protect root areas and crowns of trees from damage from construction operations and construction equipment. The Contractor shall repair such damage at no costs to Owner. Provide fences or other barricade where necessary for such protection.

D. Contractor shall modify exhaust pipes on construction equipment as needed to ensure that tree crowns are not damaged from exhaust heat from vertical exhaust pipes on top of construction crowns are not damaged from exhaust heat from vertical exhaust pipes on top of construction equipment.
   1. Equipment shall not contact tree trunks, limbs or foliage.
   2. Contractor shall be responsible for providing all tree work/repair to any damage to existing trees
   3. during the contract period. Damage to any existing trees shall be reported immediately to the
   4. Owner's Representative. Contractor shall submit to Owner's Representative a written program of
   5. corrective pruning and tree care to repair damage with name of qualified forester or arboriculturist
   6. for Owner's approval.

1.04 REFERENCE STANDARDS:

A. American National Standard for Tree Care Operations Arisi-A-300 Tree shrub and other woody plant maintenance-standard practices, 1995.

1.05 SUBMITTALS:

A. Furnish required copies of manufacturers literature, samples, certifications, or laboratory analytical data for the following items:
   1. Tree paint (manufacturer's literature)
   2. Urban forester or Arborist. (Resume with education, experience and credentials)

PART 2 - PRODUCTS

2.01 TRENCHING MACHINE

A. Shall be small non-riding track type trencher equal to Case 300.

2.02 SHARP SAND

A. ASTM C-33 for fine aggregate.

2.03 TREE PROTECTION FENCE POSTS

A. 7' long metal t-posts.

2.04 TREE PAINT

A. Thompson Tree Seal, Cabot Tree Paint or approved equal.

2.05 PRUNING TOOLS

A. Shall be of good quality and working condition, sharp, and of the approved type for arboricultural work.

2.06 WOOD FOR TREE PROTECTION PLANKING

A. Shall be construction grade Southern Yellow Pine.

B. Wood for planking: two (2") x four (4")

2.07 FENCING

A. Shall be orange plastic fencing 4' tall.

2.08 INSECTICIDE

A. Shall be "Astro Insecticide" as manufactured by FMC Corporation, Agricultural Products Group, 1735 Market Street, Philadelphia, PA 19103 (800.321.1362) or approved equal.

2.09 WATER

A. Suitable for irrigation.

PART 3 - EXECUTION

3.01 WORKMANSHIP

A. Work shall be performed by personnel trained and experienced in this work and shall be done under the direction of a qualified forester or arborist on Contractor's staff. Owner shall review and approve Contractor’s program for repair to damaged trees prior to the work being done.

B. Work shall be performed in conformance with recognized horticultural and arboricultural practices. Where job requirements require deviation from normal practice, obtain approval.

3.02 FENCES AND BARRICADES:

A. Fences and/or barricades shall be installed prior to the commencement of any site preparation work (cleaning, grubbing or grading) placed where shown on the drawings or as herein described. Tree fencing shall be maintained throughout the construction project in order to prevent the following:
   1. Soil compaction in the root zone area resulting from vehicular traffic or storage of
   2. Root zone disturbances due to grade changes (greater than 3” inches cut or fill), and /or trenching not reviewed or authorized by the Owner’s representative.
   3. Wounds to exposed roots, trunks, or limbs by mechanical equipment.
   4. Other activities detrimental to tress such as: chemical storage, cement truck wash-out and

B. In general, fences and barricades are intended to alert those working on the project that equipment and machinery are not to be stored or operated in the root zone. Where not shown, the fences shall be placed at the drip line. The exact location of fences shall be marked on site by Contractor and approved by Owner’s Representative prior to construction of barricades.

C. Posts shall be installed eight (8”) feet O.C. maximum, one and one half (1 1/2’) feet deep. Fence material pulled taut and secured with galvanized wire.

3.03 TREE PLANKING:

A. A. Where exceptions result in temporary fence being closer than four feet to a tree trunk, protect trunk with strapped-on wood planking to a vertical height of 8 feet (or to the limits of the lower branches).

B. B. Place two x fours with sides touching completely around the circumference of the tree. Secure at three points; top, middle and bottom with galvanized wire; twisted taut and stapled to wood planking.

3.04 TREE PROTECTION:

A. A. All trees to be preserved on the property shall be protected against damage during construction operations by fencing as shown; subject to the approval of the Owner’s Representative. The tree protection shall be installed prior to commencement of any site preparation work (clearing, grubbing or grading) and maintained in repair for the duration of the

construction work unless otherwise directed. No material shall be stored or construction operation shall be carried on within a distance as shown of any tree to be saved or within the tree protection fencing. Tree protection shall remain until all work is completed.

1. Place 6” of mulch to completely cover the area underneath the drip line of the trees in areas where foot traffic cannot be avoided.
2. Trees shall be watered once a week during periods of hot dry weather as directed by Owner’s representative to thoroughly saturate soil.
3. All grading within protected root zone areas shall be by hand or small equipment to prevent root damage resulting from soil compaction and rutting. Prior to grading relocate protective fencing to two feet behind grade change area.

B. Any damage done to existing tree crowns or root systems shall be repaired immediately by an approved tree surgeon at the Owner's direction. Roots exposed and/or damaged during demolition and/or grading operations shall be cut off cleanly inside the exposed or damaged area, the cut surfaces painted with an approved tree paint, and the topsoil and mulch placed over the exposed root area immediately. The Owner shall have his representative present on the site to observe these operations.

3.05 3.5 CONSTRUCTION EQUIPMENT:

A. Contractor shall modify construction equipment as necessary to ensure that exhaust systems Do not burn or scorch tree crowns or branches. Vertical exhaust pipes shall be turned 90 degrees.

B. Height of equipment and equipment operation heights shall be carefully monitored to ensure no damage to tree crowns or branching.

3.06 ADDITIONAL PROVISIONS:

A. No trash or warming fires shall be placed within twenty five (25') feet of the tree canopy.

B. No pedestrian traffic shall occur within the drip line of any tree without proper protection measures in place.

C. No soil shall be spread, under any tree within the drip line, unless otherwise designated or approved by owner’s representative.

D. Hand dig to preserve roots measuring one inch (1”) in diameter and larger, roots shall not be scuffed or damaged otherwise.

END OF SECTION

SECTION 01 57 13 – EROSION AND SEDIMENTATION CONTROL

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. THIS SECTION PERTAINS TO THE IMPLEMENTATION, MAINTENANCE INSPECTION, AND TERMINATION OF STORM WATER POLLUTION PREVENTION CONTROL MEASURES INCLUDING, BUT NOT LIMITED TO, EROSION AND SEDIMENT CONTROLS, STORM WATER MANAGEMENT PLANS, WASTE COLLECTION AND DISPOSAL, OFF-SITE VEHICLE TRACKING, AND OTHER APPROPRIATE PRACTICES SHOWN ON THE STORM WATER POLLUTION PREVENTION PLAN (SWPP PLAN), ON THE PLANS OR REQUIRED BY THE TEXAS POLLUTANT DISCHARGE ELIMINATION SYSTEM (TPDES) GENERAL PERMIT TXR150000.

B. THE CONTRACTOR IS RESPONSIBLE FOR MEETING ALL LOCAL, STATE AND FEDERAL REGULATIONS REGARDING EROSION CONTROL INCLUDING THE APPLICABLE PROVISIONS OF THE NATIONAL POLLUTION DISCHARGE ELIMINATION SYSTEM, PHASE II, REGULATIONS FROM THE CLEAN WATER ACT.

1.01 DEFINITIONS

A. COMMENCEMENT OF CONSTRUCTION ACTIVITIES: THE EXPOSURE OF SOIL RESULTING FROM ACTIVITIES SUCH AS CLEARING, GRADING, AND EXCAVATION ACTIVITIES, AS WELL AS OTHER CONSTRUCTION RELATED ACTIVITIES (E.G., STOCK PILING OF FILL MATERIAL, DEMOLITION).

B. LARGE CONSTRUCTION ACTIVITY: PROJECT THAT:
   1. DISTURBS FIVE ACRES OR MORE, OR
   2. DISTURBS LESS THAN FIVE ACRES BUT IS PART OF A LARGER COMMON PLAN OF DEVELOPMENT THAT WILL DISTURB FIVE ACRES OR MORE OF LAND.

C. SMALL CONSTRUCTION ACTIVITY: PROJECT THAT:
   1. DISTURBS ONE OR MORE ACRES BUT LESS THAN FIVE ACRES, OR
   2. DISTURBS LESS THAN ONE ACRE BUT IS PART OF A LARGER COMMON PLAN OF DEVELOPMENT THAT WILL ULTIMATELY DISTURB ONE OR MORE ACRES BUT LESS THAN FIVE ACRES.

D. TPDES OPERATOR:
   1. OPERATOR - THE PERSON OR PERSONS ASSOCIATED WITH A LARGE OR SMALL CONSTRUCTION ACTIVITY THAT IS EITHER A PRIMARY OR SECONDARY AS DEFINED BELOW:
      a. PRIMARY OPERATOR – THE PERSON OR PERSONS ASSOCIATED WITH A LARGE OR SMALL CONSTRUCTION ACTIVITY THAT MEETS EITHER OF THE FOLLOWING TWO CRITERIA:
         i. THE PERSONS HAVE OPERATIONAL CONTROL OVER CONSTRUCTION PLANS AND SPECIFICATIONS, INCLUDING THE ABILITY TO MAKE MODIFICATIONS TO THOSE PLANS AND SPECIFICATIONS; OR
         ii. THE PERSON OR PERSONS HAVE DAY-TO-DAY OPERATIONAL CONTROL OF THOSE ACTIVITIES AT A CONSTRUCTION SITE THAT ARE NECESSARY TO ENSURE COMPLIANCE WITH A STORM WATER

POLLUTION PREVENTION PLAN (SWPP PLAN) FOR THE SITE OR OTHER PERMIT CONDITIONS (E.G., THEY ARE AUTHORIZED TO DIRECT WORKERS AT A SITE TO CARRY OUT ACTIVITIES REQUIRED BY THE SWPP PLAN OR COMPLY WITH OTHER PERMIT CONDITIONS).

b. SECONDARY OPERATOR – THE PERSON WHOSE OPERATIONAL CONTROL IS LIMITED TO THE EMPLOYMENT OF OTHER OPERATORS OR TO THE ABILITY TO APPROVE OR DISAPPROVE CHANGES TO PLANS AND SPECIFICATIONS. A SECONDARY OPERATOR IS ALSO DEFINED AS A PRIMARY OPERATOR IF THERE ARE NO OTHER OPERATORS AT THE CONSTRUCTION SITE.

E. BEST MANAGEMENT PRACTICES (BMP'S): PHYSICAL FACILITIES SCHEDULES OF ACTIVITIES, PROHIBITION OF PRACTICES, MAINTENANCE PROCEDURES, AND OTHER MANAGEMENT PRACTICES, WHEN PROPERLY DESIGNED, INSTALLED, AND MAINTAINED, WILL BE EFFECTIVE TO PREVENT OR REDUCE THE DISCHARGE OF POLLUTION ASSOCIATED WITH CONSTRUCTION ACTIVITIES. BMP'S ALSO INCLUDE TREATMENT REQUIREMENTS, OPERATING PROCEDURES, AND PRACTICES TO CONTROL SITE RUNOFF, SPILLAGE OR LEAKS, SLUDGE OR WASTE DISPOSAL, OR DRAINAGE FROM RAW MATERIAL STORAGE.

F. BLOCK SODDING: SODDING FOR EROSION CONTROL AND FOR FINAL STABILIZATION SHALL CONSIST OF PROVIDING AND PLANTING BERMUDA GRASS, SAN AUGUSTINE GRASS, OR OTHER ACCEPTABLE SOD ALONG OR ACROSS SUCH AREAS AS ARE DESIGNATED ON THE DRAWINGS AND IN ACCORDANCE WITH THE SPECIFICATION REQUIREMENTS HEREIN OUTLINED.

G. HYDROMULCH SEEDING: SEEDING, FOLLOWED BY THE APPLICATION OF A MULCH EROSION CONTROL BLANKET SHALL CONSIST OF PREPARING THE GROUND, SOWING OF SEEDS, APPLICATION OF A FERTILIZER, AND STABILIZATION WITH MULCH CONSISTING OF A BIODEGRADABLE FIBER ALONG AND ACROSS SUCH AREAS AS ARE DESIGNATED ON THE PLANS AND IN ACCORDANCE WITH THESE SPECIFICATIONS

H. SILT FENCE: THE REINFORCED FILTER FABRIC BARRIER CONSISTS OF GEOTEXTILE FABRIC SUPPORTED BY A NET REINFORCED FENCE STRETCHED ACROSS AND ATTACHED TO SUPPORTING POSTS OR FRAME AND ENTRENCHED. WORK SHALL BE PERFORMED DURING CONSTRUCTION OPERATIONS AND PRIOR TO FINAL STABILIZATION TO CONTROL EROSION AND SEDIMENTATION AS DESIGNATED ON THE PLANS AND IN ACCORDANCE WITH THESE SPECIFICATIONS.

I. INLET PROTECTION BARRIERS: THE INLET PROTECTION BARRIER CONSISTS OF A GEOTEXTILE FABRIC (FILTER FABRIC) SUPPORTED BY A NET REINFORCED FENCE STRUCTURE AND CONSTRUCTED AROUND A STORM DRAIN INLET, CATCH BASIN, OR CULVERT. AN ALTERNATIVE DESIGN OF THE INLET PROTECTION BARRIER, AS APPROVED BY THE ENGINEER, CONSISTS OF FIBER ROLLS PLACED AROUND A FRAME, STAKED IN PLACE (OR WEIGHTED DOWN WITH CLEAN GRAVEL BAGS), AND CONSTRUCTED AROUND A STORM DRAIN INLET, CATCH BASIN OR CULVERT. THIS WORK SHALL BE PERFORMED DURING CONSTRUCTION OPERATIONS AND PRIOR TO FINAL STABILIZATION TO CONTROL EROSION AND SEDIMENTATION. AS DESIGNATED ON THE PLANS AND IN ACCORDANCE WITH THESE SPECIFICATIONS.

J. SEDIMENT BASINS: A SEDIMENT BASIN IS A TEMPORARY BASIN OR DAM CONSTRUCTED ACROSS A WATERWAY OR EXCAVATED LOCATION TO INTERCEPT SEDIMENT-LADEN RUNOFF AND TO TRAP AND RETAIN THE SEDIMENT. A SEDIMENT BASIN IS USUALLY INSTALLED AT POINTS OF DISCHARGE FROM DRAINAGE AREAS GREATER THAN 5 ACRES. WORK SHALL BE PERFORMED DURING CONSTRUCTION OPERATIONS AND PRIOR TO FINAL STABILIZATION TO CONTROL EROSION AND

SEDIMENTATION AS DESIGNATED ON THE PLANS AND IN ACCORDANCE WITH THESE SPECIFICATIONS.

K. STABILIZED CONSTRUCTION ACCESS: THIS WORK SHALL CONSIST OF THE INSTALLATION OF TEMPORARY EROSION PROTECTION AND SEDIMENT CONTROL STABILIZED CONSTRUCTION ACCESS - TYPE I, ROCK, UTILIZED DURING CONSTRUCTION OPERATIONS AND PRIOR TO FINAL STABILIZATION, IN ACCORDANCE WITH THESE SPECIFICATIONS AND CONSTRUCTION DRAWINGS.

L. ROCK FILTER DAMS: ROCK FILTER DAMS ARE TEMPORARY BERMS CONSTRUCTED OF STONE TO INTERCEPT AND SLOW STORM WATER RUNOFF TO RETAIN SEDIMENT ON THE CONSTRUCTION SITE.

1. DEPENDING UPON THE TYPE OF ROCK FILTER DAM SPECIFIED IN THE CONSTRUCTION PLANS AS TYPE 1, 2, 3, OR 4, THE AGGREGATE FILL MAY BE UNWRAPPED, WRAPPED IN TWISTED HEXAGONAL WIRE MESH, OR CONFINED IN A GABION WIRE BASKET. APPLICATIONS OF ROCK FILTER DAMS ARE AS FOLLOWS:
   a. TYPE 1 DAMS MAY BE USED AT TOE OF SLOPES, AROUND INLETS, IN SMALL DITCHES, AND AT DIKE OR SWALE OUTLETS. TYPE 1 DAMS ARE RECOMMENDED FOR EROSION AND SEDIMENT CONTROL FROM A DRAINAGE AREA OF 5 ACRES OR LESS.
   b. TYPE 2 DAMS MAY BE USED IN DITCHES AND AT DIKE OR SWALE OUTLETS.
   c. TYPE 3 DAMS MAY BE USED IN STREAM FLOW.
   d. TYPE 4 SACK GABIONS MAY BE USED IN DITCHES AND SMALLER CHANNELS TO FORM AN EROSION AND SEDIMENT CONTROL DAM

1.02 REGULATORY REQUIREMENTS

A. CONTRACTOR SHALL COMPLY WITH ALL CURRENT, APPLICABLE CODES AND REGULATIONS.

B. CONTRACTOR SHALL COMPLY WITH ALL STANDARD SPECIFICATIONS AND DETAILS OF AUTHORITIES HAVING JURISDICTION FOR WORK IN THE RIGHT-OF-WAY OR EASEMENTS.

C. PRIOR TO COMMENCEMENT OF WORK, THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING, AT THE CONTRACTORS OWN EXPENSE, ALL CONSTRUCTION PERMITS NECESSARY TO COMPLETE THE PROJECT ACCORDING TO THE PLANS AND SPECIFICATIONS.

1.03 SUBMITTALS

A. SUBMIT A COPY OF THE STORM WATER POLLUTION PREVENTION PLAN (SWPP PLAN).

B. SUBMIT A COPY OF THE NOTICE OF INTENT (NOI).

C. SUBMIT A COPY OF THE NOTICE OF TERMINATION (NOT).

D. SUBMIT MANUFACTURER'S LITERATURE FOR PRODUCT SPECIFICATIONS AND INSTALLATION INSTRUCTIONS.

E. SUBMIT MANUFACTURER’S CATALOG SHEETS AND OTHER PRODUCT DATA ON GEOTEXTILE OR FILTER FABRICS, OUTLET PIPE, PERFORATED RISER AND CONNECTORS.

F. SUBMIT PROPOSED METHODS, EQUIPMENT, MATERIALS, AND SEQUENCE OF OPERATIONS FOR STORM-WATER POLLUTION PREVENTION STRUCTURES.

G. SUBMIT SHOP DRAWINGS FOR INLET BASKETS.

1.04 QUALITY ASSURANCE

A. CODES AND STANDARDS: PERFORM EARTHWORK COMPLYING WITH REQUIREMENTS OF AUTHORITIES HAVING JURISDICTION.

PART 2 – PRODUCTS

2.01 SUSTAINABLE MATERIALS

A. CONTRACTOR SHALL STRIVE TO UTILIZE SUSTAINABLE MATERIALS, WHICH INCLUDE RAPIDLY RENEWABLE MATERIALS, REGIONAL MATERIALS, REGIONALLY MANUFACTURED MATERIALS, REGIONALLY EXTRACTED MATERIALS, RECYCLED CONTENTS.

2.02 GRASS

A. MATERIALS FOR EROSION CONTROL SEEDING SHALL CONFORM TO THE REQUIREMENTS OF 32 92 13 – HYDROMULCH SEEDING.

B. MATERIALS FOR EROSION CONTROL SEEDING SHALL CONFORM TO THE REQUIREMENTS OF 32 92 00 – TURF AND GRASSES.

2.03 BANK SAND BACKFILL

A. DURABLE BANK RUN SAND CLASSIFIED AS SP, SW, OR SM BY UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487) MEETING FOLLOWING REQUIREMENTS:

1. LESS THAN 15 PERCENT PASSING NUMBER 200 SIEVE WHEN TESTED IN ACCORDANCE WITH ASTM D 1140. AMOUNT OF CLAY LUMPS OR BALLS MAY NOT EXCEED 2 PERCENT.
2. MATERIAL PASSING NUMBER 40 SIEVE SHALL MEET THE FOLLOWING REQUIREMENTS WHEN TESTED IN ACCORDANCE WITH ASTM D 4318: PI NOT EXCEEDING 7.

2.04 WATER

A. WATER USED FOR MIXING OR CURING SHALL BE REASONABLY CLEAN AND FREE OF OIL, SALT, ACID, ALKALI, SUGAR, VEGETABLE MATTER OR OTHER SUBSTANCES INJURIOUS TO THE FINISHED PRODUCT.

B. WATER SOURCES OTHER THAN THE LOCAL MUNICIPAL DOMESTIC WATER SUPPLY MUST BE APPROVED BY THE OWNER'S REPRESENTATIVE.

C. IF ONSITE RECLAIMED WATER SOURCES ARE USED, TANKS AND APPURTENANCES MUST BE CLEARLY MARKED WITH THE WORDS "NON-POTABLE" WATER.

2.05 STABILIZED CONSTRUCTION ACCESS

A. PROVIDE CRUSHED AGGREGATE FOR LONG- AND SHORT-TERM CONSTRUCTION EXITS. FURNISH AGGREGATES THAT ARE CLEAN, HARD, DURABLE, AND FREE FROM ADHERENT COATINGS SUCH AS SALT, ALKALI, DIRT, CLAY, LOAM, SHALE, SOFT OR FLAKY MATERIALS, AND ORGANIC AND INJURIOUS MATTER. USE 4 TO 8-INCHES AGGREGATE FOR TYPE 1. USE 2 TO 4-INCHES AGGREGATE FOR TYPE 3.

2.06 SILT FENCE

A. WOVEN OR NONWOVEN GEOTEXTILE FILTER FABRIC MADE OF POLYPROPYLENE, POLYETHYLENE, ETHYLENE, OR POLYAMIDE MATERIAL, IN CONTINUOUS ROLLS OF LONGEST PRACTICAL LENGTH.

B. GRAB STRENGTH: 100 PSI IN ANY PRINCIPAL DIRECTION (ASTM D-4632), CBR PUNCTURE STRENGTH >200 PSI (ASTM D-3786), AND EQUIVALENT OPENING SIZE BETWEEN 50 AND 140.

C. FURNISH ULTRAVIOLET INHIBITORS AND STABILIZERS FOR MINIMUM 6 MONTHS OF EXPECTED USABLE CONSTRUCTION LIFE AT TEMPERATURE RANGE OF 0 DEGREES F TO 120 DEGREES F.

D. PROVIDE NET REINFORCEMENT OF AT LEAST 12.5 GAUGE (SWG) GALVANIZED WELDED WIRE MESH, WITH A MAXIMUM OPENING SIZE OF 2 × 4 IN., AT LEAST 24 IN. WIDE, UNLESS OTHERWISE SHOWN ON THE PLANS.

E. TENCATE GEOSYNTHETICS, CONTECH ENGINEERED SOLUTIONS, OR EQUIVALENT.

2.07 INLET PROTECTION BARRIERS

A. GEOTEXTILE SHALL BE PER THE REQUIREMENTS OF PARAGRAPH 2.6 OF THIS SECTION.

B. PROVIDE NET REINFORCEMENT OF AT LEAST 12.5 GAUGE (SWG) GALVANIZED WELDED WIRE MESH, WITH A MAXIMUM OPENING SIZE OF 2 × 4 IN., AT LEAST 24 IN. WIDE, UNLESS OTHERWISE SHOWN ON THE PLANS.

C. BARRIER STAKES: NOMINAL 2 BY 2 INCH MOISTURE-RESISTANT TREATED WOOD OR STEEL POSTS (MIN. OF 1.25 LBS. PER LINEAR FOOT AND BRINELL HARDNESS GREATER THAN 140) WITH SAFETY CAPS ON TOP; LENGTH AS REQUIRED FOR MINIMUM 12 INCH BURY AND FULL HEIGHT OF FILTER FABRIC.

2.08 DROP INLET BASKET

A. PROVIDE STEEL FRAME MEMBERS IN ACCORDANCE WITH ASTM A36.

B. CONSTRUCT TOP FRAME OF BASKET WITH TWO SHORT SIDES OF 2 INCH BY 2 INCH AND SINGLE LONG SIDE OF 1 INCH BY 1 INCH, 1/8 INCH ANGLE IRON. CONSTRUCT BASKET HANGERS OF 2 INCH BY 1/4 INCH IRON BARS. CONSTRUCT BOTTOM FRAME OF 1 INCH BY 1/4 INCH IRON BAR OR 1/4 INCH PLATE WITH CENTER 3 INCHES REMOVED. USE MINIMUM 1/4 INCH DIAMETER IRON RODS OR EQUIVALENT FOR SIDES OF INLET BASKET.

C. WELD AMINIMUM OF 14 RODS IN PLACE BETWEEN TOP FRAME/BASKET HANGER AND BOTTOM FRAME. EXACT DIMENSIONS FOR TOP FRAME AND INSERT BASKET WILL BE DETERMINED BASED ON DIMENSIONS OF TYPE OF INLET BEING PROTECTED.

2.09 SANDBAGS

A. PROVIDE WOVEN MATERIAL MADE OF POLYPROPYLENE, POLYETHYLENE, OR POLYAMIDE MATERIAL.

1. MINIMUM UNIT WEIGHT OF FOUR OUNCES PER SQUARE YARD.
2. MINIMUM GRAB STRENGTH OF 100 LBS IN ANY PRINCIPAL DIRECTION (ASTM D4632).
3. MULLEN BURST STRENGTH EXCEEDING 300 LBS (ASTM D4833).
4. ULTRAVIOLET STABILITY EXCEEDING 70 PERCENT. AFTER 500 HOURS OF EXPOSURE (ASTM 4355).
5. SIZE: LENGTH: 18 TO 24 INCHES. WIDTH: 12 TO 18 INCHES. THICKNESS: 6 TO 8 INCHES. WEIGHT: APPROXIMATELY 40 TO 50 POUNDS NOT TO EXCEED 75 POUNDS.

2.10 BAGGED GRAVEL BARRIER

A. PROVIDE A BAGGED GRAVEL BARRIER.

1. MINIMUM UNIT WEIGHT OF FOUR OUNCES PER SQUARE YARD.
2. MINIMUM GRAB STRENGTH OF 100 LBS IN ANY PRINCIPAL DIRECTION (ASTM D4632).
3. MULLEN BURST STRENGTH EXCEEDING 300 LBS (ASTM D4833).
4. ULTRAVIOLET STABILITY EXCEEDING 70 PERCENT. AFTER 500 HOURS OF EXPOSURE (ASTM 4355).
5. SIZE: LENGTH:18 TO 24 INCHES. WIDTH: 12 TO 18 INCHES. THICKNESS: 6 TO 8 INCHES. WEIGHT: APPROXIMATELY 40 TO 50 POUNDS NOT TO EXCEED 75 POUNDS.

2.11 ROCK FILTER DAM

A. MATERIALS. GEOTEXTILE FABRIC SHALL CONSIST OF A WOVEN MONOFILAMENT OR SPUNBOND NONWOVEN FIBERS CONSISTING OF LONG-CHAIN SYNTHETIC POLYMERS COMPOSED OF AT LEAST 95 PERCENT BY WEIGHT OF POLYOLEFINS. GEOTEXTILE FABRIC SHALL EQUAL OR EXCEED THE FOLLOWING AVERAGE ROLL VALUES OR AS DIRECTED BY THE ENGINEER:

1. MINIMUM AVERAGE ROLL VALUE.
   a. ELONGATION ³ 50 PERCENT.
   b. GRAB STRENGTH – 200 POUNDS.
   c. PUNCTURE STRENGTH – 75 POUNDS.
   d. UV STABILITY (RETAINED STRENGTH) – 50 PERCENT AFTER 500 HOURS OF EXPOSURE.
2. MAXIMUM AVERAGE ROLL VALUE.
   a. APPARENT OPENING SIZE (AOS) – 0.6 MM/#30 US SIEVE.

B. GEOTEXTILE FABRIC SHALL BE RESISTANT TO COMMONLY ENCOUNTERED SOIL CHEMICALS, MILDEW, ROT, INSECTS, AND DETERIORATION RESULTING FROM EXPOSURE TO SUNLIGHT OR HEAT. GEOTEXTILE FABRIC SHALL PROVIDE AN EXPECTED USEABLE LIFE COMPARABLE TO THE ANTICIPATED CONSTRUCTION PERIOD.

C. AGGREGATE FOR THE ROCK FILTER DAMS SHALL CONSIST OF CRUSHED STONE. AGGREGATE PARTICLES SHALL BE COMPOSED OF CLEAN, HARD, DURABLE MATERIALS FREE FROM ADHERENT COATINGS, SALT, ALKALI, DIRT, CLAY, LOAM,

SHALE, SOFT OR FLAKY MATERIALS OR ORGANIC AND INJURIOUS MATTER. AGGREGATE SHALL BE CUBIC OR ROUNDED FORM, NOT ELONGATED, FLAT, SHAPES. SPALLS, FRAGMENTS, AND CHIPS SHALL NOT EXCEED 5 PERCENT BY WEIGHT. CRUSHED CONCRETE MAY BE SUBSTITUTED FOR THE CRUSHED STONE. AGGREGATE SIZE SHALL DEPEND UPON THE TYPE OF ROCK FILTER DAM SPECIFIED IN THE CONSTRUCTION PLANS. AGGREGATE SIZE BASED ON TYPE OF ROCK FILTER DAM IS AS FOLLOWS:

1. TYPE 1:
   a. USED AT THE TOE OF SLOPES, AROUND INLETS, IN SMALL DITCHES, AND AT DIKE OR SWALE OUTLETS FOR A DRAINAGE AREA OF 5 ACRES OR LESS.
   b. 3 INCHES TO 5 INCHES, OPEN-GRADED.
2. TYPE 2:
   a. USED IN DITCHES AND AT DIKE OR SWALE OUTLETS.
   b. 3 INCHES TO 5 INCHES, OPEN-GRADED.
3. TYPE 3:
   a. USED IN STREAM FLOW.
   b. 4 INCHES TO 8 INCHES, OPEN-GRADED.
4. TYPE 4:
   a. SACK GABIONS MAY BE USED IN DITCHES AND SMALLER CHANNELS TO FORM AN EROSION AND SEDIMENT CONTROL DAM.
   b. 3 INCHES TO 5 INCHES, OPEN-GRADED.

D. MESH IS REQUIRED FOR REINFORCED TYPE ROCK FILTER DAMS. MESH SHALL BE 20 GAUGE GALVANIZED DOUBLE TWISTED HEXAGONAL WIRE MESH WITH 1-INCH DIAMETER HEXAGONAL OPENINGS. MESH WIRE SHALL BE ZINC COATED PRIOR TO BEING DOUBLE TWISTED. REINFORCING SPIRAL BINDERS, LACING WIRE, AND STIFFENERS SHALL BE MADE OF WIRE HAVING THE SAME COATING MATERIAL AND SAME WIRE SIZE AS THE WIRE MESH. GABION WIRE BASKETS SHALL EQUAL OR EXCEED THE REQUIREMENTS OF THE WIRE MESH.

PART 3 – EXECUTION

3.01 PREPERATION

A. PROTECT AND MAINTAIN BENCHMARKS AND SURVEY CONTROL POINTS FROM DISTURBANCE DURING CONSTRUCTION.

B. PROTECT EXISTING SITE IMPROVEMENTS TO REMAIN FROM DAMAGE DURING CONSTRUCTION. RESTORE DAMAGED IMPROVEMENTS TO THEIR ORIGINAL CONDITION, AS ACCEPTABLE TO OWNER.

C. PLAN WORK TO MINIMIZE THE TIME AREAS ARE TO BE EXPOSED WITHOUT VEGETATIVE COVER.

D. PREPARE A SWPP PLAN FOLLOWING THE REQUIREMENTS OF THE CONSTRUCTION GENERAL PERMIT AND THE REQUIREMENTS OF THE LOCAL MS4. IF CONFLICTS EXIST BETWEEN THE CONSTRUCTION GENERAL PERMIT AND THE REQUIREMENTS OF THE MS4, THE MORE STRINGENT REQUIREMENTS WILL APPLY.

   1. UPDATE OR REVISE THE SWPPP AS NEEDED DURING THE CONSTRUCTION FOLLOWING THE REQUIREMENTS OF THE CONSTRUCTION GENERAL PERMIT.

2. SUBMIT THE SWPPP AND ANY UPDATES OR REVISIONS TO THE OWNER'S REPRESENTATIVE FOR REVIEW AND ADDRESS COMMENTS PRIOR TO COMMENCING, OR CONTINUING, CONSTRUCTION ACTIVITIES.

E. NOTICE OF INTENT FOR LARGE CONSTRUCTION ACTIVITY
1. FILL OUT, SIGN, AND DATE TCEQ NOTICE OF INTENT (NOI) FORM FOR STORM WATER DISCHARGES ASSOCIATED WITH CONSTRUCTION ACTIVITY UNDER THE TPDES CONSTRUCTION GENERAL PERMIT (TXR 150000) FOR THE CONTRACTOR AND OWNER.
2. TRANSMIT THE SIGNED CONTRACTOR'S AND OWNER'S COPY OF THE NOI, ALONG THE REQUIRED FEES TO THE TCEQ. PROVIDE A COPY OF THE DOCUMENTS TO THE OWNER'S REPRESENTATIVE.
3. SUBMISSION OF THE NOTICE OF INTENT FORM BY THE CONTRACTOR AND OWNER IS REQUIRED A MINIMUM OF SEVEN DAYS BEFORE COMMENCEMENT OF CONSTRUCTION ACTIVITIES.

F. CONSTRUCTION SITE NOTICE FOR SMALL CONSTRUCTION ACTIVITY
1. FILL OUT, SIGN, AND DATE THE CONSTRUCTION SITE NOTICE, CONTAINED IN THE TPDES GENERAL PERMIT TXR 150000.
2. TRANSMIT THE SIGNED CONSTRUCTION SITE NOTICE TO OWNER'S REPRESENTATIVE AT LEAST SEVEN DAYS PRIOR TO COMMENCEMENT OF CONSTRUCTION ACTIVITY.

G. CERTIFICATION REQUIREMENTS
1. COMPLETE THE LARGE CONSTRUCTION SITE "PRIMARY OPERATOR" NOTICE.
2. CONTRACTOR SHALL COMPLETE THE LARGE CONSTRUCTION SITE "SECONDARY OPERATOR" NOTICE AND PROVIDE IT TO THE OWNER AND SUBCONTRACTOR'S FOR SIGNATURE.
3. SUBMIT PROPERLY COMPLETED CERTIFICATION FORMS TO THE OWNER'S REPRESENTATIVE FOR REVIEW BEFORE BEGINNING CONSTRUCTION OPERATIONS.
4. CONDUCT INSPECTIONS IN ACCORDANCE WITH TCEQ REQUIREMENTS. USE THE EPA NPDES CONSTRUCTION INSPECTION FORM TO RECORD MAINTENANCE INSPECTIONS AND REPAIRS.

H. POST THE FOLLOWING NOTICES FROM EFFECTIVE DATE OF THE SWPP PLAN UNTIL DATE OF FINAL SITE STABILIZATION AS DEFINED IN THE CONSTRUCTION GENERAL PERMIT:
1. POST THE TPDES PERMIT NUMBER FOR LARGE CONSTRUCTION ACTIVITY, WITH A SIGNED TCEQ CONSTRUCTION SITE NOTICE FOR LARGE OR SMALL CONSTRUCTION ACTIVITY. SIGNED COPIES OF THE CONTRACTOR'S AND OWNER'S NOI, AS APPLICABLE, MUST ALSO BE POSTED.
2. POST NOTICES NEAR THE MAIN ENTRANCE OF THE CONSTRUCTION SITE IN A PROMINENT PLACE WHERE IT IS SAFELY AND READILY AVAILABLE FOR VIEWING BY GENERAL PUBLIC, LOCAL, STATE, AND FEDERAL AUTHORITIES. POST NAME AND TELEPHONE NUMBER OF CONTRACTOR'S LOCAL CONTACT PERSON, BRIEF PROJECT DESCRIPTION AND LOCATION OF THE SWPP PLAN.
    a. IF POSTING NEAR A MAIN ENTRANCE IS NOT FEASIBLE DUE TO SAFETY CONCERNS, COORDINATE POSTING OF NOTICE WITH THE OWNER'S REPRESENTATIVE TO CONFORM TO REQUIREMENTS OF THE CONSTRUCTION GENERAL PERMIT.
    b. IF PROJECT IS A LINEAR CONSTRUCTION PROJECT (E.G.: ROAD, UTILITIES, ETC.), POST NOTICE IN A PUBLICLY ACCESSIBLE LOCATION NEAR ACTIVE CONSTRUCTION. MOVE NOTICE AS NECESSARY.

3. POST A NOTICE TO EQUIPMENT AND VEHICLES OPERATORS, INSTRUCTING THEM TO STOP, CHECK, AND CLEAN TIRES OF DEBRIS AND MUD BEFORE DRIVING ONTO TRAFFIC LANES. POST AT EACH STABILIZED CONSTRUCTION ACCESS AREA.
4. POST A NOTICE OF WASTE DISPOSAL PROCEDURES IN A READILY VISIBLE LOCATION ON SITE.

I. KEEP A COPY OF THIS DOCUMENT AND THE SWPP PLAN IN A READILY ACCESSIBLE LOCATION AT THE CONSTRUCTION SITE FROM COMMENCEMENT OF CONSTRUCTION ACTIVITY UNTIL SUBMISSION OF THE NOTICE OF TERMINATION (NOT) FOR STORM WATER DISCHARGES ASSOCIATED WITH CONSTRUCTION ACTIVITY UNDER TPDES CONSTRUCTION GENERAL PERMIT (TXR 150000). CONTRACTORS WITH DAY-TO-DAY OPERATIONAL CONTROL OVER SWPP PLAN IMPLEMENTATION SHALL HAVE A COPY OF THE SWPP PLAN AVAILABLE AT A CENTRAL LOCATION, ON-SITE, FOR THE USE OF ALL OPERATORS AND THOSE IDENTIFIED AS HAVING RESPONSIBILITIES UNDER THE SWPP PLAN. UPON SUBMISSION OF THE NOT, SUBMIT ALL REQUIRED FORMS AND A COPY OF THE SWPP PLAN WITH ALL REVISIONS TO THE OWNER'S REPRESENTATIVE.

3.02 GENERAL

A. USE ALL MEANS NECESSARY TO CONTROL DUST ON OR NEAR THE SITE RESULTING FROM THE PERFORMANCE OF THE WORK. THOROUGHLY MOISTEN ALL SURFACES TO PREVENT DUST BEING A NUISANCE TO THE PUBLIC, ADJACENT USES, AND CONCURRENT WORK ON SITE. MOISTURE LEVEL DURING COMPACTION OPERATIONS SHALL NOT EXCEED THAT AMOUNT AS SPECIFIED BY GEOTECHNICAL ENGINEER.

B. INSTALL EROSION CONTROL SYSTEMS AT THE SITE'S BOUNDARY AT LOCATIONS WHERE STORMWATER RUNOFF WILL LEAVE THE SITE PRIOR TO STARTING ANY CLEARING, STRIPPING, OR EARTHWORK OPERATIONS.

C. PROPERLY DISPOSE OF SOLID WASTE, PAINTS, SOLVENTS, CLEANING COMPOUNDS, ETC.

D. STORE CONSTRUCTION MATERIALS IN DESIGNATED AREAS AWAY FROM DRAINAGEWAYS AND LOW AREAS.

E. CONSTRUCT CONTAINMENT BERMS AND UTILIZE DRIP PANS AT FUEL AND LIQUID STORAGE TANKS AND CONTAINERS.

3.03 INSTALLATION OF EROSION CONTROL DEVICES

A. INSTALL EROSION CONTROL DEVICES TO PROTECT ADJACENT AND DOWNSTREAM PROPERTIES FROM DAMAGE AND POLLUTION RESULTING FROM EROSION CAUSED BY THE WORK OF THIS CONTRACT. IMPLEMENT EROSION CONTROL MEASURES INDICATED ON DRAWINGS AND ADDITIONAL EROSION CONTROL MEASURES NECESSARY TO PREVENT DAMAGE TO ADJACENT AND DOWNSTREAM PROPERTIES.

B. INSTALL SILT FENCE LOCATED ALONG PERIMETER OF SITE OR GRADING LIMITS IMMEDIATELY FOLLOWING SITE CLEARING OPERATIONS SPECIFIED UNDER DIVISION 31 SECTION 31 11 00 – CLEARING AND GRUBBING.

1. INSTALL SILT FENCE FABRIC FROM A CONTINUOUS ROLL FOR THE LENGTH OF THE SILT FENCE WHENEVER POSSIBLE TO MINIMIZE THE NUMBER OF JOINTS. CREATE JOINTS IN FABRIC BY SECURELY FASTENING FABRIC AT THE SUPPORT POST WITH OVERLAP EXTENDING TO THE NEXT POST.
2. DRIVE SUPPORT POST INTO GROUND NOT LESS THAN 18 INCHES.

3. EXCAVATE A 4-INCH WIDE BY 4-INCH DEEP TRENCH ON UP-SLOPE SIDE OF SILT FENCE.
   a. LINE TRENCH WITH SILT FENCE FABRIC MATERIAL.
   b. BACKFILL TRENCH WITH SOIL OR GRAVEL.

C. INSTALL INLET PROTECTION BARRIERS AT ALL INLETS.

D. STABILIZED CONSTRUCTION ACCESS

1. PROVIDE STABILIZED CONSTRUCTION ROADS AND ACCESS AT CONSTRUCTION, STAGING, PARKING, STORAGE, AND DISPOSAL AREAS TO KEEP STREET CLEAN OF MUD CARRIED BY CONSTRUCTION VEHICLES AND EQUIPMENT. CONSTRUCT EROSION AND SEDIMENT CONTROLS IN ACCORDANCE WITH DRAWINGS, SPECIFICATION AND ANY REQUIREMENTS OF THE AUTHORITY HAVING JURISDICTION.
2. PLACE THE EXIT OVER A FOUNDATION COURSE, IF NECESSARY. GRADE THE FOUNDATION COURSE OR COMPACTED SUBGRADE TO DIRECT RUNOFF FROM THE CONSTRUCTION EXITS TO A SEDIMENT TRAP.
3. CONSTRUCT EXITS WITH A WIDTH OF AT LEAST 14 FT. FOR ONE-WAY AND 20 FT. FOR TWO-WAY TRAFFIC FOR THE FULL WIDTH OF THE EXIT, OR AS REQUIRED.
4. CONSTRUCT TO A DEPTH OF AT LEAST 8 IN. USING CRUSHED AGGREGATE AS SHOWN ON THE PLANS OR AS DIRECTED.

3.04 STORAGE OF SOIL MATERIALS

A. STOCKPILE BORROW MATERIALS AND SATISFACTORY EXCAVATED SOIL MATERIALS. STOCKPILE SOIL MATERIALS WITHOUT INTERMIXING. PLACE, GRADE, AND SHAPE STOCKPILES TO DRAIN SURFACE WATER. COVER TO PREVENT WINDBLOWN DUST.

B. STOCKPILE SOIL MATERIALS AWAY FROM EDGE OF EXCAVATIONS. DO NOT STORE WITHIN DRIP LINE OF REMAINING TREES.

C. STOCKPILE TOPSOIL MAY NOT EXCEED 6 FEET IN HEIGHT.

3.05 FIELD QUALITY CONTROL

A. TESTING SHALL BE THE RESPONSIBILITY OF THE OWNER AND COSTS OF INITIAL TESTING SHALL BE PAID BY OWNER. COST OF ALL SUBSEQUENT TESTING NECESSARY DUE TO NON-COMPLIANCE WITH SPECIFICATIONS SHALL BE PAID BY CONTRACTOR.

B. DENSITY TEST:

1. FREQUENCY AND SCOPE OF TESTING SHALL BE ESTABLISHED BY GEOTECHNICAL ENGINEER, AND AS REQUIRED BY LOCAL JURISDICTIONAL AUTHORITY. IF GEOTECHNICAL ENGINEER HAS NOT ESTABLISHED A FREQUENCY OF TESTING IN THE GEOTECHNICAL REPORT, TESTING SHALL BE AT EVERY 100 LINEAR FOOT OF TRENCH AT A MINIMUM OF ONE PER LIFT AND A MINIMUM OF ONE PER DAY.
2. TESTS SHALL BE PERFORMED IN ACCORDANCE WITH THE REFERENCED STANDARDS.
3. LABORATORY TESTS FOR MOISTURE DENSITY RELATIONS SHALL BE DETERMINED IN ACCORDANCE WITH ASTM D 1557. A MINIMUM OF ONE TEST SHALL BE PERFORMED FOR EACH MAJOR SOILS TYPE. IN ADDITION, SUFFICIENT NUMBER OF RETESTS OR CHECK POINTS SHALL BE PERFORMED TO EVALUATE ACCURACY OF MAXIMUM DENSITY VALUES BEING USED.

4. FIELD IN-PLACE DENSITY SHALL BE DETERMINED IN ACCORDANCE WITH ASTM TEST METHODS D 1556 OR D 2922, AND THE MOISTURE-DENSITY RELATIONS SHALL BE DETERMINED IN ACCORDANCE WITH ASTM TEST METHOD D 1557.
5. REOPEN IMPROPERLY COMPACTED TRENCHES TO DEPTH DIRECTED, THEN REFILL AND COMPACT TO THE SPECIFIED DENSITY AT NO ADDITIONAL COST TO OWNER

3.06 DRAINAGE CONTROLS

A. PROVIDE ALL NECESSARY TEMPORARY APPARATUS, PUMPS, CURBS OR DITCHES AS REQUIRED TO DIVERT OR CONVEY WATER FROM ANY SOURCE AWAY FROM THE WORK. DO NOT ALLOW WATER FROM ANY SOURCE TO ACCUMULATE WITHIN OR DAMAGE TRENCHES.

END OF SECTION 31 22 13

SECTION 01 60 00 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements governing the Contractor's selection of products for use in the Project.

B. Standards: Refer to Section "Reference Standards and Definitions" for applicability of industry standards to products specified.

1. Administrative procedures for handling requests for substitutions made after award of the Contract are included under Section "Product Substitutions."
2. Since the Owner is a governmental entity or an organization which may be exempted from the sales and use taxes on certain tangible personal property, the Contractor shall be responsible for:
    a. Determining whether such governmental entity or organization is exempt from such taxes under the Contract Documents.
    b. Determining whether your purchase of any tangible personal property for use in the performance of this contract is exempt.
    c. Obtaining any sales tax exemption certificate from the Owner.
    d. Properly issuing any sales tax exemption certificate to a seller or supplier that the sale of any item of tangible personal property qualifies for an exemption.
    e. Maintaining any records required by the laws of the State of Texas or by any valid rules and/or regulations of the Comptroller of Public Accounts of the State of Texas.
    f. Payment of any legally assessed penalties or fines for improper use of any exemption Certificate.

1.3 DEFINITIONS

A. Definitions used in this Article are not intended to change the meaning of other terms used in the Contract Documents, such as "specialties," "systems," "structure," "finishes," "accessories," and similar terms. Such terms are self-explanatory and have well recognized meanings in the construction industry.

1. "Products" are items purchased for incorporation in the Work, whether purchased for the Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

2. "Named Products" are items identified by manufacturer's product name, including make or model designation, indicated in the manufacturer's published product literature, that is current as of the date of the Contract Documents.

3. "Foreign Products", as distinguished from "domestic products," are items substantially manufactured (50 percent or more of value) outside of the United States and its possessions; or produced or supplied by entities substantially owned (more than 50 percent) by persons who are not citizens of nor living within the United States and its possessions.

4. "Materials" are products that are substantially shaped, cut, worked, mixed, finished, refined or otherwise fabricated, processed, or installed to form a part of the Work.

5. "Equipment" is a product with operational parts, whether motorized or manually operated, that requires service connections such as wiring or piping.

1.4 SUBMITTALS

A. Product List Schedule: Prepare a schedule showing products specified in a tabular form acceptable to the Architect. Include generic names of products required. Include the manufacturer's name and proprietary product names for each item listed.

1. Coordinate the product list schedule with the Contractor's Construction Schedule and the Schedule of Submittals.

B. Form: Prepare the product listing schedule with information on each item tabulated under the following column headings:

1. Related Specification Section number.
2. Generic name used in Contract Documents.
3. Proprietary name, model number and similar designations.
4. Manufacturer's name and address.
5. Supplier's name and address.
6. Installer's name and address.
7. Projected delivery date, or time span of delivery period.

C. Initial Submittal: Within 30 days after date of commencement of the Work, submit 3 copies of an initial product list schedule. Provide a written explanation for omissions of data, and for known variations from Contract requirements.

1. At the Contractor's option, the initial submittal may be limited to product selections and designations that must be established early in the Contract period.

D. Completed Schedule: Within 30 days after date of commencement of the Work, submit 3 copies of the completed product list schedule. Provide a written explanation for omissions of data, and for known variations from Contract requirements.

E. Architect's Action: The Architect will respond in writing to the Contractor within 2 weeks of receipt of the completed product list schedule. No response within this time period constitutes no objection to listed manufacturers or products, but does not constitute a waiver of the requirement that products comply with Contract Documents. The Architect's response will include the following:

1. A list of unacceptable product selections, containing a brief explanation of reasons for this action.

1.5 QUALITY ASSURANCE

A. Source Limitations: To the fullest extent possible, provide products of the same kind, from a single source.

1. When specified products are available only from sources that do not or cannot produce a quantity adequate to complete project requirements in a timely manner, consult with the Architect for a determination of the most important product qualities before proceeding. Qualities may include attributes relating to visual appearance, strength,

durability, or compatibility. When a determination has been made, select products from sources that produce products that possess these qualities, to the fullest extent possible.

B. Compatibility of Options: When the Contractor is given the option of selecting between two or more products for use on the Project, the product selected shall be compatible with products previously selected, even if previously selected products were also options.

C. Nameplates: Except for required labels and operating data, do not attach or imprint manufacturer's or producer's nameplates or trademarks on exposed surfaces of products which will be exposed to view in occupied spaces or on the exterior.

D. Labels: Locate required product labels and stamps on a concealed surface or, where required for observation after installation, on an accessible surface that is not conspicuous.

E. Equipment Nameplates: Provide a permanent nameplate on each item of service-connected or power-operated equipment. Locate on an easily accessible surface which is inconspicuous in occupied spaces. The nameplate shall contain the following information and other essential operating data:
   1. Name of product and manufacturer.
   2. Model and serial number.
   3. Capacity.
   4. Speed.
   5. Ratings.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store and handle products in accordance with the manufacturer's recommendations, using means and methods that will prevent damage, deterioration and loss, including theft.

B. Schedule delivery to minimize long-term storage at the site and to prevent overcrowding of construction spaces.

C. 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.

D. Deliver products to the site in the manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting and installing.

E. Inspect products upon delivery to ensure compliance with the Contract Documents, and to ensure that products are undamaged and properly protected.

F. Store products at the site in a manner that will facilitate inspection and measurement of quantity or counting of units.

G. Store heavy materials away from the Project structure in a manner that will not endanger the supporting construction.

H. Store products subject to damage by the elements above ground, under cover in a weathertight enclosure, with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer's instructions.

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, unused at the time of installation.

1. Provide products complete with all accessories, trim, finish, safety guards and other devices and details needed for a complete installation and for the intended use and effect.

B. Standard Products: Where available, provide standard products of types that have been produced and used successfully in similar situations on other projects.

C. Product Selection Procedures: Product selection is governed by the Contract Documents and governing regulations, not by previous Project experience. Procedures governing product selection include the following:

D. Proprietary Specification Requirements: Where only a single product or manufacturer is named, provide the product indicated. No substitutions will be permitted.

E. Semi-proprietary Specification Requirements: Where two or more products or manufacturers are named, provide one of the products indicated. No substitutions will be permitted.

1. Where products or manufacturers are specified by name, accompanied by the term "or equal," or "or approved equal" comply with the Contract Document provisions concerning "substitutions" to obtain approval for use of an unnamed product.

F. Non-Proprietary Specifications: When the Specifications list products or manufacturers that are available and may be incorporated in the Work, but do not restrict the Contractor to use of these products only, the Contractor may propose any available product that complies with Contract requirements. Comply with Contract Document provisions concerning substitutions to obtain approval for use of an unnamed product.

G. Descriptive Specification Requirements: Where Specifications describe a product or assembly, listing exact characteristics required, with or without use of a brand or trade name, provide a product or assembly that provides the characteristics and otherwise complies with Contract requirements.

H. 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 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.

I. Compliance with Standards, Codes and Regulations: Where the Specifications only require compliance with an imposed code, standard or regulation, select a product that complies with the standards, codes or regulations specified.

J. Visual Matching: Where Specifications require matching an established Sample, the Architect's decision will be final on whether a proposed product matches satisfactorily.

1. Where no product available within the specified category matches satisfactorily and

also complies with other specified requirements, comply with provisions of the Contract Documents concerning substitutions for selection of a matching product in another product category, or for noncompliance with specified requirements.

K. Visual Selection: Where specified product requirements include the phrase "...as selected from manufacturer's standard colors, patterns, textures..." or a similar phrase, select a product and manufacturer that complies with other specified requirements. The Architect will select the color, pattern and texture from the product line selected.

L. Allowances: Refer to individual Specification Sections and "Allowance" provisions in Division-1 for allowances that control product selection, and for procedures required for processing such selections.

PART 3 - EXECUTION

3.1 INSTALLATION OF PRODUCTS

A. Comply with manufacturer's instructions and recommendations for installation of products in the applications indicated. Anchor each product securely in place, accurately located and aligned with other Work.

1. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

END OF SECTION

SECTION 01 70 00 - EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for project closeout, including but not limited to:
   1. Inspection procedures.
   2. Project record document submittal and digital archiving.
   3. Operating and maintenance manual submittal and digital archiving.
   4. Submittal of warranties.
   5. Final cleaning.
   6. Demonstration and training videotapes.

B. Closeout requirements for specific construction activities are included in the appropriate Sections in Divisions 2 through 26.

1.3 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for certification of Substantial Completion, complete the following. List exceptions in the request.
   1. In the Application for Payment that coincides with, or first follows, the date Substantial Completion is claimed, show 100 percent completion for the portion of the Work claimed as substantially complete. Include supporting documents for completion as indicated in these Contract Documents and a statement showing an accounting of changes to the Contract Sum.
   2. If 100 percent completion cannot be shown, include a list of incomplete items, the value of incomplete construction, and reasons the Work is not complete.
   3. Advise Owner of pending insurance change-over requirements.
   4. Submit specific warranties, workmanship bonds, maintenance agreements, final certifications, and similar documents.
   5. Obtain and submit releases enabling the Owner unrestricted use of the Work and access to services and utilities; include occupancy permits, operating certificates and similar releases.
   6. Submit record drawings, maintenance manuals, final project photographs, damage or settlement survey, property survey, and similar final record information.
   7. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable. Extra materials include but are not necessarily limited to those listed in the “Summary of Extra Materials” following this Section.
   8. Make final change-over of permanent locks and transmit keys to the Owner. Advise the Owner's personnel of change-over in security provisions.
   9. Complete start-up testing of systems, and instruction of the Owner's operating and maintenance personnel. Discontinue or change over and remove temporary facilities from the site, along with construction tools, mock-ups, and similar elements.

B. Inspection Procedures: On receipt of a request for inspection, the Architect will either proceed with inspection or advise the Contractor of unfilled requirements. The Architect will prepare the Certificate(s) of Substantial Completion following inspection(s), or advise the Contractor of

construction that must be completed or corrected before the certificate will be issued.

1. The Architect will repeat inspection when requested, and assured by the Contractor in writing, that the Work has been substantially completed.
2. Results of the completed inspection will form the basis of requirements for final acceptance.

1.4 FINAL ACCEPTANCE

A. Preliminary Procedures: Before requesting final inspection for certification of final acceptance and final payment, complete the following. List exceptions in the request.

1. Submit the final payment request with releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.
2. Submit an updated final statement, accounting for final additional changes to the Contract Sum.
3. Submit a certified copy of the Architect's final inspection list of items to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance, and the list has been endorsed and dated by the Architect.
4. Submit final meter readings for utilities, a measured record of stored fuel, and similar data as of the date of Substantial Completion, or when the Owner took possession of and responsibility for corresponding elements of the Work.
5. Submit consent of surety to final payment.
6. Submit Notice of Termination as required in Division 1 Section “Erosion and Sediment Control”.
7. Submit a final liquidated damages settlement statement.
8. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
9. Complete final clean up requirements, including touch-up painting. Touch-up and otherwise repair and restore marred exposed finishes.

B. Re-inspection Procedure: The Architect will re-inspect the Work upon receipt of notice that the Work, including inspection list items from earlier inspections, has been completed, except items whose completion has been delayed because of circumstances acceptable to the Architect.

1. Upon completion of re-inspection, the Architect will prepare a certificate of final acceptance, or advise the Contractor of Work that is incomplete or of obligations that have not been fulfilled but are required for final acceptance.
2. If necessary, re-inspection will be repeated.
3. Should the Architect perform reinspections, due to failure of the Work to comply with the claims of status of completion made by the Contractor, the Owner shall compensate the Architect for additional services; and the Owner shall deduct the amount of the compensation from the final payment to the Contractor.

1.5 RECORD DOCUMENT SUBMITTALS

A. General: Do not use record documents for construction purposes; protect from deterioration and loss in a secure, fire-resistive location; provide access to record documents for the Architect's reference during normal working hours.

B. **Record Drawings**: Maintain a clean, undamaged set of black-line-on-white-prints of Contract Drawings at the Project Site. Mark the set in colors to show the actual installation where the installation varies from the Work as originally shown. Mark whichever drawing is most capable of showing conditions fully and accurately. Give particular attention to concealed

elements that would be difficult to measure and record at a later date.

1. Mark new information that is important to the Owner but was not shown on Contract Drawings or Shop Drawings.

2. Note related Proposal Requests (PR), Architect's Supplemental Instructions (ASI), Requests for Information (RFI), and Change Order (CO) numbers where applicable.

3. At completion of project, transfer all Project Record Data to one complete set of black line drawings. Utilize the following color code, make all changes neatly and legibly:
   a. Red for Architectural Work
   b. Blue for Structural Work
   c. Green for Plumbing Work
   d. Orange for HVAC Work
   e. Brown for Electrical Work
   f. Black for other written notations

4. Organize record drawing sheets into manageable set, bind with durable paper cover sheets, and print suitable titles, dates and other identification on each sheet, including 'RECORD DRAWINGS'. Where no changes are necessary on a sheet, add the phrase "NO CHANGES".

5. Contractor to provide CAD/BIM for all drawings and deliver to the Architect and Owner for review. Architect will make a cursory review of the drawings and mark any needed changes or additions and return to the Contractor.

6. Make any corrections and re-scan sheets as necessary. Print final half-size set and deliver the printed set and DVD containing a single indexed digital file to the Owner. Deliver duplicate DVD to the Architect. Reference "Document Scanning" below for scanning and delivery requirements.
   a. Include separate indexed DVD to the Owner indicating locations of plumbing shutoff valves and electrical disconnects.

7. The costs of scanning and printing record drawings for review and final delivery shall be paid by the Contractor.`

C. **Record Specifications**: Maintain at the project site one complete copy of the Project Manual, including addenda. Mark these specifications to show variations in actual Work performed in comparison with the text of the Specifications and modifications. Give particular attention to substitutions, selection of options and similar information on elements that are concealed or cannot otherwise be readily discerned later by direct observation.
   1. Upon completion of the Work, submit a hard-copy of the record Specifications to the Architect for review. Architect will make a cursory review of the record documents and mark any needed changes or additions to the hard-copy and return to the Contractor.

   2. Make any corrections and scan specification pages. Reference "Document Scanning" below for scanning and delivery requirements.

   3. The costs of scanning and printing record specifications for review and final delivery shall be paid by the Contractor.

D. **Record Project Data**: Make hard copies for binders including Change Orders, Proposal Requests and responses, Requests for Information and responses, and Architect's Supplemental Instructions.

   1. Submit one complete set of Record Project Data to the Architect for review. Architect will

make a cursory review of the documents and mark any needed changes or additions to the hard-copy and return to the Contractor.

2. Make any corrections and digitally scan all Project Data pages. Deliver DVD containing a single indexed digital file to the Owner. Deliver duplicate DVD to the Architect. Reference “Document Scanning” below for scanning and delivery requirements.

3. The costs of scanning and printing record Project Data for review and final delivery shall be paid by the Contractor.

E. **Material Finishes Binder:** Provide Finishes Binder with physical samples of all finish materials included in completed Work. Group all samples according to Specification Section.
   1. Samples shall include, but not be limited to Paint, Vinyl Wall Covering, Plastic Laminates, Carpet, Rubber Base, VCT, Wood Stains, and other Finishes and Color Selections, regardless of whether they are same as Color Schedule.
   2. Label each sample with name of manufacturer, any product number, style or series, and color.
   3. Make needed changes to Color Schedule and include in the Finishes Binder.
   4. Where samples are or a size, material, or thickness that do not allow inclusion in the Finishes Binder (such as face brick or tile pavers), include product cut sheets from the manufacturer indicating manufacturer, any product number, style or series, and color.
   5. Deliver completed Finishes Binder to Architect for review. Architect will make a cursory review of the Finishes Binder and mark any needed changes or additions and return to the Contractor.
   6. Make any corrections and deliver completed binder to the Owner.
   7. The costs of scanning, printing, and binding record Finishes pages for review and final delivery shall be paid by the Contractor.

F. **Maintenance and Operations Manuals**: Organize operating and maintenance data into suitable sets of manageable size.
   1. Provide (1) Binder Set and Deliver to Project Site.
   2. Provide (1) single indexed digital PDF to owner via flash drive or CD.
      a. Emergency instructions.
      b. Spare parts list.
      c. Copies of warranties.
      d. Wiring diagrams.
      e. Recommended "turn-around" cycles.
      f. Inspection procedures.
      g. Shop Drawings and Product Data.
      h. Fixture lamping schedule.

   3. Deliver to Architect for review. Architect will make a cursory review of the Maintenance and Operations Binders and mark any needed changes or additions and return to the Contractor.
   4. Make any corrections and print final sets. Digitally scan all Binder pages and deliver the printed Binder sets on one DVD containing digital files to the Owner within 90-days of Substantial Completion. Deliver duplicate DVD to the Architect.
   5. The costs of scanning, printing, and binding Maintenance and Operations information for review and final delivery shall be paid by the Contractor.

G. **Demonstration and Training Video:** Submit two copies of all demonstrations on (1) DVD and deliver to owner within 90 days of substantial completion
   1. Identification: On each copy provide an applied label with the following information:

      a. Name of Project.
      b. Name and address of photographer.

c. Name of Architect (and Construction Manager when applicable).
d. Name of Contractor.
e. Date video was recorded.
f. Description of video content including description of subject building equipment and/ or systems, and general description of training or procedures covered.

H. **Close-Out Document Manuals** (submit 2 copies): Organize close-out materials into heavy-duty 2-inch D-Slant binders, with pocket folders and deliver to Architect for review. Spine and covers should be labeled. Include and organize the material as follows:
1. Index
2. Consent of Surety to Final Payment AIA G707
3. Contractor's Affidavit of Release of Liens AIA G706A
4. Contractor's Affidavit of Payment of Debts and Claims AIA G706
5. Certificate of Substantial Completion AIA G704
6. General Contractor's Written Guarantee
7. Final list of Subcontractor/Suppliers/Local Representatives
8. Subcontractor's Written Guarantee
9. Sub Contractor's Waiver of Lien (subcontractors/major suppliers)
10. Contractor's Haz-Mat Certificates
11. Subcontractor's Haz-Mat Certificates
12. Project Compliance Certificate
13. Extra Stock Verifications
14. Roofing Warranty & Documentation
15. Warranties
16. Include extended warranties page at beginning of warranty section.
17. Upon review and approval of Architect and Owner of closeout manuals, Contractor shall deliver (1) binder copy of the above material and (1) copy of the digitized & indexed (PDF) files to the Owner(@ the project site). Also Provide one duplicate DVD to the Architect. Refer to “Document Scanning” below for additional information concerning PDF scanning and bookmarking requirements. The cost of printing, scanning, and binding of Closeout Documents shall be paid by the Contractor.

I. **Document Scanning:** Upon review and approval of all closeout documents, including all information listed above, Contractor to contact reprographics or digital archiving company for PDF scanning and bookmarking of all information into one file for delivery to Owner on DVD readable by computer with Windows operating system. Note the following concerning PDF scanning and bookmarking:
1. Final documents shall be one digital file each for the following information indexed according to major and minor criteria as indicated below:
a. Record Drawings organized and bookmarked by drawing number and title
b. Record Specifications organized and bookmarked by specification number and name
c. Record Product Data organized and bookmarked by specification section and name
d. Operation and Maintenance Manuals organized and bookmarked by specification section and name
e. Closeout Manuals organized by contractor and/or subcontractor name and trade.
f. Include extended warranties page at beginning of warranty section.

2. Deliver 1 copy of DVD to the Owner and 1 copy to the Architect.

3. All documents shall be scanned at a minimum resolution of 300 dpi.

4. Submit proposed document table of contents to Architect for review prior to completion of scanning and bookmarking work.

5. OCR (searchable) PDF are NOT REQUIRED.

6. Approved Vendors for Reprographics, Digital Archiving, and Scanning:
   a. Thomas Printworks, 713-621-0022, www.thomasprintworks.com
   b. DataBank Houston, 713-645-0308, www.databankimx.com
   c. Delta T Digital Archiving, 972-494-2300, www.deltatltd.com

PART 2 - PRODUCTS

2.1 CLEANING AGENTS: Use cleaning materials and agents recommended by the 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.

PART 3 - EXECUTION

3.1 CLOSEOUT PROCEDURES

A. Operating and Maintenance Instructions: Arrange for each installer of equipment that requires regular maintenance to meet with the Owner's personnel to provide instruction in proper operation and maintenance. If installers are not experienced in procedures, provide instruction by manufacturer's representatives. Include a detailed review of the following items:
   1. Maintenance manuals.
   2. Record documents.
   3. Spare parts and materials.
   4. Tools.
   5. Lubricants.
   6. Fuels.
   7. Identification systems.
   8. Control sequences.
   9. Hazards.
   10. Cleaning.
   11. Warranties and bonds.
   12. Maintenance agreements and similar continuing commitments.

B. As part of instruction for operating equipment, demonstrate the following procedures:
   1. Start-up.
   2. Shut down.
   3. Emergency operations.
   4. Noise and vibration adjustments.
   5. Safety procedures.
   6. Economy and efficiency adjustments.
   7. Effective energy utilization.
   8. Upon review and approval of Architect and Owner of close-out manuals, Contractor to send documents to reprographics company for scanning. Refer to Section H below for additional information concerning PDF scanning and bookmarking requirements. The cost of scanning and bookmarking close out manuals shall be paid by the Contractor.

C. Demonstration and Training Video: Record instruction of Owner's personnel in the operation and maintenance of equipment and systems. Edit video to remove non-instructional conversation. Photographer shall select vantage points to best show equipment, systems, and procedures demonstrated.
   1. Contractor may, with Owner’s written approval and in compliance with other requirements, provide manufacturer’s standard demonstration and training video in lieu of on-site custom recorded video.

D. Attic Stock Materials Schedule: Provide a schedule of all attic stock materials. Include

information pertaining to quality, description, manufacturer, model no., color, and finish.

3.2 FINAL CLEANING

A. General: General cleaning during construction is required by the General Conditions and included in Section "Temporary Facilities".

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to the condition expected in a normal, commercial building cleaning and maintenance program. Comply with manufacturer's instructions.
   1. Complete the following cleaning operations before requesting inspection for Certification of Substantial Completion.
   2. Remove labels that are not permanent labels.
   3. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compound and other substances that are noticeable vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials.
   4. Clean exposed exterior and interior hard-surfaced finishes to a dust-free condition, free of stains, films and similar foreign substances. Restore reflective surfaces to their original reflective condition. Leave concrete floors broom clean. Vacuum carpeted surfaces.
   5. Wipe surfaces of mechanical and electrical equipment. Remove excess lubrication and other substances. Clean plumbing fixtures to a sanitary condition. Clean light fixtures and lamps.
   6. Clean the site, including landscape development areas, of rubbish, litter and foreign substances. Sweep paved areas broom clean; remove stains, spills and other foreign deposits. Rake grounds that are neither paved nor planted, to a smooth even-textured surface.

C. Removal of Protection: Remove temporary protection and facilities installed for protection of the Work during construction.

D. Compliance: Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the Owner's property. Do not discharge volatile, harmful or dangerous materials into drainage systems. Remove waste materials from the site and dispose of in a lawful manner.

   1. Where extra materials of value remaining after completion of associated Work have become the Owner's property, arrange for disposition of these materials as directed.

END OF SECTION

SECTION 01 73 29 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for cutting and patching.

B. Refer to other Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

1. Requirements of this Section also apply to mechanical and electrical installations, as well as work specified in Divisions 2 through 32. Refer to Division-23 and Division-26 Sections for other requirements and limitations applicable to cutting and patching mechanical and electrical installations.

1.3 SUBMITTALS

A. Cutting and Patching Proposal: Where approval of procedures for cutting and patching is required before proceeding, submit a proposal describing procedures well in advance of the time cutting and patching will be performed and request approval to proceed. Include the following information, as applicable, in the proposal:

1. Describe the extent of cutting and patching required and how it is to be performed; indicate why it cannot be avoided.
2. Describe anticipated results in terms of changes to existing construction; include changes to structural elements and operating components as well as changes in the building's appearance and other significant visual elements.
3. List products to be used and firms or entities that will perform Work.
4. Indicate dates when cutting and patching is to be performed.
5. List utilities that will be disturbed or affected, including those that will be relocated and those that will be temporarily out-of-service. Indicate how long service will be disrupted.
6. Where cutting and patching involves addition of reinforcement to structural elements, submit details and engineering calculations to show how reinforcement is integrated with the original structure.
7. Approval by the Architect to proceed with cutting and patching does not waive the Architect's right to later require complete removal and replacement of a part of the Work found to be unsatisfactory.

1.4 QUALITY ASSURANCE

A. Requirements for Structural Work: Do not cut and patch structural elements in a manner that would reduce their load-carrying capacity or load-deflection ratio.

1. Obtain approval of the cutting and patching proposal before cutting and patching the following structural elements:
    a. Foundation construction.
    b. Bearing and retaining walls.
    c. Structural concrete.
    d. Structural steel.

e. Lintels.
f. Structural decking.
g. Miscellaneous structural metals.
h. Equipment supports.
i. Piping, ductwork, vessels and equipment.
j. Structural systems of special construction in Division-13.

B. Operational and Safety Limitations: Do not cut and patch operating elements or safety related components in a manner that would result in reducing their capacity to perform as intended, or result in increased maintenance, or decreased operational life or safety.

1. Obtain approval of the cutting and patching proposal before cutting and patching the following operating elements or safety related systems:
   a. Shoring, bracing, and sheeting.
   b. Primary operational systems and equipment.
   c. Air or smoke barriers.
   d. Water, moisture, or vapor barriers.
   e. Membranes and flashings.
   f. Fire protection systems.
   g. Noise and vibration control elements and systems.
   h. Control systems.
   i. Communication systems.
   j. Conveying systems.
   k. Electrical wiring systems.
   l. Special construction specified by Division-13 Sections.

C. Visual Requirements: Do not cut and patch construction exposed on the exterior or in occupied spaces, in a manner that would, in the Architect's opinion, reduce the building's aesthetic qualities, or result in visual evidence of cutting and patching. Remove and replace Work cut and patched in a visually unsatisfactory manner.

1. If possible retain the original installer or fabricator to cut and patch the following categories of exposed Work, or if it is not possible to engage the original installer or fabricator, engage another recognized experienced and specialized firm:
   a. Matched-veneer woodwork.
   b. Preformed metal panels.
   c. Window wall system.
   d. Acoustical ceilings.
   e. Finished wood flooring.
   f. Carpeting.
   g. Aggregate wall coating.
   h. Wall covering.
   i. HVAC enclosures, cabinets or covers.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Use materials that are identical to existing materials. If identical materials are not available or cannot be used where exposed surfaces are involved, use materials that match existing adjacent surfaces to the fullest extent possible with regard to visual effect. Use materials whose installed performance will equal or surpass that of existing materials.

PART 3 - EXECUTION

3.1 INSPECTION

A. Before cutting existing surfaces, examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed. Take corrective action before proceeding, if unsafe or unsatisfactory conditions are encountered.

1. Before proceeding, meet at the 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.

3.2 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.

B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project that might be exposed during cutting and patching operations.

1. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
2. Take all precautions necessary to avoid cutting existing pipe, conduit or ductwork serving the building, but scheduled to be removed or relocated until provisions have been made to bypass them.

3.3 PERFORMANCE

A. General: Employ skilled workmen to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay.

1. Cut existing construction to provide for installation of other components or performance of other construction activities and the subsequent fitting and patching required to restore surfaces to their original condition.

B. Cutting: Cut existing construction using methods least likely to damage elements to be retained or adjoining construction. Where possible review proposed procedures with the original installer; comply with the original installer's recommendations.

1. In general, where cutting is required use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut holes and slots neatly to size required with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.
3. Cut through concrete and masonry using a cutting machine such as a carborundum saw or diamond core drill.
4. Comply with requirements of applicable Sections of Division-2 where cutting and patching requires excavating and backfilling.
5. By-pass utility services such as pipe or conduit, before cutting, where services are shown or required to be removed, relocated or abandoned. Cut-off pipe or conduit in walls or partitions to be removed. Cap, valve or plug and seal the remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after by-passing and cutting.

C. Patching: Patch with durable seams that are as invisible as possible. Comply with specified tolerances.

1. Where feasible, inspect and test patched areas to demonstrate integrity of the installation.
2. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
3. Where removal of walls or partitions extends one finished area into another, patch and repair floor and wall surfaces in the new space to provide an even surface of uniform color and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary to achieve uniform color and appearance.
4. Where patching occurs in a smooth painted surface, extend final paint coat over entire unbroken containing the patch, after the patched area has received primer and second coat.
5. Patch, repair or rehang existing ceilings as necessary to provide an even plane surface of uniform appearance.

3.4 CLEANING

A. Thoroughly clean areas and spaces where cutting and patching is performed or used as access. Remove completely paint, mortar, oils, putty and items of similar nature. Thoroughly clean piping, conduit and similar features before painting or other finishing is applied. Restore damaged pipe covering to its original condition.

END OF SECTION

SECTION 01 78 00 - WARRANTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies general administrative and procedural requirements for warranties and bonds required by the Contract Documents, including manufacturers' standard warranties on products and special warranties.
   1. Refer to the General Conditions for terms of the Contractor's special warranty of workmanship and materials.
   2. Refer to Section 01 80 00 – Special Owner Requirements for procedures to be followed in correcting work under warranty.
   3. Closeout requirements are included in Section "Execution and Closeout Procedures."
   4. Specific requirements for warranties for the Work and products and installations that are specified to be warranted, are included in the individual Sections of Divisions 2 - 33.
   5. Certifications and other commitments and agreements for continuing services to Owner are specified elsewhere in the Contract Documents.

B. Separate Prime Contracts: Each Contractor responsible for warranties related to his Contract.

1.3 DEFINITIONS

A. Standard Product Warranties are preprinted written warranties published by manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.

B. Special Warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the Owner.

1.4 WARRANTY REQUIREMENTS

A. The General Contractor will be the first point of contact for warranty work performed by subcontractors and manufacturers. Refer to Section 01 80 00 – Special Owner Requirements for procedures to be followed in reporting and correcting work under warranty.

B. Related Damages and Losses: When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.

C. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation. The warranty period shall not be extended.

D. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work, including the cost of equipment needed to perform the Work, regardless of whether the Owner has benefited from use of the Work through a portion of its anticipated useful service life.

E. Owner's Recourse: Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights, or remedies.
   1. Rejection of Warranties: Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.
      a. The Owner reserves the right to refuse to accept Work for the Project where a special warranty, certification, or similar commitment is required on such Work or part of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.

1.5 SUBMITTALS

A. Submit written warranties to the Architect prior to the date of activation. If the Architect's Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the Work, or a designated portion of the Work, submit written warranties upon request of the Architect.
   1. When a designated portion of the Work is completed and occupied or used by the Owner, by separate agreement with the Contractor during the construction period, submit properly executed warranties to the Architect within fifteen days of completion of that designated portion of the Work.
   2. When a special warranty is required, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the Owner through the Architect for approval prior to final execution.
   3. Forms for special warranties are included at the end of particular Sections. Prepare a written document utilizing the appropriate form, ready for execution by the warrantor. Submit a draft to the Owner through the Architect for approval prior to final execution.
      a. Refer to individual Sections of Divisions-2 through -16 for specific content requirements, and particular requirements for submittal of special warranties.

B. Form of Submittal: At Final Completion compile two copies of each required warranty and bond, properly executed. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual.
   1. Bind warranties and bonds in heavy-duty, commercial quality, durable 3-ring vinyl covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2" by 11" paper.
      a. Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark the tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product, and the name, address and telephone number of the installer.
      b. Identify each binder on the front and the spine with the typed or printed title "WARRANTIES AND BONDS, the Project title or name, and the name of the Contractor.
   2. When operating and maintenance manuals are required for warranted construction, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

PART 2 - PRODUCTS (Not applicable).

PART 3 - EXECUTION (Not applicable).

END OF SECTION

SECTION 01 78 10 – CERTIFICATION OF PROJECT COMPLIANCE

CERTIFICATION OF PROJECT COMPLIANCE

Completion of this form is required under the provisions of §61.1036(c)(3)(F) TAC for all public school district construction projects. Instructions for completion of this form can be found on page 2.

1. PROJECT INFORMATION

Facility:

Address:

City:

DISTRICT:

ARCHITECT/ENGINEER: Stantec

CONTRACTOR/CM:

CONTRACT DATE:

DATE DISTRICT AUTHORIZED PROJECT:

BRIEF DESCRIPTION OF PROJECT: A new sixth grade school facility comprising of classrooms, labs, administrative offices, and dining area with full kitchen.

2. CERTIFICATION OF DESIGN AND CONSTRUCTION

The intent of this document is to assure that the school district has provided to the architect/engineer the required information and the architect/engineer has reviewed the School Facilities Standards as required by the State of Texas, and used his/her reasonable professional judgment and care in the architectural/engineering design and that the contractor has constructed the project in a quality manner in general conformance with the design requirements and that the school district certifies to project completion.

3. The District certifies that the educational program and the educational specifications of this facility along with the identified building code to be used have been provided to the Architect/Engineer.

DISTRICT: **BY:** **DATE:**

4. The Architect/Engineer certifies the above information was received from the school district, and that the building(s) were designed in accordance with the applicable building codes. Further, the facility has been designed to meet or exceed the design criteria relating to space (minimum square footage), educational adequacy, and construction quality as contained in the School Facilities Standards as adopted by the Commissioner of Education, June 9, 2003, and as provided by the district.

ARCHITECT/ENGINEER **BY:** **DATE:**

5. The Contractor/CM certifies that this project has been constructed in general conformance with the construction documents as prepared by the Architect/Engineer listed above.

CONTRACTOR/CM: **BY:** **DATE:**

DISTRICT: **BY:** **DATE:**

6. The District certifies completion of the project (as defined by the Architect/Engineer and Contractor).

INSTRUCTIONS FOR COMPLETION OF "CERTIFICATION OF PROJECT COMPLIANCE" FORM

Section 1. Identify the following:
- name and address of the school facility
- name of the school district
- the Architect/Engineer and Contractor
- the date of execution of the construction contract
- the date that the school district authorized the superintendent to hire an architect/engineer
- scope of the project.

Section 2. This section outlines the intent of the document. No action required.

Section 3. This section is to be executed by the school district upon transmittal of the information (as listed) to the architect/engineer and is to remain in the custody of the school district throughout the entire project.

Section 4. This section is to be executed by the architect/engineer upon completion of the plans and specifications and in conjunction with the completion of the plan review for code compliance (ref. 19 TAC §61.1033 or §61.1036, School Facilities Standards) and returned to the school district's files.

Section 5. This section is to be executed by the contractor upon substantial completion of the project and retained in the school district's files.

Section 6. This section is to be executed by the school district upon acceptance and occupancy of the project.

NOTE: DO NOT SUBMIT THIS DOCUMENT TO THE TEXAS EDUCATION AGENCY. The school district will retain this document in their files indefinitely until review and/or submittal is required by representatives of the Texas Education Agency.

END OF DOCUMENT

SECTION 01 80 10

PROJECT PHOTOGRAPHIC DOCUMENTATION

PART 1 – SUMMARY

1.1 SECTION INCLUDES:

A. Comprehensive digital photographic documentation of the construction process progressively and at selected milestones.

B. Documentation inclusive of electronic indexing, navigation, storage and remote access throughout construction.

C. Support, security of information and technological requirements related to the documentation.

D. Delivery of completed photographic documentation shall be provided in digital PDF format on a portable drive system (“thumb drive”). Files shall be placed in separate directories on the drive, with name of each directory being the date of the photographic record. Obtain receipt from Owner.

PART 2 –REQUIREMENTS

2.1 GENERAL DOCUMENTATION

A. Indexing and navigation system shall utilize actual construction drawings or equivalent as the basis for an interactive on-line interface. For all documentation referenced herein, indexing and navigation must be organized by both time (date-stamped) and location throughout the Project.

B. Documentation shall combine indexing and navigation system with inspection-grade high-resolution digital photography designed to capture actual conditions throughout construction and at critical milestones. Documentation shall be accessible to the Owner, Architect, Consultants, and Contractor without copyright on-line through use of an Internet connection arranged by this Contractor during construction. Documentation shall allow for multiple-user access, simultaneously, on-line. Access shall adhere to industry standards for information security and protection of data. Multi-tiered access levels shall be achievable through use of individual passwords, if required by the Owner.

C. Before construction, the building pad, adjacent streets, roadways, parkways, driveways, curbs, sidewalks, landscaping, adjacent utilities and adjacent structures surrounding the building pad and site shall be photographed. Overlapping photographic techniques shall be used to insure maximum coverage. Indexing and navigation accomplished through interactive architectural drawings. If site work or pad preparation extensive, this documentation shall be provided immediately before construction and at several pre-determined intervals before first work commences.

D. Construction progress for all trades shall be tracked at pre-determined intervals, but not less than once every thirty (30) calendar days (“Progressions”). Progression documentation shall comprehensively track both the exterior and interior construction or renovation of the building(s). Exterior Progressions shall track 360 degrees around the site and each building. Interior Progressions shall track interior improvements beginning when stud work commences and continuing until Project completion.

E. As-built condition of pre-slab utilities and site utilities shall be documented prior to pouring slabs, placing concrete and/or backfilling. This process shall include all underground and in-slab utilities within the building(s) envelope(s) and utility runs in the immediate vicinity of the building(s) envelope(s). This shall also include utilities enclosed in slab-on-deck in multi-story buildings. Overlapping photographic techniques shall be used to insure maximum coverage. Indexing and navigation shall be accomplished through interactive site utility plans.

F. As-built conditions of mechanical, electrical, plumbing and all other systems shall be documented post-inspection and pre-insulation, wall finish installation or as near to this milestone as is reasonably possible. This process shall include all finished systems located in the walls and ceilings of all buildings at the Project. Overlapping photographic techniques shall be used to insure maximum coverage. Indexing and navigation shall be accomplished through interactive architectural drawings.

G. As-built conditions of exterior skin and elevations shall be documented with an increased concentration of digital photographs as directed by Owner in order to capture pre-determined focal points, such as waterproofing, window flashing, steel work, architectural or plaster detailing. Overlapping photographic techniques shall be used to insure maximum coverage. Indexing and navigation shall be accomplished through interactive elevations or elevation details.

H. As-built finished conditions of the interior of each building including floors, ceilings and walls shall be documented at certificate of occupancy or equivalent, or just prior to tenant/owner occupancy, or both, as directed by Owner. Overlapping photographic techniques shall be used to insure maximum coverage. Indexing and navigation shall be accomplished through interactive architectural drawings.

I. Miscellaneous events that occur during any Contractor site visit, or events captured by the Client independently, shall be dated, labeled and inserted into a Section in the navigation structure entitled “Slideshows,” allowing this information to be stored in the same “place” as the formal scope.

J. Customizable project-specific digital photographic documentation shall take place of other details or milestones. Indexing and navigation shall be accomplished through interactive architectural plans.

PART 3 – SPECIFIC PROJECT DOCUMENTATION

A. Slideshows – Shows overall stages of construction for the project in a slideshow format. The slideshow section also shall allow for the inclusion of client pictures, aerial photographs, and other timely images which do not fit into any regular photo path.

B. Existing Conditions Site Survey of the existing building pad as well as all streets, curbs, parking, landscaping and structures immediately adjacent to the proposed project area. The existing conditions survey shall occur just prior to the start of construction, to be scheduled by client.

C. Monthly UAV Drone Progressions to include both panoramic photos and aerial video of the entire project site captured monthly, or as directed by client.

D. Monthly Exterior Progressions 360 degrees around the structure to include all elevations and building envelope on monthly intervals, or as directed by client.

E. 5 Sets of Interior Wall Progressions that captures each major wall at framing, substantial MEP, drywall, paint/trim, punch list, or as directed by client.

F. 5 Sets of Interior Ceiling Progressions that captures overhead system placement, typically at fireproof, plumbing, data cable, mechanical HVAC, or as directed by client.

G. MEP As-Built of the entire building to include documentation of all mechanical, electrical and plumbing systems, to be conducted after rough-ins are complete, just prior to insulation and or drywall, or as directed by client.

END OF SECTION

SECTION 01 91 00 - GENERAL COMMISSIONING REQUIREMENTS

PART 1 – GENERAL

1.1. RELATED DOCUMENTS

1.1.1. Specifications throughout all Divisions of the Project Manual, which pertain to operable and non-operable equipment and/or building systems, are directly applicable to this Section, and this Section is directly applicable to them.

1.2. SUMMARY

1.2.1. This Section establishes general and administrative requirements pertaining to commissioning of equipment, devices, and building systems on the project. Technical requirements for commissioning of particular systems and components are established in the respective technical sections of this Project Manual.

1.2.2. It is of primary concern that all operable systems installed in the Project perform in accordance with the Contract Documents, the Owner's Project Requirements (OPR) and the Basis of Design (BOD). During Commissioning, the Contractor systematically demonstrates to the Owner or Owner's representative that the operable systems have been installed and performing in strict accordance with the Contract Documents.

1.2.3. Commissioning requires cooperation and involvement of all parties throughout the construction process. The Contractor shall deliver a successful Commissioning process. Successful Commissioning requires that installation of all building systems complies with Contract Document requirements and that full operational check-out and necessary adjustments are performed prior to Substantial Completion with the exception of Deferred tests approved in advance by the Owner.

1.2.4. Commissioning will encompass and coordinate traditionally separate functions of system documentation, installation checkout, System Verification Checklists and start-up, control system calibration and point-to-point checkout, testing, adjusting, and balancing, Functional Performance Tests, Integrated System Tests, Contractor demonstration to the Owner, and training of Owner's personnel. This requires assembling all related documentation into one cohesive collection. Commissioning is intended to achieve the following specific objectives of the Contract Documents:

1.2.4.1. Verify and document proper installation and intended performance of equipment, systems, and integrated systems.

1.2.4.2. Ensure that operating and maintenance and Commissioning documentation requirements are complete.

1.2.4.3. Provide the Owner with functional buildings and systems that meet the Contract Document requirements and the Owner's Project Requirements (OPR) at Substantial Completion.

1.3. DEFINITIONS

1.3.1. Basis of Design (BOD): A document that records the concepts, calculations, decisions, and product selections used to meet the Owner's Project Requirements 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.

1.3.2. Commissioning (Cx): A systematic process confirming that building systems have been installed, properly started, and consistently operated in strict accordance with the Project

Documents, that all systems are complete and functioning in accordance with the Contract Documents at Substantial Completion, and the Contractor has provided the Owner adequate system documentation and training.

1.3.3. Commissioning Authority (CxA): Party having a contractual agreement with the Owner to provide third party commissioning services as defined herein under Commissioning Authority's Role and Responsibilities. Commissioning Authority may represent the Owner and is authorized to act on behalf of the Owner. The Commissioning Authority does not have authority to alter design or installation procedures without the written approval of the Owner or the design team.

1.3.4. Contract Documents: The General Conditions, Drawings, Specifications, Addenda, and other documents developed by the A/E Team and approved by the Owner that constitute the contractual obligations of the project scope.

1.3.5. Control Point and Sensor Calibration Verification: Process of verifying the point integrity and/or sensor calibration from the physical point of monitoring (sensor, contact, actuator, etc.) to the digital point location at the Operator's interface within the respective control system (Building Automation, Lighting Controls, Power Status and Monitoring, etc.).

1.3.6. Deferred Testing: Functional Performance or Integrated System Tests performed after Substantial Completion due to partial occupancy, partial equipment acceptance, seasonal requirements, design, or other site conditions that prohibit the test from being performed prior to Substantial Completion.

1.3.7. Deficiency: Condition of a component, piece of equipment, or system that is not in compliance with the Project Documents.

1.3.8. Functional Performance Test (FPT): Test of dynamic function and operation of equipment and systems executed by the Contractor and witnessed by the CxA. Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, life safety conditions, power failure, etc. Systems are operated through all specified sequences of operation. Components are verified to be responding in accordance with requirements in the Project Documents.

1.3.9. Functional Performance Testing Procedures: Commissioning protocols, detailed test procedures and instructions in tabular and script-type format that fully describe system configuration and steps required to determine if the system is performing and functioning properly.

1.3.10. Integrated Systems Test (IST): Test of dynamic function and operation of multiple systems. Integrated Systems Tests are tested under various modes, such as fire alarm and emergency situations, life safety conditions, power failure, etc. Systems are integrally operated through all specified sequences of operation. Systems and interconnections are verified to be responding in accordance with the requirements in the Project Documents.

1.3.11. Integrated Systems Testing Procedures: Commissioning protocols and detailed test procedures and instructions in tabular and script-type format that fully describe system configurations and steps required to determine if the interacting systems are performing and functioning properly.

1.3.12. Operational Testing: Activities and testing occurring after initial energizing and/or start-up of equipment that determine whether equipment is operating within the manufacturer's recommendations and the design requirements. These activities are intended to ensure that equipment and systems meet all warranty requirements and are ready for Functional Performance Testing. Common examples are Testing, Adjusting and Balancing of HVAC systems and initial load testing of electrical equipment.

1.3.13. Owner's Project Requirements (OPR): A written document that details the functional requirements of a project and the expectations of how the facility will be used and operated. These include project goals, measurable performance criteria, cost considerations, benchmarks, success criteria and supporting information.

1.3.14. Project Documents: Consists of the Contract Documents, Approved Submittals, Requests for Information (RFI), Vendor documentation, Operations and Maintenance (O&M) information and other documentation that determines the requirements for acceptable installation and operation of the specific equipment and systems on the project.

1.3.15. System Verification Checklist (SVC): A list of static inspections and material or component tests that verify proper installation of equipment (e.g., belt tension, oil levels, labels affixed, gages in place, sensors calibrated, etc.), start-up activities and documentation, as well as operational testing results. The checklists are meant to document all activities for an individual piece of equipment from procurement on the project through operational testing are performed in accordance with the requirements in the project documents.

1.3.16. Start-up: The activities where equipment is initially energized, tested and operated. Start-up is completed prior to Operational Testing and Functional Performance Testing and is an integral item documented in the System Verification Checklist (SVC).

1.3.17. Training Plan: A detailed plan prepared by the Contractor and reviewed by the Owner and Commissioning Authority that outlines the training activities, instructors, time durations, and system requirements in accordance with the Contract Documents and Commissioning Plan.

1.3.18. Trending: Data collection of monitored points using the Building Automation System, Lighting Controls System, Power Status and Monitoring System or independent data acquisition instrumentation.

1.4. COMMISSIONING TEAM

1.4.1. Owner shall appoint the following Members:
- 1.4.1.1. Owner's Project Manager and any other designated representatives of the Owner's staff.
- 1.4.1.2. Commissioning Authority (CxA)
- 1.4.1.3. Architect/Engineer (A/E)
- 1.4.1.4. Test, Adjust and Balance Firm (TAB) – may be sub-contracted to the CxA

1.4.2. Contractor shall appoint the following Members:
- 1.4.2.1. Individuals, each having authority to act on behalf of the entity they represent, explicitly organized to implement the Commissioning process through coordinated actions. At a minimum, the Contractor shall designate a Commissioning Coordinator and each major sub-contractor (Mechanical,

Electrical, Plumbing, Building Automation) shall have a dedicated representative.

1.4.2.2. Vendor representatives (as needed) required for start-up, operational testing, Functional Performance Testing, Integrated Systems Testing, and Owner Training activities.

1.4.2.3. Representatives of independent testing agencies (Test, Adjust and Balance, Electrical Testing Agency, etc.)

1.5. ROLES AND RESPONSIBILITIES

1.5.1. Roles and responsibilities of Commissioning Team members related to the Commissioning Process are provided in this Section. The respective entities defined below shall fulfill the listed roles and responsibilities as contained herein. Specific technical roles and responsibilities are defined in other sections of the Project Specifications.

1.5.2. Owner's Roles and Responsibilities:

1.5.2.1. Provide guidance in development of the Owner's Project Requirements (OPR).

1.5.2.2. Review Technical Specifications containing Commissioning requirements.

1.5.2.3. Approve the Commissioning Scope of Work and schedule of Commissioning activities.

1.5.2.4. Assign Owner's representatives and schedule them to participate in Commissioning activities, including the following:

1.5.2.4.1. Commissioning Team meetings.

1.5.2.4.2. Review and approval of the Commissioning Plan, Training Plan, System Verification Checklist templates, Functional Performance Test Procedures, Integrated Systems Test Procedures, Deferred Testing Plans, Final Commissioning Process Report, Systems Manual, Measurement and Verification Plan and other Commissioning documents.

1.5.2.4.3. Attend Owner Training sessions in operation and maintenance of systems and equipment.

1.5.2.4.4. Observation of Contractor's demonstration of systems and equipment operation.

1.5.3. Commissioning Authority's (CxA) Roles and Responsibilities:

1.5.3.1. Prepare the Commissioning Plan with the Owner's and Contractor's review and input.

1.5.3.2. Periodically attend and/or review the proceedings of the regular Construction Meetings hosted by the Contractor to understand the progress of construction activities on the project.

1.5.3.3. Conduct and document Commissioning Team meetings including the Commissioning Kickoff Meeting.

1.5.3.4. Perform site visits as necessary to observe component and system installations prior to energizing or start-up of equipment and systems.

1.5.3.5. Review and comment on product data and shop drawing submittals and coordination drawings applicable to systems being commissioned.

1.5.3.6. Following submittal review and approvals by the A/E team, review the sequences of operation and coordinate with the Contractor and A/E Team in order to prepare the Functional Performance Test Procedures and Integrated Systems Test procedures. Submit to the Owner and Contractor for review and comment prior to facilitating FPTs and ISTs on the project.

1.5.3.7. Upon written notice that equipment or systems are ready for initial energizing or start-up, review the progress of the System Verification Checklist(s) for the respective systems and components and ensure that all requirements have been completed by the Contractor to permit energizing or start-up in accordance with the project documents; CxA shall issue written notice to the Owner and Contractor that equipment is ready to energize or start-up. CxA will witness and ensure proper documentation is provided by the Contractor for major equipment energizing and start-ups as executed by the Contractor with appropriate notice as indicated herein.

1.5.3.8. Witness, verify, and document results of Functional Performance Tests and Integrated Systems Tests.

1.5.3.9. Coordinate resolution of deficiencies identified during site observations, equipment energizing or start-up, Functional Performance Testing, Integrated Systems Testing, Deferred Testing, and during the warranty period.

1.5.3.10. Review the Operating and Maintenance (O&M) documents to ensure that as-built information and correct data is included prior to the Owner Training sessions; review final O&M submittal to ensure compliance with the requirements in the project documents and provide written comments to the Owner.

1.5.3.11. Review the Contractor's Training Plan and individual training agendas for compliance with the requirements in the project documents. Recommend acceptance to the Owner prior to the Contractor scheduling training sessions with the Owner. Review the attendance and content of the training sessions to ensure the requirements of the project documents are completed. Conduct a survey of the Owner's personnel to evaluate the effectiveness of the Owner Training.

1.5.3.12. Compile the Final Commissioning Process Report and submit to the Owner for review and approval.

1.5.4. Architect/Engineer's (A/E) Roles and Responsibilities:

1.5.4.1. Specify control sequences of operation within the Contract Documents that comply with the OPR and BOD.

1.5.4.2. Incorporate Commissioning requirements into the Contract Documents if requested by the Owner.

1.5.4.3. Attend Commissioning Team meetings.

1.5.4.4. Review the Commissioning Plan, System Verification Checklist templates, Functional Performance Test Procedures, Integrated Systems Test Procedures, Deferred Testing Plans, and other Commissioning documents as required by the Owner or the Contract Documents.

1.5.4.5. Review Contractor's Training Plan and provide comments to the Owner.

1.5.4.6. Approve technical requirements for correction of Deficiencies identified during Commissioning, Deferred Tests, and during the warranty period.

1.5.4.7. Review Operating and Maintenance Manuals and provide comments to the Owner.

1.5.5. Contractor's Roles and Responsibilities:

1.5.5.1. Contractor shall review and provide comments on documents produced by the Commissioning Authority, and shall accept the Commissioning Plan, System Verification Checklists, Functional Performance Test Procedures, and Integrated System Test Procedures as approved by the Owner.

1.5.5.2. Provide an individual, subject to the Owner's approval, experienced in construction and Commissioning of building systems to organize, schedule, conduct, and document the Contractor's responsibilities in the Commissioning process. The Contractor shall assign this individual to act as the Contractor's Commissioning Coordinator. The Contractor's Commissioning Coordinator may have additional duties such as MEP Coordinator, but not as Project Manager or Superintendent. Submit qualifications demonstrating the Commissioning Coordinator's technical expertise and experience to the Owner for approval. In the event that Contractor chooses to subcontract its Commissioning obligations, then Contractor must submit the subcontractor's qualifications and personnel to Owner for Owner's approval.

1.5.5.3. Furnish and install systems that meet all requirements of the Contract Documents.

1.5.5.4. Ensure that Commissioning Process activities are incorporated into the Master Project Schedule. The Contractor shall coordinate with the CxA and the Owner to determine the required activities, durations and predecessors.

1.5.5.5. Submit inspection requests, start-up requests and all supporting documentation in accordance with the Contract Documents, General Conditions, and Commissioning Plan.

1.5.5.6. Cooperate with Owner's representative(s), provide access to work and provide adequate labor, resources, and time for Commissioning.

1.5.5.7. Furnish copies of all shop drawings and submittals, manufacturers' literature, maintenance information, and any other information required for the Commissioning process. Contractor must submit to the Owner installation and checkout materials actually shipped inside equipment and actual field checkout sheet forms used by the factory or field technicians. This requirement does not supersede any additional requirements contained in the Contract Documents.

1.5.5.8. Schedule and conduct pre-installation meetings and pre-commissioning meetings with subcontractors and equipment suppliers related to Commissioning. Contractor must invite Architect/Engineer, Owner and CxA to attend the pre-installation meetings and pre-commissioning meetings.

1.5.5.9. Provide qualified personnel, including subcontractors as required, to fully perform the testing and operational demonstrations required by the Contract Documents and the Commissioning Plan, including any Deferred Testing or re-testing related to warranty work.

1.5.5.10. Correct deficiencies identified during any stage of the Commissioning process.

1.5.5.11. Coordinate with the CxA to develop the Training Plan and submit to the Owner for approval. Provide training to the Owner's personnel in accordance with the Contract Documents and the approved Training Plan. Coordinate with the Owner to schedule training sessions and coordinate subcontractor/vendor participation in all training sessions.

1.5.5.12. Perform Deferred Testing and make necessary amendments to Operating and Maintenance Manuals and as-built drawings for applicable issues identified during the Deferred Testing.

1.5.5.13. Perform system maintenance during construction as specified and recommended by the Owner and send the maintenance records to the Owner for Record.

1.5.5.14. Document the equipment as it arrives onsite to ensure that the submitted and received equipment is correct as it arrives onsite, including the completion of the system verification sections pertaining to the procurement process.

1.6. SYSTEMS TO BE COMMISSIONED

1.6.1. The following systems shall be commissioned according to the process defined in this Section:

1.6.1.1.1 Major HVAC Systems (100% including but not limited to the list below)
1.6.1.1.2 Air Handling Units
1.6.1.1.3 Fan Coil Units
1.6.1.1.4 Exhaust Fans
1.6.1.1.5 Supply Fans
1.6.1.1.6 Pumps
1.6.1.1.7 Chillers
1.6.1.1.8 Boilers

1.6.1.2. Terminal Units (10% Sampling)

1.6.1.3. Building Automation System

1.6.1.4. Lighting Controls - Occupancy Sensors (25% greater than 25 sensors installed, 100% less than 25 sensors installed)

1.6.1.5. Lighting - Daylight Controls (100%)

1.6.1.6. Lighting - Time Switch Controls (100%)

1.6.1.7. Normal and Emergency Power Systems

PART 2 - PRODUCTS

2.1. COMMISSIONING PLAN

2.1.1. Document developed by the CxA that provides the structure, schedule, and coordination plan for the Commissioning Process from the Pre-construction phase through the Occupancy Phase. The Commissioning Plan shall describe the project and systems to be commissioned, Commissioning Process activities and deliverables, procedures to follow throughout the process, specific roles and responsibilities for each participant, and general description of testing and verification methods.

2.1.2. The Commissioning Plan shall comply with the Owner's Project Requirements (OPR).

2.1.3. The Commissioning Team shall review the Commissioning Plan prior to the Pre-Commissioning Meeting and submit written comments or questions to the CxA to be addressed in the meeting.

2.1.4. Following the Pre-Commissioning meeting, the CxA shall incorporate all changes discussed and agreed upon in the Pre-Commissioning meeting and submit the Final Commissioning Plan to the Commissioning Team for approval and acceptance.

2.1.5. If changes to the Commissioning Plan are needed during the Commissioning Process, the CxA shall edit the plan and distribute to the Commissioning Team for approval and acceptance.

2.1.6. The Contractor's acceptance shall constitute acceptance of all parties sub-contracted to the Contractor. The Contractor shall ensure that all sub-contractors and vendors agree and accept the Commissioning Plan.

2.2. SYSTEM VERIFICATION CHECKLISTS

2.2.1. System Verification Checklists (SVCs) are important to ensure that the equipment and systems are connected and operational and that Functional Performance Testing proceeds without unnecessary delays. These checklists document the inspections and procedures necessary to take a piece of equipment from a static state into an operating state. These checklists augment the manufacturer's start-up checklists to provide a complete document from procurement to the start of Functional Performance Testing when combined.

2.2.2. The CxA shall develop the System Verification Checklist templates for review by the Cx Team. The Contractor, appropriate Subcontractors and Vendors shall support the CxA in development of SVCs for each system and components by providing any necessary supporting documentation as requested by the CxA and reviewing and commenting on the checklist templates in accordance with the Project Specifications and the Commissioning Plan.

2.2.3. Once the checklist templates are reviewed and accepted, the CxA will produce checklists for all equipment and components to be commissioned on the project utilizing an

electronic commissioning database that is accessible via web portal or local field tool (i.e., iPad, tablet, laptop, etc.).

2.2.4. The CxA shall provide login access and training to the Contractor and other members of the Cx Team in the use of the electronic commissioning database.

2.2.5. The Contractor shall be responsible for completing the required sections of the System Verification Checklists utilizing the electronic commissioning database and providing all supporting documentation via electronic transmittal to the CxA. Additional requirements for completion of the SVCs are included in this section and other technical sections of the Specifications.

2.2.6. Once equipment arrives on the project site, the Contractor or sub-contractors shall begin completing the individual checklists and continue throughout the installation process. The checklists are meant to be progressive and a tool for tracking progress.

2.2.7. Once the SVCs are electronically completed, the CxA will review and approve the checklists and supporting documentation and compile the information to include in the Final Commissioning Process Report.

2.3. FUNCTIONAL PERFORMANCE TESTING PROCEDURES:

2.3.1. The purpose of the Functional Performance Testing Procedures is to verify and document that the equipment and systems on the project individually perform in accordance with the requirements in the Contract Documents and meet the Owner's Project Requirements.

2.3.2. The CxA shall develop specific script-type test procedures to verify and document proper operation of each piece of equipment and system. The Contractor shall provide any supporting information to the CxA that may be needed including but not limited to product submittals, O&M information, and sequences of operation. Once developed, the CxA will issue to the Cx Team for review and comment.

2.3.3. The Commissioning Team shall review the Functional Performance Test procedures and submit written comments or questions to the CxA. The Contractor shall ensure that the sub-contractors and any vendors that would be involved with Functional Performance Testing review the procedures and provide comments.

2.3.4. The CxA will coordinate with the Cx Team to address any comments and produce the final FPT procedures for acceptance by the Cx Team. The Contractor's acceptance shall constitute acceptance of all parties sub-contracted to the Contractor.

2.3.5. The Contractor shall utilize the FPT procedures for any pre-testing activities prior to Functional Performance Testing.

2.4. INTEGRATED SYSTEMS TESTING PROCEDURES:

2.4.1. The purpose of the Integrated Systems Testing Procedures is to verify and document that all the integrated equipment and systems on the project perform together in accordance with the requirements in the Contract Documents and meet the Owner's Project Requirements.

2.4.2. The CxA shall develop specific script-type test procedures to verify and document proper operation of the integrated systems throughout the facility. The Contractor shall provide

any supporting information to the CxA that may be needed including but not limited to product submittals, O&M information, and sequences of operation. Once developed, the CxA will issue to the Cx Team for review and comment.

2.4.3. The Commissioning Team shall review the Integrated Systems Testing procedures and submit written comments or questions to the CxA. The Contractor shall ensure that the sub-contractors and any vendors that would be involved with Integrated Systems Testing review the procedures and provide comments.

2.4.4. The CxA shall coordinate with the Cx Team to address any comments and produce the final IST procedures for acceptance by the Cx Team. The Contractor's acceptance shall constitute acceptance of all parties sub-contracted to the Contractor.

2.4.5. The CxA shall also develop the IST personnel matrix that will be utilized to track the individual testing teams involved with the IST. The CxA will distribute the matrix to the Cx Team so that the Contractor and Owner can assign the appropriate personnel to the appropriate teams.

2.4.6. The CxA shall also host a coordination meeting prior to the IST to review the IST procedures, complete any final coordination, review safety procedures, and answer any questions.

2.4.7. The CxA estimates there will be two Integrated Systems Tests on the project. The first will test the Data Center systems separately and the second will test the entire facility. Requirements of the testing are included in the respective technical sections of the Project Specifications.

2.4.8. The IST procedures shall be utilized by the Contractor for any pre-testing activities prior to official Integrated Systems Testing.

2.5. TRAINING PLAN

2.5.1. Contractor, in coordination with Owner and CxA, shall develop the Training Plan with project specific requirements for Owner Training, after reviewing the different systems to be installed and commissioned. The purpose of the Training Plan is to specifically communicate the required content and training durations required by the Owner based upon the type of equipment and the Owner's past experience.

2.5.2. The Contractor shall review all of the individual technical sections of this specification for specific training requirements.

2.5.3. The Contractor shall coordinate with the Owner to ensure that the proposed training requirements meet the Owner's needs and expectations.

2.5.4. The Contractor shall coordinate with the sub-contractors and vendors to ensure the Owner Training requirements can be achieved and gather any additional information or recommendations.

2.5.5. Any changes to the training requirements in this specification must follow contractual protocols.

2.5.6. The Training Plan shall include a list of systems and equipment for which training will be provided according to the three-tiered training approach outlined in the project specifications.

2.5.7. All training sessions shall have a syllabus indicating the following as a minimum in addition to any other specification requirements:

2.5.7.1. Session Objectives

2.5.7.2. Proposed Instructor(s)

2.5.7.3. Instructor Qualifications

2.5.7.4. Training Materials that will be provided

2.5.7.5. Location and durations of the various parts of the training session (i.e., Classroom, On-site, etc.)

2.5.7.6. Applicable specification sections and O&M Manual sections

2.5.7.7. Detailed outline of training session content

2.5.8. The Contractor shall coordinate with the CxA to organize the systemic training sessions comparable to the organization of the Systems Manual.

2.5.9. Owner training must be completed prior to the contractor obtaining substantial completion by the Owner.

2.6. FINAL COMMISSIONING PROCESS REPORT

2.6.1. The CxA shall prepare the Final Commissioning Process Report that will include the following:

2.6.1.1. Executive Summary

2.6.1.2. Participants and Roles

2.6.1.3. Brief building description

2.6.1.4. Overview of commissioning and testing scope

2.6.1.5. General description of testing and verification methods

2.6.1.6. Appendices with supporting information, issues log, and communications

2.6.2. The Contractor shall coordinate with the CxA to provide any additional information that may be needed to complete the Final Commissioning Process Report.

2.6.3. The Contractor shall resolve any outstanding commissioning items prior to the CxA preparing the final commissioning report.

2.6.4. The CxA shall issue the Final Commissioning Process Report to the Cx Team for review. The Owner shall approve the Final Commissioning Process report after any comments or discrepancies are resolved by the CxA.

PART 3- EXECUTION

3.1. PROJECT SCHEDULE

3.1.1. The Contractor shall integrate all Commissioning activities into the detailed Project Schedule. All parties will address scheduling problems and make necessary notifications in a timely manner to expedite the Commissioning Process.

3.2. COMMISSIONING TEAM MEETINGS

3.2.1. Upon obtaining Owner's approval of the Commissioning Plan, the CxA shall coordinate with the Cx Team to schedule, plan, and conduct a Pre-Commissioning Meeting with all parties involved in the Commissioning process. This meeting should include the major subcontractors, specialty manufacturers/suppliers, Architect/Engineer, Test, Adjust, and Balance (TAB) Firm, Electrical Testing Agency, and Owner's representatives as participants.

3.2.2. Contractor shall prepare for the Pre-Commissioning Meeting by supplying the following documents created by the CxA to all applicable sub-contractors and vendors: Commissioning Plan, Example System Verification Checklists, Example Functional Performance Test Procedures and Example Integrated Systems Test Procedures.

3.2.3. The CxA shall conduct the Pre-Commissioning Meeting and review all aspects of the Commissioning Plan and applicable specifications.

3.2.4. The Commissioning Plan shall be reviewed with all attendees and the scope of work discussed. Contractor should be prepared to distribute copies of the pertinent sections to the various subcontractors involved in the Commissioning process.

3.2.5. The final outcome of the meeting shall be an understanding of the commissioning process, roles and responsibilities, and consensus acceptance of the Commissioning Plan by the Cx Team.

3.2.6. The Contractor may request additional meetings with the CxA and individual sub-contractors to clarify roles, responsibilities and procedures as needed.

3.3. TEST EQUIPMENT

3.3.1. Contractor shall provide all specialized tools, test equipment and instruments required to execute start-up, checkout, and testing of equipment.

3.3.2. All specialized tools, test equipment and instruments required to execute start-up, checkout, and testing of equipment shall be of sufficient quality and accuracy to test and/or measure system performance within specified tolerances. A testing laboratory must have calibrated test equipment within the previous twelve (12) months. Calibration shall be NIST traceable. Contractor must calibrate test equipment and instruments according to manufacturer's recommended intervals and whenever the test equipment is dropped or damaged. Calibration tags must be affixed to the test equipment or certificates readily available.

3.4. REPORTING

3.4.1. Beginning at the procurement stage for the equipment included in the Cx scope, the Contractor shall communicate at least monthly with all members of the Commissioning Team, keeping them apprised of construction progress and scheduling changes.

3.4.2. Contractor shall submit Deficiency reports to the Owner within five (5) days of the deficiency occurrence. This includes responses to items noted by the Commissioning Authority.

3.5. DEFICIENCY RESOLUTION

3.5.1. The CxA shall document any issues noted during observation or testing activities in the Commissioning Issues Log (CxIL). The CxIL shall be distributed electronically to the Cx Team at regular intervals.

3.5.2. The Contractor shall respond in writing to the CxA within 10 days to all new CxIL items regardless of the disposition. This response does not constitute a request for re-verification, only an acknowledgement of the outstanding item. The Contractor should utilize CxIL responses to update the Cx Team on the progress of deficiency resolution.

3.5.3. The Contractor shall respond to the CxA and the Owner indicating CxIL items that are completed and ready for the CxA to verify completion.

3.5.4. If any item indicated complete by the Contractor is found to be incomplete by the CxA upon re-verification the Contractor is responsible for all costs and additional compensation resulting from incomplete Cx Issues Log items.

3.6. REQUEST FOR ENERGIZING / START-UP OF EQUIPMENT

3.6.1. The Owner and/or Owner’s representative may install lockout devices on equipment in addition to the Contractor’s lockout / tagout devices once permanent power is connected to the facility. This lock would be removed once the proper start-up notification is received by the Owner and/or CxA, and the CxA has reviewed the appropriate SVCs and supporting documentation to verify the equipment is ready for energizing and/or start-up.

3.6.2. These requirements do not supersede any additional requirements noted elsewhere in the Contract Documents or as required by applicable code authorities.

3.6.3. Contractor shall notify Owner and CxA in writing to request initial energizing and/or start-up of equipment and systems at least 72 hours (not including weekends or holidays) prior to the scheduled start-up.

3.6.4. Contractor shall complete the applicable sections of the System Verification Checklist(s) evidencing the Contractor’s thorough inspection of the system and readiness for start-up activities as required by the Project Documents and the Commissioning Plan. Contractor shall submit required supporting documentation to the Owner and/or CxA, including but not limited to, factory testing reports, alignment reports, electrical testing reports and any other documentation required by the Project Documents prior to energizing and/or start-up.

3.6.5. The CxA shall review the SVCs and supporting documentation within the 72 hour notice period and confirm in writing that the systems and equipment are approved to proceed with energizing and start-up.

3.6.6. The CxA and/or owner may witness equipment energizing and/or start-up at the scheduled time, but witness is not required, unless noted elsewhere in the Specifications, as long as written approval is received as noted herein.

3.6.7. Contractor shall perform Start-up under supervision of the responsible manufacturer's representative in accordance with manufacturer's instructions and Project Document requirements.

3.6.8. Contractor shall complete all required factory start-up documentation and applicable items in the System Verification Checklists, prior to startup, to ensure compliance with the requirements in the Project Documents.

3.7. OPERATIONAL TESTING

3.7.1. Once the appropriate start-up activities are completed, the Contractor shall complete all necessary operational testing requirements included in the Project Documents prior to Functional Performance Testing. Specific requirements for systems and equipment are included in other technical sections of the Specifications.

3.7.2. Contractor shall complete all operational testing items in the System Verification Checklist and submit all supporting documentation to the Owner and/or CxA for review.

3.7.3. Contractor and manufacturer's representatives shall supervise and coordinate adjustments and balancing of all devices and systems for proper operation prior to requesting a Functional Performance Test(s).

3.7.4. Contractor shall clearly list outstanding items or System Verification Checklist items not completed successfully. Contractor shall obtain from Subcontractor or vendor completed forms documenting any outstanding deficiencies within five (5) days of completion of energizing and/or start-up activities.

3.7.5. Contractor shall review completed deficiencies to determine if outstanding items prevent execution of the Functional Performance Tests and shall issue any necessary responses to the Owner and/or Commissioning Authority.

3.7.6. Contractor shall notify Owner and CxA in writing to request Functional Performance Testing of equipment and systems at least 72 hours (not including weekends or holidays) prior to the scheduled activities. Owner may require Contractor to reschedule Functional Performance Testing to ensure availability of Owner’s representative(s) as needed.

3.7.7. The CxA shall review the SVCs and supporting documentation within the 72 hour notice period and confirm in writing that the systems and equipment are approved to proceed with Functional Performance Testing.

3.7.8. If any item indicated complete by the Contractor is found to be incomplete by the CxA upon re-verification the Contractor is responsible for all costs and additional compensation resulting from incomplete System Verification Checklist items.

3.8. CONTROL POINT AND SENSOR CALIBRATION VERIFICATION

3.8.1. Automation systems installed on the project must be fully verified for point integrity and sensor calibration prior to Functional Performance Testing. Additional requirements for this verification are listed in other technical sections of the Specifications.

3.8.2. The Contractor shall verify these points according to the requirements in the project documents as part of start-up and operational testing of systems.

3.8.3. The TAB contractor shall independently verify each sensor and point and document the results to be included in the Final TAB Report.

3.8.4. The CxA will witness, at their discretion, this verification and/or independently verify and document the results to be included in the Final Commissioning Process Report.

3.8.5. These activities must be completed prior to the Contractor requesting Functional Performance Testing as indicated herein.

3.9. FUNCTIONAL PERFORMANCE TESTING

3.9.1. The objective of Functional Performance Testing is to demonstrate that each system operates according to the requirements in the Project Documents and meets the OPR and BOD.

3.9.2. Contractor shall operate, or cause to be operated, each system, device, or equipment item, both intermittently and continuously, for a duration period as indicated in the Specification Section(s) for each item and/or in accordance with the Project Documents, the Commissioning Plan and applicable Functional Performance Testing procedures.

3.9.3. Contractor shall operate each component device and each building system to the full extent of its capability, from minimum to maximum, and under automatic control and manual control.

3.9.4. The CxA and members of the Cx Team, including the Owner's personnel, may observe Functional Performance Testing of equipment components and systems. The CxA shall facilitate the Functional Performance Testing activities according to the accepted FPT procedures and record the results of all testing activities.

3.9.5. The CxA shall record any deficiencies noted during the testing in the CxIL. If significant deficiencies exist, the owner and/or CxA may request that the testing activities be terminated and re-scheduled after proper verification by the Contractor. The Contractor is responsible for all costs and additional compensation resulting from deficiencies and incomplete systems noted during scheduled Functional Performance Testing.

3.9.6. All Functional Performance Testing of Integrated Systems must be completed in accordance with the Project Documents and the Commissioning Plan prior to the Contractor scheduling the Integrated Systems Testing activities.

3.10. INTEGRATED SYSTEMS TESTING

3.10.1. The objective of Integrated Systems Testing is to demonstrate that each integrated system operates jointly and/or independently of other systems according to the requirements in the Contract Documents.

3.10.2. Contractor shall operate each system, jointly and independently of other systems, through selected modes of operation (fire alarm integration with HVAC, emergency power modes, equipment failures among related systems, etc.) according to the accepted Integrated Systems Testing procedures developed by the CxA. The CxA shall facilitate and document the testing, organizing the appropriate testing teams and providing sufficient instruction to all participants to conduct efficient and effective testing activities.

3.10.3. Integrated Systems Testing typically involves multiple teams with representation from the CxA, Owner, and Contractor. The Contractor shall provide any needed communication

equipment (i.e., radios) or make available any centralized intercom or paging system for communication with all testing groups.

3.10.4. The Contractor shall provide no less than 7 days (not including weekends or holidays) notice when requesting to conduct the Integrated Systems Testing. All personnel must be assigned to the Personnel Matrix by the CxA and a coordination meeting held within the 7 day period as prescribed elsewhere in this section.

3.10.5. Contractor conducts Integrated Systems Testing after all applicable Functional Performance Testing is satisfactorily completed and approved by the Owner and/or CxA.

3.10.6. The CxA shall record any deficiencies noted during the testing in the CxIL. If significant deficiencies exist, the owner and/or CxA may request that the testing activities be terminated and re-scheduled after proper verification by the Contractor. The Contractor is responsible for all costs and additional compensation resulting from deficiencies and incomplete systems noted during scheduled Integrated Systems Testing.

3.11. DEMONSTRATION AND OWNER TRAINING

3.11.1. The Contractor, in coordination with Owner and CxA, shall develop the Training Plan with project specific requirements for Owner Training as required throughout various sections of the Project Specifications.

3.11.2. The specific requirements for scheduling and conducting the Owner Training are included in other sections of this Specification.

3.11.3. Owner Training activities shall not occur until the Training Plan is approved by the Owner and the Contractor has submitted all O&M information for review and use during the training sessions.

3.11.4. The Contractor shall notify the CxA of all training sessions. The Contractor shall record attendance of the training sessions and the Owner shall ensure the appropriate personnel are in attendance.

3.11.5. The CxA shall ensure the content of the Owner Training sessions meets the requirements in the Project Documents.

3.11.6. The CxA may conduct surveys of the Owner’s personnel to gauge the effectiveness of the Owner training sessions. If unfavorable surveys are received by the Owner’s personnel indicating unsatisfactory training, the Owner reserves the right to require the Contractor to re-train in those specific areas of non-conformance until the requirements in the Project Documents are satisfactorily completed.

3.11.7. Owner training must be completed prior to the contractor obtaining substantial completion by the Owner.

3.12. DEFERRED / SEASONAL TESTING

3.12.1. All Construction phase requirements of the Commissioning Process must be completed prior to Substantial Completion or as indicated elsewhere in this Specification.

3.12.2. If any testing or other requirements cannot be completed prior to Substantial Completion due to the building structure, required occupancy condition, or other condition, performance of such test may be delayed to later in the warranty period, upon approval of

the Owner. Contractor shall reschedule testing according to the protocols described in this section and any other operational protocols prescribed by the Owner.

3.12.3. Contractor shall complete all outstanding commissioning requirements as part of this Contract during the warranty period. Contractor shall schedule all activities with Owner and/or CxA.

3.12.4. The CxA shall document any deferred testing activities and ensure the appropriate commissioning documents are updated. The Contractor shall provide any additional documentation needed by the CxA to complete these requirements.

END OF SECTION

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE (BUILDING CONCRETE)

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 cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

B. Cast in place concrete includes the following:
1. Foundations and footings.
    a. Drilled Piers.
    b. Light pole bases.
    c. Flag pole base.
2. Slab on grade.
3. Fill for steel deck.
4. Equipment pads and bases.

C. Related Requirements:

1. Quality Requirements: Materials Section 01 40 00 – testing.
2. Section 03 52 16 – Insulating Concrete Roof Fill
3. Division 09 for requirements relating to specified floor coverings, finishing, and curing of interior concrete floor slabs.
4. Section 31 23 15 - Building Earthwork
5. Section 31 63 29 – Drilled Concrete Piers and Shafts

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference prior to any work beginning by trade. Time, date and location as determined by a construction manager.

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

    a. Contractor's superintendent.
    b. Independent testing agency responsible for concrete design mixtures.
    c. Ready-mix concrete manufacturer.
    d. Concrete Subcontractor.
    e. Special concrete finish Subcontractor.

2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, methods for achieving specified floor and slab flatness and levelness floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.5 ACTION SUBMITTALS

A. General: Submit the following according to Conditions of the Contract and Division 1 Specification Sections.

B. Product Data: For each type of product.

C. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments. Designs shall be submitted a minimum of 48 hours prior to the placement of any concrete. Submit properties of mixtures for each class of concrete including:
1. Mixture Identification by class
2. Specified compressive strength, f'_c, that is applicable for the class
3. Specified exposure class in Part 2, “PRODUCTS”, Article “CONCRETE MIXTURES, GENERAL”
4. Documentation of strength test records of similar class of concrete used to establish standard deviation in accordance with ACI 318, when test records exist
5. Required average compressive strength, f'_{cr}, for each class of concrete
6. Documentation of f'_{cr} of proposed mixtures(s)
7. Intended placement method
8. Slump or slump flow
9. Air content
10. Density
11. Water/cement ratio (w/cm), when specified
12. Documentation supporting other specified requirements of concrete mixtures
13. Nominal maximum aggregate size or Size number
14. Type and information about the ingredient materials proposed for use including:
    a. Cementitious Materials
    b. Aggregates
    c. Admixtures
    d. Water
    e. Fibers, color pigments, and other additions
15. Amounts of mixing water to be withheld for later addition at Project site.

D. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement. Comply with CRSI's "Manual of Standard Practice" and ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures." Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement. Original contract drawings shall not be reproduced for use as a portion of the Shop drawing.

E. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
1. Submit original shop drawings indicating the proposed construction joint locations to the Architect/Engineer at least 14 days prior to beginning formwork on the portion of the building in question.

1.6 INFORMATIONAL SUBMITTALS

A. Information submittals are mandatory submittals by the sub-contractor to the General Contractor, Construction Manager and Design Professional which are not returned but kept for the project record.

B. Material certificates in lieu of material laboratory test reports when permitted by Architect/Engineer. For each of the following, material certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with or exceeds specified requirements.

1. Cementitious materials.
2. Admixtures. Provide certification that chloride content complies with specification requirements.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Fiber reinforcement.
6. Waterstops.
7. Curing compounds.
8. Floor and slab treatments.
9. Bonding agents.
10. Adhesives.
11. Vapor retarders. Certificate shall include permeance ratings expressed in grains of water vapor per square foot per hour per inch of mercury.
12. Semi-rigid joint filler.
13. Joint-filler strips.
14. Repair materials.

C. Material Test Reports: For the following, from a qualified testing agency:

1. Aggregates**:** Include sieve analysis, dry rodded unit weight of coarse aggregate, and the specific gravities of both fine and coarse aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

D. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

E. Field quality control reports: The independent testing laboratory shall submit laboratory test reports for concrete materials directly to the Architect/Engineer with copy to others in accordance with the provisions of section 014000 "Quality Requirements." State in each report whether or not the test specimens comply with the specified requirements and indicate any deviations therefrom.

1.7 QUALITY ASSURANCE

A. Codes and Standards: Comply with provisions of the following codes, specifications, and standards, except where more stringent requirements are shown or specified:

1. American Concrete Institute (ACI) 301, "Specifications for Structural Concrete for Buildings."
2. ACI 304 "Recommended Practice for Measuring, Mixing, Transporting, & Placing Concrete"
3. ACI 305 "Hot Weather Concreting".
4. ACI 306 "Recommended Practice for Cold Weather Concreting"
5. ACI 311 "Recommended Practice for Concrete Inspection"
6. ACI 318 "Building Code Requirements for Reinforced Concrete."
7. ACI 347 "Recommended Practice for Concrete Formwork"
8. Concrete Reinforcing Steel Institute (CRSI), "Manual of Standard Practice."

B. Mix designs: Test in accordance with the requirements of PART 2 - PRODUCTS, article "PROPORTIONING AND MIX DESIGNS".

A. Materials and installed work may require testing and retesting at any time during progress of Work. Tests, including retesting of rejected materials for installed Work, shall be done at Contractor's expense.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: When the manufacturer does not comply with all requirements of Part 1, Quality Assurance, Manufacturer Qualifications, engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures. The manufacturer is permitted to engage a qualified independent testing agency to perform specific tests for project submittals. The contractor is responsible for the cost of the preconstruction testing service.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

1.10 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for more than one day in a row, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
4. Removal of formwork shall be delayed during cold weather to assure adequate structural strength, unless approved strength accelerating measures are taken.
5. Contractor shall provide to the Architect/Engineer a written description of procedures to be used for cold weather concreting in accordance with Part 1, “ACTION SUBMITTALS”. The details should include, but not be limited to, the following:
    a. Procedures for protecting the subgrade from frost and the accumulation of ice or snow on reinforcement or forms prior to placement.
    b. Methods for temperature protection during placement.
    c. Types of covering, insulation, housing, or heating to be provided.
    d. Curing methods to be used during and following the protection period.
    e. Use of strength accelerating admixtures.
    f. Methods for verification of in-place strength.
    g. Procedures for measuring and recording concrete temperatures.
    h. Procedures for preventing drying during dry, windy conditions.

B. Hot-Weather Placement: Comply with ACI 301 and 305.1 and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.
3. Provide submittals required by ACI 305.1 in accordance with Part 1, “ACTION SUBMITTALS”.
4. Water Reducing and Retarding Compound: The manufacturer of the mixture shall submit in writing to the Architect/Engineer and the Contractor, special recommendations for quantities to be used under various temperature and job conditions to assure that the concrete can be maintained at a uniform consistency while in the mixer truck and sufficiently workable between lifts to prevent the occurrence of lift lines with the specified placement and consolidation techniques, and as approved by the Architect/Engineer. Assure that the proper admixture and dosage is used during hot weather (mix temperature over 90 deg F.) to prevent slump loss from plant to site.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301.
2. ACI 336.
3. ACI 117.

2.2 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Plywood, metal, or other approved panel materials.
2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

    a. High-density overlay, Class 1 or better.
    b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
    c. Structural 1, B-B or better; mill oiled and edge sealed.
    d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.

3. Overlaid Finnish birch plywood.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.

E. Hole Forms: Plastic, removable, coiling forms for handrail and guardrail post supports.
   1. Basis-of-Design: Econ-O-Post Hole Form, Deslauriers, Inc. 800-743-4106 www.deslinc.com
      a. For post up to 2-3/8 inch outside diameter: EPHF-3.
      b. For post greater than 2-3/8 inch outside diameter to 3-1/2 inch outside diameter: EPHF-4.
   2. Coordinate locations with post indicated on plans, shop drawings, setting drawings and with railing installers. Coordinate form sizes required with post sizes.

F. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

G. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

H. Form-Release Agent: Commercially formulated form-release agent with a maximum of 450 g/l volatile organic compounds (VOCs) that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.

   1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

I. Form Ties: Factory-fabricated, removable or snap-off glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

   1. Furnish units that leave no corrodible metal closer than 1 1/2 inch to the plane of exposed concrete surface.
   2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.
   3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

J. Expanded polystyrene (EPS) and Extruded polystyrene (XPS) Forms: Complies with ASTM D6817 / D6817M, treated to resist insects and suitable for below grade applications; EPA registered treatment, meeting requirements of ICC ES AC239, and recognized in an ISS ES report.

   1. Products: Subject to compliance with requirements, product which may be incorporated in the Work include, but are not limited to, the following:

      a. Foam-Control EPS; 952-892-0809; www.geofoam.com
      b. InsulFoam GF; 403-248-6616; www.insulfoam.com
      c. Atlas EPS; 616-878-1568; www.atlaseps.com
      d. DOW Building Solutions; 800-583-2583; www.building.dow.com
      e. Owens Corning; 800-438-7465; commercial.owenscorning.com/products
      f. Kingspan; 800-241-4402; www.trustgreenguard.com/insulation-board
      g. Substitutions: Section 01 60 00-Product Requirements

   2. Minimum material requirements for EPS and XPS foams:

      a. Size: Largest practicable sizes.
      b. Thickness: As indicated.
      c. Density: As indicated (1.15 lb/cu. ft, min.)
      d. Compressive Strength: As indicated (5.8 psi at 1% deformation, min.)

e. Deformation: 1% maximum.

3. Connector Plates: Manufacturer’s galvanized or stainless steel plates with two-sided multi-barbed design, capable of piercing geofoam and resisting lateral movement between blocks during installation.

4. Lateral Holding Strength: 60 lbs.

2.3 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

B. Low-Alloy-Steel Reinforcing Bars, including Deformed Bar Anchors: ASTM A 706/A 706M, deformed.

C. Plain-Steel Wire: ASTM A 1064/A 1064M, as drawn.

D. Deformed-Steel Wire: ASTM A 1064/A 1064M.

E. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, plain, fabricated from as-drawn steel wire into flat sheets.

F. Deformed-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, flat sheet.

2.4 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

B. Epoxy-Coated Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, ASTM A 775/A 775M epoxy coated.

C. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A 775/A 775M.

D. Zinc Repair Material: ASTM A 780/A 780M.

E. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel wire or plastic according to CRSI's "Manual of Standard Practice," and as follows:
1. For slabs on grade, use supports with sand plates or horizontal runners where base material will not support chair legs.
2. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.5 CONCRETE MATERIALS

A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

B. Cementitious Materials:

1. Portland Cement: ASTM C 150/C 150M, Type I. Type III cement may be used in lieu of Type I at contractor's option, when acceptable to the Architect/Engineer.
2. Fly Ash: ASTM C 618, Class F.
3. Slag Cement: ASTM C 989/C 989M, Grade 100 or 120.

C. Normal-Weight Aggregates: ASTM C 33/C 33M, coarse aggregate or better, graded. Provide aggregates from a single source for exposed concrete.

1. Maximum Coarse-Aggregate Size: As indicated in Section 2.13 “CONCRETE MIXTURES FOR BUILDING ELEMENTS”.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
3. For exposed exterior surfaces, do not use fine or coarse aggregates that contain substances that cause spalling. Do not use aggregates containing soluble salts or other substrates such as iron sulfides, pyrite, marcasite or ocher which can cause stains on exposed concrete surfaces.
4. Local aggregates not complying with ASTM C 33 that have been shown to produce concrete of adequate strength and durability by special tests or actual service may be used when acceptable to Architect/Engineer.

D. Lightweight Aggregate: ASTM C 330/C 330M, as indicated in Section 2.13 “CONCRETE MIXTURES FOR BUILDING ELEMENTS”.

E. Air-Entraining Admixture: ASTM C 260/C 260M.
1. Products: Subject to compliance with requirements, products which may be incorporated in the Work include, but are not limited to, the following:
   a. MasterAir VR 10 or MasterAir AE 200; BASF Construction Chemicals – Building Systems; 800-722-8899; www.master-builders-solutions.basf.us
   b. Eucon Air Mix or Eucon Air series; Euclid Chemical Company; 800-321-7628; www.euclidchemical.com
   c. Darex AEA or Daravair series; W. R. Grace & Co.-Conn; 866-333-3726; www.graceconstruction.com
   d. Sika AEA series of Sika Air series; Sika Corporation, USA; 800-933-7452; www.sikaconstruction.com

F. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
   a. Products: Subject to compliance with requirements, product which may be incorporated in the Work include, but are not limited to, the following:

      1) MasterPozzolith or MasterPolyheed; BASF Construction Chemicals – Building Systems; 800-722-8899; www.master-builders-solutions.basf.us
      2) Eucon WR or Eucon MR; Euclid Chemical Company; 800-321-7628; www.euclidchemical.com
      3) WRDA series; W. R. Grace & Co.-Conn; 866-333-3726; www.graceconstruction.com
      4) Plastocrete 161; Sika Corporation, USA; 800-933-7452; www.sikaconstruction

2. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
   a. Products: Subject to compliance with requirements, products which may be incorporated in the Work include, but are not limited to, the following:

1) MasterSet R 300 ; BASF Construction Chemicals – Building Systems; 800-722-8899; www.master-builders-solutions.basf.us
2) Eucon Retarder 75; Euclid Chemical Company; 800-321-7628; www.euclidchemical.com
3) Daratard 17; W. R. Grace & Co.-Conn 866-333-3726; www.graceconstruction.com
4) Plastiment; Sika Corporation, USA; 800-933-7452; www.sikaconstruction.com
5) Metco WR; Metalcrete Industries; 800-526-5602; www.metalcreteindustries.com

3. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F and/or High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
   a. Products: Subject to compliance with requirements, products which may be incorporated in the Work include, but are not limited to, the following:

      1) Super P; Anti-Hydro International, Inc.; 800-777-1773; www.anti-hydro.com
      2) MasterRheobuild 1000; BASF Construction Chemicals – Building Systems; 800-722-8899; www.master-builders-solutions.basf.us
      3) Eucon 37; Euclid Chemical Company; 800-321-7628; www.euclidchemical.com
      4) Daracem series or ADVA series; W. R. Grace & Co.-Conn; 866-333-3726; www.graceconstruction.com
      5) Superslump ; Metalcrete Industries; 800-526-5602; www.metalcreteindustries.com
      6) Sikament series; Sika Corporation, USA; 800-933-7452; www.sikaconstruction.com

4. Water Reducing, Accelerating Admixture: ASTM C 494, Type E.
   a. Products: Subject to compliance with requirements, products which may be incorporated in the Work include, but are not limited to, the following:

      1) MasterSet FP 20; BASF Construction Chemicals – Building Systems; 722-8899; www.master-builders-solutions.basf.us
      2) ACCELGUARD 80; Euclid Chemical Company; 800-321-7628; www.euclidchemical.com
      3) Daraset series; W. R. Grace & Co.-Conn ; 866-333-3726; www.graceconstruction.com
      4) Q-Set; Dayton Superior; 888-977-9600; www.daytonsuperior.com
      5) Accel Set; Metalcrete Industries; 800-526-5602; www.metalcreteindustries.com
      6) SikaSet NC; Sika Corporation, USA; 800-933-7452; www.sikaconstruction.com

G. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C 494/C 494M, Type C.
   1. Products: Subject to compliance with requirements, products which may be incorporated in the Work include, but are not limited to, the following:
      a. MasterLife CI 30; BASF Construction Chemicals – Building Systems; 800-722-8899; www.master-builders-solutions.basf.us
      b. Eucon BCN or Eucon CIA; Euclid Chemical Company; 800-321-7628; www.euclidchemical.com
      c. DCI or DCI-S; W. R. Grace & Co.-Conn; 866-333-3726; www.graceconstruction.com

d. Sika CNI; Sika Corporation, USA; 800-933-7452; www.sikaconstruction.com

H. Water: ASTM C 94/C 94M and potable. Non-potable water sources, with documented conformance of ASTM C1602, may be submitted for approval by the Architect/Engineer prior to construction.

2.6 WATERSTOPS

A. Flexible Rubber Waterstops: CE CRD-C 513, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
1. Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the Work include, but are not limited to, the following:
a. Williams Products, Inc.; 800-521-9594; www.williamsproducts.net
2. Profile: Flat dumbbell with center bulb at expansion joints and Flat dumbbell without center bulb at construction joint.
3. Dimensions: Minimum of 4 inches by 3/16 inch thick at cold joints and 6 inches by 3/8 inch thick at expansion joints; nontapered.

B. Flexible PVC Waterstops: CE CRD-C 572, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
1. Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the Work include, but are not limited to, the following:
a. Greenstreak; 800-325-9504; www.greenstreak.com
b. Vinylex Corporation;800-325-3602; www.vinylexwaterstop.com
2. Profile: Flat dumbbell with center bulb at expansion joints and Flat dumbbell without center bulb at construction joint.
3. Dimensions: Minimum of 4 inches by 3/16 inch thick at cold joints and 6 inches by 3/8 inch thick at expansion joints; nontapered.

C. Preformed Plastic Adhesive Waterstops: Federal Specification SS S 210A. It shall be supplied in extruded form of suitable cross section and of a size to seal the joint areas of concrete sections. The plastic waterstop shall be protected by a suitable removable two piece wrapper. The two piece wrapper shall be so designed that one half may be removed longitudinally without disturbing the other half, to facilitate application of the sealing compound.
1. Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include; but are not limited to, the following:
a. Waterstop-RX; CETCO; 800-527-9948; www.cetco.com
b. Synko Flex, Henry Company 800-486-1278 www.henry.com
c. Ram Nex, K.T. Snyder Company, Inc.

D. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.

2.7 VAPOR RETARDERS

A. Sheet Vapor Retarder: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape.
1. Provide manufacturer's recommended mastics and gusset tape at all joints, to create a continuous membrane.
2. Products for Slab-on-Grade: Subject to compliance with requirements, products which may be incorporated in the Work include the following:
a. VB-350; Inteplast Group; 877-535-0555; www.barrierbac.com

b. VaporBlock Plus; Raven Industries Inc.; 605-335-0174; www.ravenefd.com
c. 15 mils thick Stego Wrap; Stego Industries, LLC; 877-464-7834; www.stegoindustries.com
d. 15 mils thick Perminator; W.R. Meadows, Inc.; 800-342-5976; www.wrmeadows.com
e. Polyethylene sheet not less than 15 mils thick (must provide proof of compliance with ASTM E 1745).

B. Bituminous Vapor Retarder: 110-mil- thick, semiflexible, seven-ply sheet membrane consisting of reinforced core and carrier sheet with fortified asphalt layers, protective weathercoating, and removable plastic release liner. Furnish manufacturer's accessories, including bonding asphalt, pointing mastics, and self-adhering joint tape.
1. Product: Subject to compliance with requirements, products which may be incorporated in the Work include the following:
a. Premoulded Membrane Vapor Seal with Plasmatic Core; W.R. Meadows, Inc.; 800-342-5976; www.wrmeadows.com
2. Water-Vapor Permeance: 0.0011 grains/h x sq. ft. x inches Hg; ASTM E 154.
3. Tensile Strength: 140 lbf/; ASTM E 154.
4. Puncture Resistance: 90 lbf; ASTM E 154.

2.8 CHEMICAL HARDENERS

A. Colorless aqueous solution containing a blend of magnesium fluosilicate and zinc fluosilicate combined with a wetting agent, containing not less than 2 lbs. of fluosilicates per gal.
1. Products: Subject to compliance with requirements, products which may be incorporated in the Work include, but are not limited to, the following:
a. MasterKure HD 300WB; BASF Construction Chemicals – Building Systems; 800-722-8899; www.master-builders-solutions.basf.us
b. Surfhard; Euclid Chemical Company; 800-321-7628; www.euclidchemical.com
c. Liqui-Hard; W.R. Meadows, Inc. 800-342-5976; www.wrmeadows.com

2.9 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components complying with ASTM C 309, Type I-D, Class A; odorless; that penetrates, hardens, and densifies concrete surfaces.

1. Provide material that has a maximum volatile organic compound (VOC) rating of 350 mg per liter.
2. Do not use curing compound on recessed slab areas which receive paver tile, quarry tile, ceramic tile or terrazzo finish floor material. These areas shall be water cured only.
3. Products: Subject to compliance with requirements, products which may be incorporated in the Work include, but are not limited to, the following:
a. A-H 3 Way Sealer WB Anti-Hydro International, Inc. 800-777-1773; www.anti-hydro.com
b. MasterKure CC series BASF Construction Chemicals – Building Systems; 800-722-8899; www.master-builders-solutions.basf.us
c. Cure and Seal series; Dayton Superior; 888-977-9600; www.daytonsuperior.com
d. Eucocure VOX; Euclid Chemical Company ;800-321-7628; www.euclidchemical.com
e. L&M Cure R; LATICRETE International, Inc.; 800-243-4788; www.laticrete.com
f. Seal N Kure; Metalcrete Industries; 800-526-5602; www.metalcreteindustries.com
g. CS-309-25; W.R. Meadows, Inc.; 800-342-5976; www.wrmeadows.com

2.10 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
   1. Products: Subject to compliance with requirements, products which may be incorporated in the Work include, but are not limited to, the following:
      a. MasterKure ER 50; BASF Construction Chemicals – Building Systems; 800-722-8899; www.master-builders-solutions.basf.us
      b. Aquafilm series; Dayton Superior; 888-977-9600; www.daytonsuperior.com
      c. Eucobar; Euclid Chemical Company; 800-321-7628; www.euclidchemical.com
      d. E-Con; LATICRETE International, Inc.; 800-243-4788; www.laticrete.com
      e. Waterhold; Metalcrete Industries; 800-526-5602; www.metalcreteindustries.com
      f. Evapre; W.R. Meadows, Inc.; 800-342-5976; www.wrmeadows.com

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.
   1. Products: Subject to compliance with requirements, products which may be incorporated in the Work include, but are not limited to, the following:
      a. MasterKure CC Series; BASF Construction Chemicals – Building Systems; 800-722-8899; www.master-builders-solutions.basf.us
      b. Cure and Seal series Dayton Superior 888-977-9600 www.daytonsuperior.com
      c. Aqua-Cure VOX; Euclid Chemical Company; 800-321-7628; www.euclidchemical.com
      d. Dress & Seal WB; LATICRETE International, Inc.; 800-243-4788; www.laticrete.com
      e. Metcure; Metalcrete Industries; 800-526-5602; www.metalcreteindustries.com
      f. Vocomp-20;W.R. Meadows, Inc.; 800-342-5976; www.wrmeadows.com

2.11 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 according to ASTM D 2240.

C. Bonding Agent: ASTM C 1059/C 1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
   1. Products: Subject to compliance with requirements, products which may be incorporated in the Work include, but are not limited to, the following:
      a. Polyvinyl Acetate (Interior Only):
         1) PVA Bonding Agent J41; Dayton Superior; 888-977-9600; www.daytonsuperior.com
         2) Tammsweld; Euclid Chemical Company; 800-321-7628; www.euclidchemical.com
         3) Weld-Crete ; Larsen Products Corp.; 800-633-6668; www.larsenproducts.com

4) Herculox; Metalcrete Industries; 800-526-5602 ; www.metalcreteindustries.com
5) Intralok ; W.R. Meadows, Inc.; 800-342-5976; www.wrmeadows.com

b. Acrylic or Styrene Butadiene:
1) MasterEmaco A 660; BASF Construction Chemicals – Building Systems; 800-722-8899; www.master-builders-solutions.basf.us
2) Acrylic Bonding Agent J40; Dayton Superior; 888-977-9600; www.daytonsuperior.com
3) SBR Latex; Euclid Chemical Company; 800-321-7628; www.euclidchemical.com
4) Daraweld C; W. R. Grace & Co.-Conn; 866-333-3726; www.graceconstruction.com
5) Everbond; LATICRETE International, Inc.; 800-243-4788; www.laticrete.com
6) Acrylpave; Metalcrete Industries; 800-526-5602; www.metalcreteindustries.com
7) Acry-Lok; W.R. Meadows, Inc.; 800-342-5976; www.wrmeadows.com

D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:

1. Products: Subject to compliance with requirements, products which may be incorporated in the Work include, but are not limited to, the following:
a. MasterInject 1500; BASF Construction Chemicals – Building Systems; 800-722-8899; www.master-builders-solutions.basf.us
b. Sure Bond J58 ; Dayton Superior; 888-977-9600; www.daytonsuperior.com
c. Euco Epoxy System #452; Euclid Chemical Company; 800-321-7628; www.euclidchemical.com
d. Epobond; LATICRETE International, Inc.; 800-243-4788; www.laticrete.com
e. Metco Hi Mod Epoxy; Metalcrete Industries; 800-526-5602; www.metalcreteindustries.com
f. Sikadur 32 Hi-Mod; Sika Corporation, USA; 800-933-7452; www.sikaconstruction.com
g. Stonset Primer; Stonhard; 800-257-7953; www.stonhard.com
h. Rezi-Weld 1000; W.R. Meadows, Inc.; 800-342-5976; www.wrmeadows.com

E. Reglets: Fabricate reglets of not less than 0.022-inch- thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

F. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.12 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150/C 150M, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.

4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.

1. Cement Binder: ASTM C 150/C 150M, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

2.13 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
1. Use a qualified testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures. Use qualified testing agency to develop supplementary performance test data for additional requirements identified in this specification.

2. Design mixtures shall meet the specified strength and durability requirements listed below or as provided in the Contract Documents, whichever is more stringent. Exposure classes listed below are defined by ACI 318, and the design mixture shall comply with the durability requirements of each exposure class.

B. Cementitious Materials - Unless otherwise indicated in the Contract Documents or as indicated below, concrete mixtures may use any cementitious materials listed in PART 2 section “Concrete Materials”.
1. Cementitious materials other than Portland cement shall not exceed the ACI 318 limits for the designated exposure classifications of each mix class.

C. Limit water-soluble, chloride-ion content in hardened concrete to following limits depending on the exposure category assigned to the structural member identified in this section of the specification or in the contract documents, whichever is more stringent. The limits are stated in terms of chloride ions in percent by weight of cement.
1. Reinforced in Exposure Category C0 – 1.00%
2. Reinforced in Exposure Category C1 – 0.30%
3. Reinforced in Exposure Category C2 – 0.15%

D. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a w/c ratio below 0.50.
4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

E. Air Content: Provide total air content for each class of concrete based on the nominal maximum size of aggregate and the assigned exposure class for resistance to freezing and thawing indicated in 2.12. Concrete for members categories as Exposure Category F0 should be non-air entrained, unless noted otherwise on the Contract Documents.

Nominal Maximum Aggregate Size, inch	Total Air Content (%)	
	Exposure Class F2 and F3	Exposure Class F1
3/8	6.0 to 9.0%	4.5 to 7.5%
1/2	5.5 to 8.5%	4.0 to 7.0%
3/4	4.5 to 7.5%	3.5 to 6.5%
1	4.5 to 7.5%	3.0 to 6.0%
1-1/2	4.0 to 7.0%	3.0 to 6.0%
2	3.5 to 6.5%	2.5 to 5.5%
3	3.0 to 6.0%	2.0 to 5.0%

F. Slump – Provide documentation in submittal prior to commencement of Work of target slump or slump flow value for each class of concrete. Consistency of concrete shall be established to facilitate placement with minimized potential for segregation.

G. Alkali silica reactivity – For structural concrete members that will be moist in service and when it is determined as per Section 2.2B that the aggregate source used needs to include mitigative measures, submit documentation demonstrating that the proposed cementitious materials used with the aggregates by ASTM C1567 tests with an expansion after 14 days of exposure less than or equal to 0.1%.

H. The installer and manufacturer shall coordinate to establish properties of fresh concrete to facilitate placement and finishing with reduced potential for segregation and bleeding. Factors shall include but are not limited to slump or slump flow, setting time, method of placement, rate of placement, hot and cold weather placement, curing, and concrete temperature. Selection of fresh concrete properties shall be notified to the Engineer of Record in the submittal.

I. Contractor shall indicate reportable changes in sources of materials and quantities when such changes are necessary to ensure constructability, performance of concrete and compliance with the specification requirements. The contractor is permitted to make minor adjustments less than the reportable deviations noted in the original submittal to concrete mixtures to ensure uniformity of concrete without a re-submittal for review or approval.

2.14 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

B. Identification: Deliver all reinforcement to the project site bundled, tagged and marked. Use metal tags indicating bar size, lengths, and other information corresponding to markings shown on placement diagrams.

C. Rejected Materials: Reinforcing with any of the following defects will not be permitted in the work:
   1. Bar lengths, depths, and bends exceeding the specified fabrication tolerances. Bends or kinks not indicated on drawings or final shop drawings.
   2. Bars with reduced cross section due to excessive rusting or other cause.

2.15 CONCRETE MIXING

A. General: Concrete may be mixed at batch plants or it may be transit mixed as specified herein. Batch plants must comply with the requirements of ACI 304, with sufficient capacity to produce concrete of the quality specified, in quantities required to meet the construction schedule. All plant facilities are subject to the acceptance of the Architect/Engineer. Plant facilities shall be calibrated by testing agencies specifically qualified for this as frequently as necessary to insure accuracy to plus or minus 0.4% of the total capacity of the components of the plant, but at a frequency not to exceed 6 months.

B. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, furnish batch ticket information, and as specified, provided the quantity and rate of delivery will permit unrestricted progress of the work in accordance with the placement schedule. Discharge of the concrete shall be completed within l l/2 hours after water is added to the mix or by the time the drum has revolved 300 times, whichever occurs first.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

C. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.
3. Do not exceed the catalog rating or nameplate capacity for a total volume of materials used per batch.
4. Equip the mixer with automatic controls, or semi-automatic controls, if acceptable, for proportioning materials and the proper measured quantities.
5. Do not exceed 30 minutes total elapsed time between intermingling of damp aggregates and cement to the discharge of the completed mix.
6. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.\

2.16 FABRICATION OF REINFORCEMENT

A. General: Shop-fabricate reinforcing bars to conform to the required shapes and dimensions, with fabrication tolerances complying with ACI 315. In case of fabricating errors, do not re-bend or straighten reinforcement in a manner that will injure or weaken the material.

B. Identification: Deliver all reinforcement to the project site bundled, tagged and marked. Use metal tags indicating bar size, lengths, and other information corresponding to markings shown on placement diagrams.

C. Rejected Materials: Reinforcing with any of the following defects will not be permitted in the work:

1. Bar lengths, depths, and bends exceeding the specified fabrication tolerances. Bends or kinks not indicated on drawings or final shop drawings.
2. Bars with reduced cross-section due to excessive rusting or other cause.

PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support assumed values of live load, dead load, weight of moving equipment operated on formwork, concrete mix, height of concrete drop, vibrator frequency, ambient temperature, foundation pressures, stresses, lateral stability, and other factors pertinent to safety of the structure during construction.

B. Construction loads, including reshoring loads, on in place construction shall at no time exceed the live load for which the in place construction was designed. If the contractor is uncertain about the design live loads, it shall be his responsibility to obtain these from the Architect/Engineer.

C. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
   1. Earth forming of grade beams is permitted, with the exception that the top 6-inches of exterior grade beams must be formed. Earth forming must be accompanied by lime-stabilization of the subgrade to prevent sloughing. Trench width shall be 2-inches wider than stated beam width to account for increase cover thickness required by ACI, i.e. 3-inches at sides and bottom for cast-against earth.

D. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:

   1. Class A, 1/8 inch for smooth-formed finished surfaces.
   2. Class C, 1/2 inch for rough-formed finished surfaces.

E. Construct forms tight enough to prevent loss of concrete mortar.

F. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

   1. Install keyways, reglets, recesses, and the like, for easy removal.
   2. Do not use rust-stained steel form-facing material.

G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

I. Chamfer exterior corners and edges of permanently exposed concrete.

J. Forms for Exposed Concrete: Drill forms to suit ties used and to prevent leakage of concrete mortar around tie holes. Do not splinter forms by driving ties through improperly prepared holes.

   1. Do not use metal cover plates for patching holes or defects in forms.

K. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

L. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

M. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

N. Coat contact surfaces of forms with an approved, non-residual, low-VOC form-release agent, according to manufacturer's written instructions, before placing reinforcement.

1. Do not allow excess form coating material to accumulate in forms or come into contact with in place concrete surfaces against which fresh concrete will be placed. Apply according to manufacturer's instructions.
2. Coat steel forms with a non-staining, rust preventative material. Rust stained steel formwork is not acceptable.

3.2 EMBEDDED ITEM INSTALLATION

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Anchor bolts shall be set with securely fastened templates, and the threaded area shall be protected from concrete laitance. Anchor bolts shall be accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
    a. Where conduit, pipe, or other items are to be embedded in concrete beams, slabs, or columns, they shall be placed not closer than the diameter of the largest of the adjacent items and with a net reduction in the concrete area (of a 12 inch wide strip in slabs) not in excess of 9% without prior approval of the Engineer. The location of such embedded items shall generally be at the middle or centroid of the member.
3. Install dovetail anchor slots in concrete structures as indicated.
4. Hole Forms for Slabs: Install “hole forms” in concrete structures where railing posts are indicated on drawings.
5. Forms for Slabs: Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and contours in finished surfaces. Provide and secure units to support screed strips using strike off templates or compacting type screeds.

3.3 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.
1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place may not be removed in less than 14 days and until concrete has achieved at least 70 percent of its 28-day design compressive strength. Determine potential compressive strength of in place concrete by testing field cured specimens representative of concrete location or members.
2. Form facing material may be removed 4 days after placement only if shores and other vertical supports have been arranged to permit removal of form facing material without loosening or disturbing shores and supports.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material are not acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 SHORING AND RESHORING INSTALLATION

A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.

1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

B. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

C. Keep reshores in place a minimum of 15 days after placing upper tier, or longer, if required, until concrete has attained its required 28 day strength and heavy loads due to construction operations have been removed.

3.5 VAPOR-RETARDER INSTALLATION

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.

1. Lap joints 6 inches and seal with manufacturer's recommended tape.

B. Bituminous Vapor Retarders: Place, protect, and repair bituminous vapor retarder according to manufacturer's written instructions.

3.6 STEEL REINFORCEMENT INSTALLATION

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as approved by Architect/Engineer to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
1. Provide sufficient numbers of supports and of strength to carry the reinforcement. Do not place reinforcing bars more than 2 inches beyond the last leg of any continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded-wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.7 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Locate construction joints, if required, but not shown so as to divide the slab into areas not in excess of 6000 sq. ft.(as close to square in configuration as possible), unless otherwise accepted by the Architect/Engineer. Con-form to slab placement, where shown. Before adjacent pour is made, the surface shall be roughened to an amplitude of a minimum of 1/4 inch except at exposed surfaces.

2. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
3. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete. Bulkheads designed and accepted for this purpose may be used for slabs. Keyways are to be horizontal or vertical as directed by the Architect/Engineer. Install preformed plastic adhesive waterstops in the keyway of all construction joints where vinyl, bulb type waterstops are not detailed.
4. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
6. Space vertical joints in walls as indicated in the Construction Documents. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
7. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface, dislodge aggregates, and before concrete develops random contraction cracks, but not longer than 12 hours after slab finishing.
2. Formed Contraction Joints: Insert premolded plastic, hardboard, or fiberboard strip into fresh concrete until top surface of strip is flush with slab surface. Tool slab edges round on each side of insert. After concrete has cured, at least 7 days remove inserts and clean groove of loose debris.
3. Contraction joints in unexposed floor slabs may be formed by saw cuts as soon as possible after slab finishing as may be safely done without dislodging aggregate.
4. If joint pattern is not shown, provide joints not exceeding 15 feet in either direction and located to conform to bay spacing wherever possible (at column centerlines, half bays, third bays).

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
   1. Joint fillers and sealants are specified in Division 7 Section "Joint Sealants."

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.8 WATERSTOP INSTALLATION

A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.

B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

3.9 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed. Notify other trades to permit installation of their work. Notify the Architect/Engineer and Testing Laboratory 24 hours before placing concrete.

B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

   1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

C. Do not use concrete which becomes non-plastic and unworkable, or does not meet the requirements quality control limits, or which has been contaminated by foreign materials. Do not use re-tempered concrete. Remove rejected concrete from the project site and dispose of in an acceptable location.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

E. Concrete Conveying: Handle concrete from the point of delivery and transfer to the concrete conveying equipment and to the locations of final deposit as rapidly as practical by methods which will prevent segregation and loss of concrete mix materials.

   1. Provide mechanical equipment of such size and design for conveying concrete to insure a continuous flow of concrete at the delivery end. Provide run ways above top of finished slab in all places for wheeled concrete conveying equipment for the concrete delivery point to the locations of final deposit. Do not wheel concrete directly over steel reinforcement. Keep interior surfaces of conveying equipment, including chutes, free of hardened concrete, debris, water, snow, ice, and other deleterious materials.

F. Pumping Concrete: The Contractor may at his option use pumping machines for placing the concrete subject to the following requirements:
   1. If for pumping requirements the mix design is other than specified, the Contractor shall furnish to the Architect/Engineer a mix for approval not less than 15 days prior to the time required for its use. The laboratory will make and test this mix design. After the results of these tests are noted and approval is received, this mix can be used. Cost of this laboratory work shall be paid by the Contractor.
   2. Whenever concrete is placed by pumping, it is recommended a second pump complete with sufficient pipes and hose for a complete and independent set up, or other placement equipment, be at the job prior to any placing of concrete. The Contractor shall be responsible for any corrective work which results from equipment breakdown.

G. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers no deeper than 24 inches and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.

   1. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
   2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 309.
   3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

H. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

   1. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
   2. Maintain reinforcement in position on chairs during concrete placement.
   3. Screed slab surfaces with a straightedge and strike off to correct elevations.
   4. Slope surfaces uniformly to drains where required.
   5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

I. Bonding: Roughen surfaces of set concrete at all joints, except where bonding is obtained by use of a concrete bonding agent. Clean surfaces of laitance, coatings, loose particles, and foreign matter. Roughen surfaces in a manner to expose bonded aggregate uniformly and to not leave laitance, loose particles of aggregate, or damaged concrete at the surface.

3.10 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

   1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, painting, or another similar system.

C. Rubbed Finish: Apply the following to smooth-formed-finished as-cast concrete where indicated:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix 1 part Portland cement to 1-1/2 parts fine sand with a 1:1 mixture of bonding admixture and water. Add white Portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces 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 unless otherwise indicated.

3.11 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.

1. Apply scratch finish to monolithic slab surfaces to receive concrete floor topping or mortar setting beds for tile, Portland cement terrazzo, and other bonded applied cementitious finish flooring material, and where indicated.

2. After placing slabs, finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:

a. Specified overall values of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15.

3. Slope surfaces uniformly to drains where required.

C. Float Finish: After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating, using float blades or float shoes only, when surface water has disappeared, or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats. Restraighten, cut down high spots, and fill low spots. Uniformly slope surfaces to drains. Repeat float passes and re-straightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as specified; slab surfaces to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand bed terrazzo; and where indicated.

2. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:

    a. Specified overall values of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15.

D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to monolithic slab surfaces exposed to view and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or another thin film-finish coating system.
2. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:
    a. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.
    b. Specified overall values of flatness, F(F) 30; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 15; for suspended slabs.

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thinset method. While concrete is still plastic, slightly scarify surface with a fine broom.

1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

G. Chemical Hardener Finish: On concrete floors which remain exposed and as directed apply chemical hardener finish to interior concrete floors. Apply liquid chemical hardener after complete curing and drying of the concrete surface. Dilute liquid hardener with water (parts of hardener/water as follows), and apply in 3 coats; first coat, 1/3 strength; second coat, 1/2 strength; third coat, 2/3 strength. Evenly apply each coat, and allow 24 hours for drying between coats.

1. Apply proprietary chemical hardeners, in accordance with manufacturer's printed instructions.

2. After final coat of chemical hardener solution is applied and dried, remove surplus hardener by scrubbing and mopping with water.

3.12 MISCELLANEOUS CONCRETE ITEM INSTALLATION

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

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct concrete bases as indicated on the Contract Documents.
3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
4. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

3.13 CONCRETE PROTECTING AND CURING

A. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h 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.

B. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.

C. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

D. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than three days with the following materials:

   a. Water.
   b. Continuous water-fog spray.
   c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 4-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 3 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.

   a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
   b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.

c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies does not interfere with bonding of floor covering used on Project.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions, followed by shading or moist curing adequate to keep temperature of the concrete at 80 degrees F or below during the curing period. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

   a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

5. Temperature of Concrete During Curing: When the atmospheric temperature is 85 degrees F. and above, or during other climatic conditions which will cause too rapid drying of the concrete, make arrangements before the start of concrete placing for the installation of wind breaks or shading, and for fog spraying, wet sprinkling, or moisture retaining covering. Protect the concrete continuously for the concrete curing period. Provide hot weather protection complying with the requirements of Part 1 “GENERAL”, Article “FIELD CONDITIONS”.

6. Protection from Mechanical Injury: During the curing period, protect concrete from damaging mechanical disturbances including load stresses, heavy shock, excessive vibration, and from damage caused by rain or flowing water. Protect all finished concrete surfaces from damage by subsequent construction operations. Concrete trucks, cranes, or excessive concentrations of loads will not be permitted on any slab without prior written approval of the Architect/Engineer during the curing period or subsequent construction.

7. Sealer and Dustproofer: Apply a second coat of specified curing and sealing compound only to surfaces given a first coat.

3.14 LIQUID FLOOR TREATMENT APPLICATION

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.

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 (7) days' old.
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.

B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.15 JOINT FILLING

A. Joint fillers and sealants are specified in Division 7 Section "Joint Sealants."

3.16 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part Portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/4 inch in any dimension to solid concrete. Limit cut depth to 1 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching mortar matches surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

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. Repair finished surfaces containing defects. Surface defects include spalls, pop-outs, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
5. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and 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.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval. Under no circumstances will "dusting" of wet concrete during finishing operations be allowed.

3.17 SOURCE QUALITY CONTROL

A. Concrete Batch Facility: The testing laboratory shall perform inspections of the concrete batching facility at intervals not to exceed one per 1,000 cubic yards of concrete placed or at least one each six months. The inspection shall include verification of the calibration of scales, aggregate analysis of the current stockpiles, verification of batching procedures, and compliance with the original mix design. First inspection shall take place before any concrete is placed. The cost of each inspection shall be paid by the testing allowance.
   1. Test results will be reported in writing to Architect, Structural Engineer, ready mix producer, and Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the Project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7 day tests and 28 day tests. If any breaks are below specified or expected strengths, the Testing Laboratory shall report any visible anomalies.

3.18 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

   1. The testing laboratory shall monitor concrete properties at time of placement and report to the Contractor any deviation from the project specifications. It shall be the responsibility of the Contractor to control the concrete and comply with the project specifications. If the Contractor cannot adequately control the quality of the concrete, then the Architect/Engineer shall direct the testing laboratory to control the concrete. The cost of this service shall be paid for by the Contractor.

B. Perform testing and inspections as indicated on the Contract Documents.

C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172/C 172M shall be performed according to the following requirements:
   1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof. One specimen tested at 7 days, two specimens tested at 28 days, and one specimen retained in reserve for later testing if required.

      a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

   2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
   3. Air Content: ASTM C 231/C 231M, pressure method, for normal-weight concrete; ASTM C 173/C 173M, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
5. Unit Weight: ASTM C 567/C 567M, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
6. Compression Test Specimens: ASTM C 31/C 31M.

    a. Cast and laboratory cure one set of four standard cylinder specimens for each composite sample.
    b. For pumped concrete, one set of compression test cylinders shall be obtained at both the point of discharge and point of placement.
7. Curing of Compression Test Specimens: After preparation of the test cylinders, to prevent evaporation of water from the unhardened concrete, cover the cylinders immediately after finishing with a non-reactive plate or impervious plastic sheeting. Protect the outside surface of cardboard molds from any source of water for the first 24 hours after casting. Field curing procedures for test cylinders for 28 day compressive strengths are not the same as those for determining strength for form removal time.
    a. For test cylinders for 28 days compressive strength determination, during the first 24 hours after molding, store all test cylinders under conditions that maintain the temperature immediately adjacent to the cylinders in the range of 60 to 80 degrees F. and prevent loss of moisture from the specimens. If the Architect/Engineer or testing laboratory have questions concerning the storage temperature, they may require that the contractor provide a temperature record of the cylinders by means of maximum minimum thermometers. At the end of 20 hours plus or minus four hours, cylinders are to be transported to the laboratory, removed from the molds, and placed in a moist condition at 73.4 plus or minus 3 degrees F. until the moment of testing.
    b. Cure test cylinders to be used for determining strength for form removal time as nearly as practical in the same manner as the concrete in the structure. Cylinders shall be stored in or on the structure as near the point of use as possible, and as far as is practical, with the same exposure to the elements. Remove test cylinders from field storage and store in lime water at 73.4 plus or minus 3 degrees F. for 24 hours plus or minus 4 hours immediately before testing.
    c. Cylinders shipped from the field to the laboratory shall be packed in sturdy wood boxes or other suitable containers surrounded by wet sawdust or other suitable packing material and shall be protected from freezing during shipment.

8. Compressive-Strength Tests: ASTM C 39/C 39M; test one laboratory-cured specimens at 7 days, two specimens at 28 days, and retain one specimen in reserve for later testing if required.

    a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
    b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
    c. If the compressive strength tests fail to meet the minimum requirements specified, the concrete represented by such tests will be considered deficient in strength and subject to additional testing as herein specified.

9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
10. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive

strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

11. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
12. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
13. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
14. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
15. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

D. Measure floor and slab flatness and levelness according to ASTM E 1155 within 48 hours of finishing.

E. Formed Concrete Dimensional Tolerances: Formed concrete having any dimension smaller than required, and outside the specified tolerance limits, will be considered deficient in strength and subject to additional testing as herein specified.
1. Formed concrete having any dimension greater than required will be rejected if the appearance or function of the structure is adversely affected, or if the larger dimensions interfere with other construction. Repair, or remove and replace rejected concrete as required to meet the construction conditions. When permitted, accomplish the removal of excessive material in a manner to maintain the strength of the section without affecting function and appearance.

F. Strength of Concrete Structures: The strength of the concrete structure in place will be considered potentially deficient if it fails to comply with any of the requirements which control the strength of structure, including the following conditions:
1. Failure to meet compressive strength test requirements.
2. Concrete which differs from the required dimensions or location in such a manner to reduce strength.
3. Concrete subjected to damaging mechanical disturbances; particularly load stresses, heavy shock, and excessive vibration.
4. Poor workmanship and quality control likely to result in deficient strength.

3.19 PROTECTION OF LIQUID FLOOR TREATMENTS

A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION 03 30 00

SECTION 03 52 16

LIGHTWEIGHT INSULATING CONCRETE ROOF FILL (LWIC)

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Insulating concrete fill over structural roof decking.

1.02 REFERENCES

A. Reference Standards

B. ASTM C138/C138M - Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete; 2024a.

C. ASTM C150/C150M - Standard Specification for Portland Cement; 2024.

D. ASTM C172/C172M - Standard Practice for Sampling Freshly Mixed Concrete; 2025.

E. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete; 2022.

F. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection; 2025a.

G. ASTM C332 - Standard Specification for Lightweight Aggregates for Insulating Concrete; 2023.

H. ASTM C495/C495M - Standard Test Method for Compressive Strength of Lightweight Insulating Concrete; 2012 (Reapproved 2019).

I. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2023.

J. ASTM C796/C796M - Standard Test Method for Foaming Agents for Use in Producing Cellular Concrete Using Preformed Foam; 2019.

K. ASTM C869/C869M - Standard Specification for Foaming Agents Used in Making Preformed Foam for Cellular Concrete; 2024.

L. ASTM C1077 - Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation; 2025a.

M. FM (AG) - FM Approval Guide; Current Edition.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Include plans, sections, and details showing roof slopes, lightweight concrete roof insulation thicknesses, embedded board insulation, roof penetrations, roof perimeter terminations and curbs, control and expansion joints, and roof drains.

C. Product Data: Provide physical characteristics, thermal values, product limitations and application instructions.

D. Manufacturer's Installation Instructions: Indicate mix instructions.
   1. Provide mix for each lightweight concrete roof insulation mix.

E. Installer's Qualification Statement.

F. Material Test Reports: From a qualified testing agency indicating and interpreting test results of the following for compliance with requirements indicated, based on comprehensive testing of current materials:
   1. Cement.
   2. Admixtures.
   3. Insulation board.

G. Research/Evaluation Reports: Evidence of lightweight insulating concrete roof insulation's compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed cellular lightweight insulating concrete roof installations 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.
   1. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years of documented experience . Approved in writing by lightweight insulating concrete manufacturer. Approved in writing by roofing system manufacturer for the specified roof type.

B. Tested Systems:
   1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1077 and ASTM E329 to conduct the testing indicated, as documented according to ASTM E 548.
   2. ASCE-7: Provide wind uplift standard with a tested assembly to meet uplift calculation where building is located, matched to the roofing system specified FM (AG) Listing: Provide system listed in FM's "Approval Guide" for Class 1 fire rating, listed in UL “Roofing Materials Directory”.

C. Provide aggregates containing no detectable asbestos as determined by the method specified in 40 CFR 763, Subpart E, Appendix E, Section 1, "Polarized Light Microscopy."

D. Provide copy of cellular lightweight insulating concrete fill manufacturer’s 20 year, NDL warranty meeting requirements as specified herein.

E. Installer is responsible for ensuring positive drainage of the cellular lightweight insulating concrete deck. Ponding water shall be cause for rejection of the installation. Prior to installation of the roof system, the installer shall perform a ponding water test on the deck to confirm deck drainage with no evidence of ponding water. Test shall be conducted in the presence of the Architect.

1.05 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.

C. Do not use cement that shows indications of moisture damage, caking, or other deterioration.

1.06 WARRANTY

A. Manufacturer’s Warranty: Insulating concrete roof fill manufacturer shall warrant the insulating concrete roof fill system from the Project date of Substantial Completion as follows:
   1. Refer to roofing system specification section for length of warranty period.Warranty shall be a NDL “No Dollar Limit” / no penal sum type, with total replacement cost.
   2. The warranty shall provide manufacturer’s maximum extended wind rated coverage (up to hurricane force winds) as defined by the Beaufort Scale.
   3. The warranty shall guarantee the entire insulating concrete roof fill system against defective materials and workmanship of installation, with NO exclusion for ponding water.
   4. The full insulating concrete roof fill system warranty shall be guaranteed against failure of workmanship and materials. Repair of the system, including materials and labor, shall be done at no cost to the Owner.
   5. The cellular lightweight insulating concrete assembly R-Value shall be warranted to be stable, with no R-Value drift, and acceptable to the roofing manufacturer, and will be covered under the roofing manufacturer’s warranty for the same period of time.
   6. Installer’s Warranty: Installer shall guarantee that the work performed under this Contract will be free from defects in workmanship and materials, and that the insulating concrete roof fill will remain in good condition for a five-year warranty period from the date of Substantial Completion.

1.07 FIELD CONDITIONS

A. Do not place insulating concrete mix at ambient temperatures lower than 40 degrees F (5 degrees C) without heating mix water to 90 to 110 degrees F (32 to 43 degrees C).

B. Do not place cellular lightweight insulating concrete assembly during rain or snow or on surfaces covered with standing water, snow, or ice.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Coordination: It is the responsibility of Insulating Concrete Roof Fill Bidders to coordinate during the bid period with listed roofing membrane manufacturers in the Roofing Section to ensure that the Insulating Concrete Roof Fill product proposed meets all requirements of the roofing membrane manufacturers for their product and the specified roofing warranty.

B. Lightweight Insulating Concrete:
   1. Elastizell Corp. of America; www.elastizell.com
   2. Celcore Incorporated; www.celcoreinc.com
   3. Siplast Inc.; www.siplast.com

4. Aerix Industries; aerixindustries.com/mearlcrete/
5. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 MATERIALS

A. Cement: ASTM C150/C150M, Portland Type I, II or III, gray color.

B. Lightweight Aggregate: ASTM C332; Group I, perlite.

C. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to concrete.

D. Foaming Agent: Comply with ASTM C869/C869M, when tested according to ASTM C796/C796M.

E. Prohibited Materials: Vermiculite aggregates, expanded clay, and shales are strictly prohibited for use in this Project.

2.03 CONCRETE MIX

A. Test for compressive strength in accordance with ASTM C495/C495M, for wet density in accordance with ASTM C138/C138M, and for dry density after oven drying.

B. Provide concrete mix with the following minimum properties (provide greater than minimums where required by the roofing membrane manufacturer):
1. Wet Density: 53 to 63 lb./cu. ft. when tested according to ASTM C138/C138M.
2. Oven-Dry Density: 31 to 37 lb/cu.ft., when tested according to ASTM C495/C495M.
3. Compressive Strength: Minimum 350 psi when tested according to ASTM C495/C495M.

C. Polypropylene Linked: 3/4” pre-packaged reinforcing fibers impregnated with a dispersing agent. Brand as recommended by the lightweight insulating concrete manufacturer.

2.04 ACCESSORIES

A. Perimeter Joint Filler: Glass fiber strips, compressible to 50 percent original thickness under load of 25 psi (170 kPa) with full recovery.

B. Curing Compound: Type recommended by manufacturer.

C. Insulation: ASTM C578, Type I molded polystyrene with venting holes to 3 percent of board area, 0.90-lb/cu. ft. (15-kg/cu. m) minimum density.
1. Products:
a. *Insulperm* as manufactured by Siplast; www.siplast.com
b. *Aeroroof Holey Board* as manufactured by Kingspan Industries; www.kingspan.com
c. *Starrfoam-HB* as manufactured by Starrfoam Manufacturing
d. Substitutions: See Section 01 60 00 - Product Requirements.

2.05 DESIGN MIXES - GENERAL

A. Prepare design mixes for each type and strength of lightweight concrete roof insulation by either laboratory trial batch or field-test data methods. For trial batch method, use a qualified independent testing agency for preparing and reporting proposed mix designs.

B. Limit water-soluble chloride ions to the maximum percentage by weight of cement or cementitious material permitted by ACI 301.

C. Do not use the same testing agency for field quality-control testing.

D. Do not use Calcium dioxide in lightweight insulating concrete fill.

E. Design mix to produce lightweight concrete roof insulation with the specified minimum physical properties using the minimum amount of water necessary to produce a workable mix. Do not exceed maximum air content recommended by aggregate manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Metal Deck: Ensure that metal deck to receive insulating concrete fill is g-90 galvanized, 22-ga.and **ventilated** to meet or exceed manufacturer's requirements. Lightweight insulating concrete shall not be installed over a non-ventilated deck regardless of whether allowed by manufacturer or submittals.

B. Control Joints: Install control joints at perimeter of roof deck and at junctures with vertical surfaces, including curbs, walls, and vents, for full depth of lightweight concrete roof insulation. Fill control joints with joint filler.
   1. Provide 1 inch (25 mm) wide control joints for roof dimensions up to 100 feet (30 m) in length; 1-1/2 inch (38 mm) wide control joints for roof dimensions exceeding 100 feet (30 m).

C. Verify joints in precast roof members are grouted or taped to prevent seepage of wet insulating concrete.

D. Verify roof deck is free of standing water, dirt, debris, ice, or other detrimental materials.

E. Verify roof slopes and elevations are as shown on the drawings and ready to receive insulating concrete.

F. Notify Architect immediately of conditions that would prevent correct and timely installation.

G. Do not proceed with work until detrimental conditions have been corrected.

3.02 PREPARATION

A. Install 1 inch (25 mm) thick expansion joint filler at:
   1. Perimeter of roof decking.
   2. Around penetrations through deck.
   3. Every 100 ft (30 m) of deck surface dimension.
   4. Each change of deck direction on metal roof deck surfaces.

B. Install 1.5 inch (37 mm) thick expansion joint filler for roof dimensions exceeding 100 feet (30

3.03 INSTALLATION

A. Mixing and Placing

1. Mix and place lightweight concrete roof insulation according to manufacturer's written instructions, using equipment and procedures to avoid segregation of mix and loss of air content.
    a. Add 1-lb./cu. yd. of the specified reinforcing fibers to each batch during mixing operations.
2. Install insulation board according to lightweight concrete roof insulation manufacturer's written instructions.
    a. Install slurry to fill steel deck to a minimum of 1/4-inch above top of flutes.
    b. Place board insulation in wet slurry and walk board in to ensure full contact of board insulation with slurry. Do not kick the boards into place.
    c. Stagger joints, and tightly butt insulation boards.
    d. Where insulation changes thickness, install insulation boards in a stair-step configuration with a maximum step-down of 1-inch.
3. Install lightweight concrete and screed to a minimum thickness of 2-inches above top of insulation boards.
4. Deposit and screed lightweight concrete roof insulation in a continuous operation until an entire panel or section of roof area is completed. Do not vibrate or work mix except for screeding or floating. Place to depths and slopes indicated.
5. Finish top surface smooth, free of ridges and depressions, and maintain surface in condition to receive subsequent roofing system.
6. Begin curing operations immediately after placement, and air cure for not less than three days according to manufacturer's written instructions.
7. If ambient temperature falls below 32-deg F (0 deg C), protect lightweight concrete roof insulation from freezing and maintain temperature recommended by manufacturer for 72 hours after placement.

B. Venting
    1. Ensure metal deck venting remains unobstructed during slurry placement to allow for downward dehydration of the LWIC system.

C. Slope concrete for roof surface drainage as indicated.
    1. Slope top surface to 1/4 inch/foot (1:50) minimum for roof surface drainage.
    2. Deposit and screed lightweight concrete roof insulation in a continuous operation until an entire panel or section of roof area is completed. Do not vibrate or work mix except for screeding or floating. Place to depths and slopes indicated.
    3. Finish top surface smooth, free of ridges and depressions, and maintain surface in condition to receive subsequent roofing system.
    4. Begin curing operations immediately after placement, and air cure for not less than three days according to manufacturer's written instructions.
    5. If ambient temperature falls below 32-deg F (0 deg C), protect lightweight concrete roof insulation from freezing and maintain temperature recommended by manufacturer for 72 hours after placement.

D. Curing
    1. Cure in accordance with lightweight aggregate manufacturer's instructions.
    2. Protect insulating concrete from excess evaporation of surface moisture.
    3. During low humidity conditions, sprinkle water over concrete surface to aid hydration and curing.
    4. Protect installed lightweight concrete from rain until installation of roof membrane.

3.04 FIELD QUALITY CONTROL

A. An independent testing agency, as specified in Section 01 40 00 - Quality Requirements, will perform field inspection and testing for dry density.
   1. Testing Agency: Take three test samples from each 100 cubic yards (76.5 cu m) of insulating concrete placed, daily.
      a. Test 1 cylinder after 7 days and 2 cylinders after 28 days. Report failed tests to Owner immediately.
      b. If needed, final cylinder will be tested after 56 days at the request and expense of the Contractor.
      c. Testing Agency: Take one additional test sample during cold weather concreting.

B. Testing agency shall take samples according to ASTM C172/C172M, Standard Practice for Sampling Freshly Mixed Concrete except as modified by ASTM C495/C495M, Standard Test Method for Compressive Strength of Lightweight Insulating Concrete.
   1. Installed materials shall be considered as non-complying if representative samples do not show test results for the physical properties specified herein, or additional non-specified properties as required by the Insulating Concrete manufacturer.

C. Pull Tests: Reference roofing section for pull test requirements.

3.05 DEFECTIVE WORK

A. Refinish, or remove and replace, insulating concrete roof fill if surfaces are excessively scaled or too rough to receive roofing, according to roofing membrane manufacturer's written requirements.

B. Remove and replace insulating concrete roof fill that fails to comply with compressive-strength and oven-dry unit weight requirements.

3.06 CLEANING

A. Promptly remove all lightweight insulating concrete spillage, overspray, and debris from adjacent surfaces, equipment, and finishes.

B. Do not use cleaning methods or materials that could damage or stain adjacent finished work. If spillage occurs on finished surfaces, consult the surface manufacturer for recommended cleaning procedures.

C. Ensure all roof drains, scuppers, and gutters are clean, open, and free of all installed materials and construction debris.

D. Leave project site and staging areas "broom clean" and free of all packaging, excess materials, and equipment related to this Section.

3.07 PROTECTION

A. Protect installed lightweight insulating concrete from damage, foot traffic, and construction loads. Do not permit traffic of any kind on the deck until it is fully cured per the manufacturer's instructions.

B. After curing, limit access to only essential personnel required for subsequent roofing operations.

C. Provide and maintain temporary walkways, protection boards (e.g., OSB, plywood), or sacrificial high-density insulation boards in all areas subject to foot traffic or material staging to distribute loads and prevent surface damage, indentation, or crushing.

D. Do not allow concentrated loads, sharp objects, or heavy equipment on the surface of the installed deck.

E. Any damage to the cured lightweight insulating concrete system shall be repaired in accordance with the manufacturer's written instructions, prior to the installation of the roofing membrane, at no additional cost to the Owner.

END OF SECTION

SECTION 03 62 00 – NON-SHRINK GROUT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 SUMMARY

A. This specification describes non-shrink epoxy grout and non-shrink cement-based grout to be used wherever shown or implied on the drawings or called for in the specifications.

1.3 SUBMITTALS

A. Product data: Submit product data for the non-shrink grout verifying the products' compliance with this specification and describing the manufacturer's placement recommendations.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Non-Shrink Epoxy Grout: All epoxy grout shall be a pourable, non-shrink, 100% solids epoxy system. The epoxy grout system shall be supplied in units consisting of three components: resin, hardener, and specially-blended aggregate, all premeasured and prepackaged.

1. Resin component shall not contain any non-reactive diluents. Resins containing butyl glycidyl ether (BGE) or other highly volatile and hazardous reactive diluents are not acceptable.

2. Variation of component ratios is not permitted unless specifically recommended by the manufacturer.

3. The non-shrink epoxy grout shall exhibit the following properties:

    a. Working life: The mixed epoxy grout system shall have a minimum "working life" of 45 minutes at 75 degrees F.
    b. Compressive Strength: The hardened epoxy grout shall attain a minimum compressive strength of 5,500 psi in 24 hours and 10,000 psi in seven days when tested according to ASTM C 579, Method B.
    c. Thermal Coefficient: The epoxy grout shall exhibit a maximum thermal coefficient of .000030 -6 in./in./Fahrenheit when tested according to ASTM C 531 or ASTM D 696.
    d. Effective Bearing Area: The epoxy grout shall exhibit a minimum effective bearing area of 95%.

B. Non-Shrink Cement-Based Grout: Non-Shrink grout shall consist of premeasured, prepackaged materials supplied by the manufacturer requiring only the addition of water. The manufacturer's instructions must be printed on the outside of each bag.

1. The non-shrink cement-based grout shall exhibit the following properties:

    a. Non-Shrink: Grout shall comply with ASTM C1107. No shrinkage (0.0 percent) and a maximum 4.0% expansion when tested in accordance with ASTM C827. No shrinkage (0.0 percent), and a maximum of 0.3 percent expansion in the hardened state when tested in accordance with ASTM C1090.
    b. Compressive Strength: A minimum 28day compressive strength of 5,000 psi when tested in accordance with ASTM C 109.
    c. Setting Time: A minimum initial set time of 60 minutes when tested in accordance with ASTM C 191.

C. Water: Potable water.

D. Coarse Aggregate: Provide a clean, coarse aggregate conforming to ASTM C 404 (maximum size 3/8") for grout thickness greater than three inches.

2.2 MANUFACTURERS

A. Non-Shrink Epoxy Grout:

1. E³-F; Euclid Chemical Company; 800-321-7628; www.euclidchemical.com

2. Five Star HP Epoxy Grout; Five Star Products, Inc.; 800-243-2206; www.firestarproducts.com

3. Rezi-Weld 3/2; W.R. Meadows, Inc.;800-342-5976; www.wrmeadows.com

4. MasterFlow 647; BASF Construction Chemicals – Building Systems; 800-722-8899; www.master-builders-solutions.basf.us

5. Epoxy Grout J55; Dayton Superior; 888-977-9600; www.daytonsuperior.com

6. Polytops GC Grout; ChemMasters; 440-428-2105; www.chemmasters.net

B. Metallic Non-Shrink Cement-Based Grout

1. NS Metallic Grout; Euclid Chemical Company; 800-321-7628; www.euclidchemical.com

2. MasterFlow 885; BASF Construction Chemicals – Building Systems; 800-722-8899; www.master-builders-solutions.basf.us

C. Non-metallic Non-Shrink Cement-Based Grout:

1. MasterFlow 100; BASF Construction Chemicals – Building Systems; 800-722-8899; www.master-builders-solutions.basf.us

2. NS Grout; Euclid Chemical Company; 800-321-7628; www.euclidchemical.com

3. Sure‑Grip Grout; Dayton Superior; 888-977-9600; www.daytonsuperior.com

4. Five Star Grout; Five Star Products, Inc.; 800-243-2206; www.firestarproducts.com

5. Crystex;L&M Construction Chemicals, Inc.; 800-362-3331; www.lmcc.com

6. Conset Grout; ChemMasters; 440-428-2105; www.chemmasters.net

7. 588-10K Nonshrink Grout; W.R. Meadows, Inc.; 800-342-5976; www.wrmeadows.com

8. CG-86 Nonshrink Grout; W.R. Meadows, Inc.; 800-342-5976; www.wrmeadows.com

PART 3 - EXECUTION

3.1 GENERAL

A. Placing: The Contractor shall perform all mixing and placement in accordance with the manufacturer's recommendations.

B. Temperature: The temperature of the grouting surfaces and the grout shall be maintained between 50 degrees F and 90 degrees F during grouting and for a minimum of 24 hours thereafter.

C. Elimination of Voids: Grout placement shall proceed in a manner that will assure the filling of all spaces and intimate contact of the grout with contact surfaces. Grout holes shall be used; location to be approved by Architect/Engineer if not otherwise detailed.

3.2 SURFACE PREPARATION

A. Concrete Surfaces: The concrete on which the grout will bear shall have attained its design strength before grouting.

1. Concrete shall be sound and all surfaces to be in contact with the grout shall be entirely free of oil, grease, laitance, curing compounds, and other deleterious substances.

2. Surfaces shall be roughened by chipping, sandblasting or other mechanical means to assure bond of the grout to the existing concrete.

B. Metal Surfaces: All metal surfaces which are to be in direct contact with the grout shall be thoroughly cleaned to bare metal immediately before grouting. Cool down hot base plates with cold water. Heat cold base plates with hot water.

C. Adjacent Surfaces: Treat adjacent surfaces and formwork with a bond breaking material to prevent bonding of excess grout.

3.3 INSTALLATION

A. Formwork: Forms shall remain in full contact with the grout until it hardens.

1. Forms shall be watertight and capable of supporting the grout until it cures.

2. Wood forms must be sealed.

B. Non-Shrink Epoxy Grout:

1. Surface Dryness: All surfaces shall be kept completely dry before grouting.

2. Grout Removal: Surfaces from which grout is to be removed after placing shall be treated with a paste wax or release agent before placement.

C. Non-Shrink Cement-Based Grout:

1. Composition: For interior column base plates not exposed to weather, grout containing metallic particles such as aluminum powders or iron filings may be used. For any other applications, the grout shall not contain metallic particles such as aluminum powders or iron fillings or expansive cement.

2. Mixing: For grouting depths greater than three (3) inches, add 3/8" coarse aggregate to the mix following manufacturer's recommendations. Use the minimum water necessary for proper installation in accordance with flowability requirements and manufacturers recommendations for specific applications.

D. Grouting Operation: Concrete surfaces shall be washed clean, then saturated with water for 24 hours prior to placement of cement-based grout. Excess water must be removed prior to grouting. The placement of grout should be rapid and continuous so as to avoid cold joints.

1. Protect grout from external vibration caused by operating machinery for at least 24 hours.

2. Curing: Cover all exposed grout with wet burlap immediately after placement. Keep area moist for a minimum of 48 hours.

END OF SECTION 03 62 00

SECTION 04 05 03

MASONRY MORTARING AND GROUTING

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes mortar and grout for masonry.

B. Related Sections:
   1. Section 01 40 00 – Quality Requirements: Materials Testing.
   2. Section 04 20 00 - Unit Masonry Assemblies.
   3. Section 04 29 00 - Engineered Unit Masonry.
   4. Section 08 11 13 - Standard Steel Frames: Grouting steel door frames.

1.02 REFERENCE STANDARDS

A. ACI 530.1-13 - Building Code Requirements and Specification for Masonry Structures; 2013.

B. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2018.

C. ASTM C150/C150M - Standard Specification for Portland Cement; 2024.

D. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2018.

E. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019a, with Editorial Revision.

F. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2018.

G. ASTM C476 - Standard Specification for Grout for Masonry; 2022.

H. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2020.

I. ASTM C1019 - Standard Test Method for Sampling and Testing Grout for Masonry; 2020.

J. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms; 2022a.

1.03 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal requirements.

B. Samples: Submit two samples of each type of colored mortar, illustrating mortar color and range.

C. Design Data: Submit design mix when Property specification of ASTM C270 is to be used, required environmental conditions, and admixture limitations.

D. Test Reports:

1. Submit reports on mortar indicating conformance of mortar to property requirements of ASTM C270.
2. Submit reports on grout indicating conformance of grout to property requirements of ASTM C476.
3. Include descriptions of types and proportions of mortar and grout ingredients.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.04 QUALITY ASSURANCE

A. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source or producer for each aggregate.

B. Preconstruction Testing Services: Provide Material Certificates in lieu of testing, unless otherwise directed by Architect. If Material Certificates are unavailable, notify the Architect immediately upon discovery. Engage a qualified independent testing agency to perform preconstruction testing indicated below if directed by the Architect. Payment for these services will be made by the Owner except in the case of retesting for substandard materials and in the case of first time testing for substandard materials where Material Certificates were submitted as part of the Quality Control procedures for the job. Where considered appropriate by the Architect/Engineer, Prism Test shall be used where completed masonry assemblies are built with potentially substandard materials. Testing of built assemblies determined to contain substandard materials, shall be at the Contractor's expense.

C. Material Certificates (non-load bearing walls): Material Certificates proving compliance with the test below (except the Prism Test) are usually available from manufacturers. Certificates indicating compliance are acceptable to satisfy Quality Control requirements for the individual materials listed when used in masonry assemblies. Use this method of Quality Control in lieu of Prism Test unless total cost of Certificate acquisition is greater than the Prism Tests.
1. Mortar Test (Property Specification): For each mix required, per ASTM C780.
2. Grout Test (Compressive Strength): For each mix required, per ASTM C1019 with minimum compressive strength of 2,500 psi.
3. Prism Tests (required for load bearing walls, conditionally allowed for non-load bearing walls): At the Contractors option, with agreement of the Architect/Engineer, Prism Tests may be used to confirm non-load bearing masonry assembly compressive strength in lieu of Material Certificates.
    a. Prism Test: For each type of reinforced wall construction indicated, per ASTM C1314.
    b. Prepare one set of prisms for testing at 7 days and one set for testing at 28 days.
    c. Fabricate concrete masonry prisms with height-to-thickness ratio of not less than 1.33 nor more than 3.0.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

B. Cold Weather Requirements: In accordance with ACI 530.1-13 when ambient temperature or temperature of masonry units is less than 40 degrees F.

C. Hot Weather Requirements: In accordance with ACI 530.1-13 when ambient temperature is greater than 100 degrees F or ambient temperature is greater than 90 degrees F with wind velocity greater than 8 mph.

PART 2 - PRODUCTS

2.01 COMPONENTS

A. Portland Cement: ASTM C150/C150M, Type I, gray or white color as required to produce mortar color indicated.

B. MASONRY CEMENT SHALL NOT BE USED.

C. Mortar Aggregate: ASTM C144, standard masonry type.

D. Hydrated Lime: ASTM C207, Type S.

E. Grout Aggregate: ASTM C404, fine and coarse.

F. Water: Clean and potable.

G. Mortar Color: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes. Use only pigments with a record of satisfactory performance in masonry mortars.
   1. Manufacturers:
      a. "SGS Mortar Colors"; Solomon Grind-Chem Service, Inc., www.solomoncolors.com
      b. "True Tone Mortar Colors"; Davis Colors, A Subsidiary of Rockwood Industries, Inc., www.daviscolors.com

H. Water Repellent Admixture: Liquid water repellent mortar admixture intended for use with exterior decorative concrete masonry units containing integral water repellent.
   1. Manufacturers:
      a. Dry-Block Mortar Admixture; W. R. Grace & Co., www.grace.com
      b. Rheopel; Master Builders., https://master-builders-solutions.com/en-us/
      c. RainBloc for Mortar; ACM Chemistries, Inc., www.acmchem.com

I. Calcium chloride is not permitted.

J. AIR ENTRAINING ADMIXTURES SHALL NOT BE USED.

K. ANTIFREEZING ADMIXTURES SHALL NOT BE USED.

2.02 MIXES

A. Mortar Mixes:
   1. Mortar for Reinforced CMU Walls: ASTM C270, Type S using Proportion specification.
   2. Mortar for Face Brick and Unreinforced CMU Walls: ASTM C270, Type N using Proportion specification.

B. Mortar Mixing:
   1. Thoroughly mix mortar ingredients in accordance with ASTM C270 in quantities needed for immediate use.

2. Achieve uniformly damp sand immediately before mixing process.
3. Add mortar color to achieve uniformity of mix and coloration. Limit mineral-oxide pigments to no more than 10 percent of cement content by weight.
4. Re-temper only within two hours of mixing.

C. Grout Mixes:
1. Grout for Load Bearing and Non-Load Bearing Masonry: Strength as indicated on Drawings; mixed in accordance with ASTM C476.
2. Application:
a. Coarse Grout: For grouting spaces with minimum 4 inches dimension in every direction.
b. Fine Grout: For grouting other spaces.

D. Grout Mixing:
1. Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C476.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Request inspection of spaces to be grouted.

3.02 INSTALLATION

A. Install mortar in accordance with Section 04 20 00.

B. Low-Lift Grouting:
1. Use Low-Lift grouting technique for all walls and bond beams.
2. Provide minimum clear dimension of 2 inches and clear area of 8 sq. in. in verti cal cores to be grouted.
3. Place vertical reinforcement prior to laying of CMU. Extend above elevation of maximum pour height as required for splicing. Support in position at ver tical intervals not exceeding 192 bar diameters nor 10 ft.
4. Place horizontal beam reinforced as the masonry units are laid.
5. Lay CMU to maximum pour height. Do not exceed 5 foot height, or if bond beam oc curs below 5 foot height stop pour at course below bond beam.
6. Pour grout using chute or container with spout. Rod or vibrate grout during placing. Place grout continuously; do not interrupt pouring of grout for more than one hour. Terminate grout pours 1-1/2 inches below top course of pour.
7. Bond Beams: Stop grout in vertical cells 1-1/2 inches below bond beam course. Place horizontal reinforcing in bond beams; lap at corners and intersections as shown. Place grout in bond beam course before filling vertical cores above bond beam.

3.03 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Testing Frequency:
   1. One set of prism tests for every 5,000 S.F. of completed wall area.
   2. One set of mortar tests in accordance with ASTM C780 for aggregate ratio and water content, air content, consistency, and compressive strength, for every 25 C.Y. mortar.
   3. One set of grout tests in accordance with ASTM C780 for compressive strength and slump, for every 25 C.Y. grout.

END OF SECTION

SECTION 04 20 00

UNIT MASONRY ASSEMBLIES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
1. Face brick with weeps and inserts.
2. Concrete masonry units.
3. Decorative concrete masonry units.
4. Masonry joint reinforcement.
5. Ties and anchors.
6. Embedded flashing.
7. Miscellaneous masonry accessories.

B. Related Sections:
1. Section 04 05 03 - Masonry Mortaring and Grouting: Mortar and grout.
2. Section 04 29 00 - Engineered Unit Masonry.
3. Section 05 12 00 - Structural Steel Framing: Product requirements for steel anchors for placement by this section.
4. Section 05 50 00 - Metal Fabrications: Product requirements for loose steel lintels for placement by this section.
5. Section 07 27 26 - Fluid-Applied Membrane Air Barrier.
6. Section 07 90 00 - Joint Protection: Rod and sealant at control and expansion joints.

1.02 REFERENCES

A. American Concrete Institute:
1. ACI 530 - Building Code Requirements for Masonry Structures.
2. ACI 530.1 - Specifications for Masonry Structures.

B. Masonry Institute:
1. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures.

C. ASTM International:
1. ASTM A153/A153M - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
2. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
3. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
4. ASTM C67 - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.
5. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units.
6. ASTM C652 - Standard Specification for Hollow Brick (Hollow Masonry Units Made From Clay or Shale).

7. ASTM C1364 - Standard Specification for Architectural Cast Stone.
8. ASTM D226 - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
9. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

D. National Fire Protection Association:
1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

1.03 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal requirements.

B. Product Data:
1. Submit data for decorative masonry units, fabricated wire reinforcement, wall ties, anchors, cavity drainage material, and other accessories.
2. Submit data for cleaning solutions, including detailed description of methods, materials, equipment and site cleanup procedures to be used. Provide with letters of approval from brick and cleaning material manufacturers regarding the compatibility of proposed use of products together for cleaning purposes.

C. Samples:
1. Submit four samples of each type of decorative masonry unit and face brick, to illustrate color, texture and full color range. Furnish additional samples when necessary to fully illustrate the complete range of highly variable materials.
2. Submit color samples for glazed units.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

E. Shop Drawings:
1. Submit shop drawings for fabrication, bending, and placement of reinforcement bars and for steel templates for layout of dowels for masonry columns and pilasters. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures". Show bar schedules, diagrams of bent bars, lateral ties and other arrangements and assemblies as required for fabrication and placement of reinforcement for unit masonry work.
2. Provide dimensioned plan and details indicating layout, sizes, and shapes, and vertical heights of all structural glazed tile walls.
3. Submit detailed shop drawings for custom sized/shaped units including shaped brick and cast stone.

1.04 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 530 Building Code Requirements for Masonry Structures and ACI 530.1 Specification for Masonry Structures.

B. Fire Rated Wall Construction: Rating as indicated on Drawings.
1. Tested Rating: Determined in accordance with ASTM E119.

1.05 QUALIFICATIONS

A. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.06 MOCKUP

A. Section 01 40 00 - Quality Requirements: Mockup requirements.

B. Construct cavity masonry wall mockup, 8 feet (243.84 cm) long by 8 feet high, including masonry, mortar and accessories, structural backup, flashings, wall insulation, and weeps.
   1. Structural backup wall to be same as building designed backup, whether CMU, steel studs, or other. Verify with Architect where building design utilizes more than one type of backup.
   2. Include a sealant-filled control joint.
   3. Omit masonry above flashing to leave a 12 inch (304.8 mm) length of the flashing exposed to view.
   4. Clean face of mockup with masonry cleaner using methods anticipated for the Work.
   5. Include representative masonry ties and anchors for each backup substrate to demonstrate proper engagement and fastener installation.

C. Furnish removable cover to protect completed mock-up from rain or other environmental or site conditions that may alter its appearance.

D. Locate where directed by Architect/Engineer. Keep top of mock up wall covered with weighted waterproof tarp.

E. Remove mockup when directed by Architect/Engineer.

1.07 PRE-INSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Accept masonry units and accessories on site. Inspect for damage.

1.09 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

B. Cold Weather Requirements: In accordance with ACI 530.1 when ambient temperature or temperature of masonry units is less than 40 degrees Fahrenheit (4.44 degrees Celsius).

C. Hot Weather Requirements: In accordance with ACI 530.1 when ambient temperature is greater than 100 degrees Fahrenheit (37.78 degrees Celsius) or ambient temperature is greater than 90 degrees Fahrenheit (32.22 degrees Celsius) with wind velocity greater than 8 mph.

D. Bracing of Work in Progress:
   1. Where masonry erection may be exposed to high winds, installation shall be adequately braced until masonry construction has attained sufficient strength to resist wind forces.
   2. Shores and forms shall not be removed until masonry construction has attained sufficient strength to support its own weight and all other construction or environmental loads.

1.10 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Coordinate work with work of other trades built into or adjoining masonry work.

PART 2 PRODUCTS

2.01 MASONRY MATERIALS

A. Face Brick: ASTM C652, Grade SW, Type HBS, HBX, or HBA in accordance with the particular units selected for use, as indicated on Drawings.

B. Hollow Load Bearing Concrete Masonry Units (CMU): ASTM C90, lightweight.
   1. Size: Nominal modular size of 16 inches (406.4 mm) long x 8 inches (203.2 mm) high x thickness indicated.
   2. Furnish special units for bond beams and lintels as noted on structural drawings.
   3. Furnish bullnose corners at units exposed to interior of building.

C. Decorative Concrete Masonry Units: ASTM C90
   1. Ground-Faced with decorative aggregate as manufactured by Headwaters or approved equivalent in color and finish by Best or Boral.
   2. Sizes: Nominal modular size of 16-inches long x 8-inches high x indicated thicknesses.
   3. Integral Water Repellent: Units installed exposed to the exterior shall be fabricated with integral liquid polymeric water-repellent admixture. Admixture shall 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 E514, with test period extended to 24 hours, show no visible water or leaks on the back of the test specimen.
      a. Manufacturers:
         1) Dry-Block; W. R. Grace & Co., Construction Products Division, www.grace.com
         2) Rheopel; BASF www.basf-admixtures.com
         3) RainBloc; ACM Chemistries, Inc., www.acmchem.com

D. Mortar and Grout: As specified in Section 04 05 03 and as noted on Structural Drawings.

2.02 ANCHORS, TIES AND REINFORCEMENT

A. Manufacturers:
   1. AA Wire Products
   2. Heckman Building Products, www.heckmannbuildingprods.com
   3. Hohmann & Barnard (Dur-O-Wall), www.h-b.com
   4. Masonry Reinforcing Corp. of America (Wire-Bond)

5. Substitutions: Section 01 60 00 - Product Requirements.

B. Single Wythe Joint Reinforcement: ASTM A951; ladder type; steel; 9 gage side rods and cross ties; hot dip galvanized

C. Strap Anchors: Bent steel, 1-1/2 inches (38 mm) wide x 24 inches (609.6 mm) long x 1/4 inch (6.35 mm) thick, with ends turned up not less than 2 inches (50.8 mm); ASTM A153/A153M hot dip galvanized.

D. Veneer Ties for CFMF Stud Backup Walls: Rib-stiffened sheet metal plate anchors with screw holes top and bottom and projecting tabs with slotted holes for receiving vertical legs of adjustable wire ties; ASTM A153/A153M hot dip galvanized.
   1. Anchor Size: 2-3/4 inches (70 mm) wide by 3 inches (76.2 mm) high.
   2. Tie Size: 0.1875 inch (4.76 mm) diameter wire, length as required to extend to within 1 inch (25.4 mm) of veneer face.
   3. Tie Shape: Rectangular
   4. Fasteners: Type 304 stainless steel hex-washer head screws with carbon drill point as provided by Hohmann & Barnard.
      a. Size: #12 diameter x length required to penetrate steel stud flange by not less than 3 exposed threads.
      b. Complete with stainless steel backed neoprene sealing washer.
   5. Basis of Design:
      a. Running Bond Brick: Running Bond Brick: Hohmann & Barnard HB-213.
      b. Stacked Bond or Soldier Course Brick: Hohmann & Barnard HB-213 SH or 300C/HB-213 Seismic. Provide with hot-dip galvanized 0.1875 inch (4.76 mm) diameter wire reinforcing continuous within horizontal brick joint.

E. Veneer Ties for CMU Backup Walls: ASTM A82; ladder type joint reinforcement with adjustable eye and pintle type wire ties; ASTM A153/A153M hot dip galvanized.
   1. Tie Size: 0.1875 inch (4.76 mm) diameter wire, length as required to extend to within 1 inch (25.4 mm) of veneer face.
   2. Tie Shape: Rectangular
   3. Fasteners: #12 stainless steel screws self-tapping screws.
   4. Basis of Design:
      a. Modular Brick: Hohmann & Barnard, #270 Ladder Eye-Wire.
      b. King Size Brick: Hohmann & Barnard, 2-SealTM Concrete Seal Tie, wire tie with hot-dip galvanized 0.1875 inch (4.76 mm) diameter wire reinforcing continuous within horizontal brick joint.

F. Veneer Ties for Grade Beams and Concrete Backup Walls: Zinc-alloy barrel section with flanged head and eye, fastened with corrosion-resistant, self-drilling screw. Eye designed to receive tie and to serve as head for drilling fastener into concrete. Provide barrel length to suit cavity wall insulation thickness, allowing screw to seat directly against the concrete wall with flanged head covering hole in insulation.
   1. Tie Size: 0.1875 inch (4.76 mm) diameter wire, length as required to extend to within 1 inch (25.4 mm) of veneer face.
   2. Tie Shape: Triangular.
   3. Basis of Design: Hohmann & Barnard, 2-SealTM Concrete Seal Tie.

G. Dovetail Anchors: Bent steel strap formed from 0.1046 inch (2.66 mm) thick steel, with 0.1875 inch (4.76 mm) diameter triangular-shaped wire tie sized to extend within 1 inch (25.4 mm) of masonry face; ASTM A153/A153M hot dip galvanized.

H. Steel Beam and Column Anchors: Crimped 1/4 inch (6.35 mm) diameter wire anchor welded to steel member, with 0.1875 inch (4.76 mm) diameter triangular-shaped wire tie for solid masonry and rectangular-shaped wire tie for hollow masonry, sized to extend within 1 inch (25.4 mm) of masonry face; ASTM A153/A153M hot dip galvanized.

I. Reinforcing Steel: Type specified in Section 03 20 00.

J. Anchor Bolts: ASTM A307; Grade A; J-shaped or L-shaped; complete with flat washers and heavy hex nuts; hot-dipped galvanized finish, ASTM A153/A153M.

2.03 EMBEDDED FLASHING MATERIALS

A. Stainless Steel: ASTM A240, Type 304, soft temper; 0.016 inch (0.41 mm) thick; smooth finish.

B. Asphalt-Coated Copper Flashing: 5 oz/sq ft rolled sheet copper coated with flexible asphalt.
   1. Manufacturers:
      a. Cop-A-Cote; AFCO Products, Inc., www.afcoproducts.com
      b. Type ACC-Asphalt Bituminous Coated; Phoenix Building Products.
      c. Coated Copper Flashing; Sandell Manufacturing Co., Inc., www.sandellmfg.com
      d. Substitutions: Section 01 60 00 - Product Requirements.

C. Rubberized Asphalt Flashing: Composite flashing sheet consisting of self-adhesive rubberized asphalt compound bonded to a high-density cross-laminated polyethylene film; overall thickness of 0.030 inch (0.76 mm).
   1. Do not install rubberized asphalt flashing adjacent to or in contact with flexible vinyl or PVC products.
   2. Manufacturers:
      a. Perm-A-Barrier Wall Flashing; W. R. Grace & Co., www.grace.com
      b. Vycor V-40; W. R. Grace & Co., www.grace.com
      c. Polyguard 400; Polyguard Products, Inc., www.polyguardproducts.com
      d. Cloaked Flashing System, Hyload Inc., www.HyloadFlashing.com
      e. Substitutions: Section 01 60 00 - Product Requirements.

D. Lap Sealant: Type specified in Section 07 90 00.

2.04 ACCESSORIES

A. Joint Filler: ASTM D1056, Grade 2A1, closed cell neoprene; oversized 50 percent to joint width; self-expanding.

B. Cavity Wall Insulation: Extruded polystyrene board specified in Section 07 21 13.

C. Cavity Drainage Material: Open polyethylene mesh thickness required to fill cavity space, and shaped to ensure moisture drainage to cavity weeps.
   1. Manufacturers:
      a. Mortar Break; Advanced Building Products Inc., www.advancedflashing.com
      b. Mortar Net; Mortar Net USA, Ltd., www.mortarnet.com

c. CavClear Masonry Mat, Archovations, Inc., www.cavclear.com
d. Substitutions: Section 01 60 00 - Product Requirements.

D. Weeps and Inserts:
1. Open Head Joints: Full head height for face brick, 3 inches (76.2 mm) high for CMU. Space at 20” or 24” O.C depending on brick size. All weep joints to receive inserts.
2. Weep Inserts: Install stainless steel inserts at each weep. Inserts as manufactured by Weepa, www.weepa.com or approved equivalent by Rid-O-Mice.

E. Cleaning Solutions:
1. Job-Mixed Detergent Solution: Solution of 1/2-cup (0.14-L) dry measure tetrasodium polyphosphate and 1/2-cup (0.14-L) dry measure laundry detergent dissolved in 1 gal. (4 L) of water.
2. Proprietary Acidic Cleaner: Standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry and pigmented mortar surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
a. Manufacturers:
1) Diedrich Technologies, Inc.
2) EaCo Chem, Inc.
3) ProSoCo, Inc.
4) AHI Supply
5) Substitutions: Section 01 60 00 - Product Requirements.

F. Steel Lintels: Size as indicated on Drawings, hot-dip galvanized.

PART 3 EXECUTION

3.01 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: coordination and project conditions.

B. Verify field conditions are acceptable and are ready to receive work.

C. Verify items provided by other sections of work are properly sized and located.

D. Verify built-in items are in proper location, and ready for roughing into masonry work.

3.02 PREPARATION

A. Direct and coordinate placement of metal anchors supplied to other sections.

B. Furnish temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent support.

C. Wet clay and shale brick before laying when initial rate of absorption is greater than 30 grams when tested in accordance with ASTM C67.

3.03 INSTALLATION

A. Establish lines, levels, and coursing indicated. Protect from displacement.

B. Maintain masonry courses to uniform dimension. Form bed and head joints of uniform thickness.

C. Lay exposed masonry to match existing bond pattern(s):
   1. Coursing of Concrete Masonry Units:
      a. Bond: Running or match existing.
      b. Coursing: One unit and one mortar joint to equal 8 inches (203.2 mm).
      c. Mortar Joints: Concave.
   2. Typical Coursing of Modular Brick Units:
      a. Bond: 1/2 running.
      b. Coursing: Three units and three mortar joints to equal 8 inches (203.2 mm).
      c. Mortar Joints: Concave.
   3. Typical Coursing of King Size Brick Units:
      a. Bond: 1/3 running.
      b. Coursing: Three units and three mortar joints to equal 9 inches (228.6 mm).
      c. Mortar Joints: Concave.
   4. Coursing of Reinforced Concrete Masonry Units:
      a. Bond: Running.
      b. Coursing: One unit and one mortar joint to equal 8 inches (203.2 mm).
      c. Mortar Joints: Tooled concave.
   5. Coursing of Decorative Concrete Masonry Units:
      a. Bond: Running.
      b. Coursing: One unit and one mortar joint to equal 8 inches (203.2 mm).
      c. Mortar Joints: Concave.

D. Placing and Bonding:
   1. Lay solid masonry units in full bed of mortar, with full head joints.
   2. Lay hollow masonry units with face shell bedding on head and bed joints.
      a. Bed webs in mortar in starting course on footings and in all courses of piers, columns, and pilasters, and where adjacent to cells or cavities to be filled with grout.
      b. For starting course on footings where cells are not grouted, spread out full mortar bed, including areas under cells.
   3. Buttering corners of joints or excessive furrowing of mortar joints are not permitted.
   4. Remove excess mortar as work progresses.
   5. Interlock intersections and external corners.
   6. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment is required, remove mortar and replace.
   7. Perform job site cutting of masonry units with motor-driven saws to assure straight, clean, un-chipped edges. Prevent broken masonry unit corners or edges. Where possible, use full-size units without cutting.
   8. Install cut units with cut surfaces and edges concealed.
   9. Select and arrange exposed units to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.

10. Cut mortar joints flush where wall tile is scheduled or bitumen dampproofing is applied.
11. Cut mortar fins protruding into cavity from back side of face brick as work progresses.
12. Isolate masonry from vertical structural framing members.
13. At full-height walls, leave a 1” space between top of masonry and floor or roof structure above. Brace masonry from structure with 16- gauge galvanized steel angles having 4” equal legs and 8” lengths mechanically anchored to the floor or roof structure and spaced not more than 4’-0” on center.
14. Isolate top of masonry from horizontal structural framing members and slabs or decks with compressible joint filler.

E. Weeps and Inserts: Install weeps and inserts in outer wythe at maximum 24 inches (609.6 mm) oc horizontally above through-wall flashing, above shelf angles and lintels, at bottom of walls, and above other obstructions of wall cavity continuity.

F. Cavity Wall: Do not permit mortar to drop or accumulate into cavity air space or to plug weeps. Build inner wythe ahead of outer wythe to receive cavity insulation and bituminous dampproofing.
1. Install cavity drain material, notched end up, continuously at bottom of each cavity above embedded flashing.

G. Stain Prevention: As work progresses, prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
1. Protect base of walls from rain-splashed mud and from mortar splatter by coverings spread on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

H. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
1. Extend cover a minimum of 24 inches (609.6 mm) down both sides and hold cover securely in place.
2. Where one wythe of multi-wythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches (609.6 mm) down face next to unconstructed wythe and hold cover in place.

3.04 JOINT REINFORCEMENT AND ANCHORAGE

A. Install horizontal joint reinforcement in CMU walls 16 inches (406.4 mm) oc.

B. Place joint reinforcement in first and second horizontal joints above and below openings greater than 12 inches (304.8 mm) wide. Extend minimum 16 inches (406.4 mm) each side of opening.

C. Place joint reinforcement continuous in first and second joints below tops of walls.

D. Lap joint reinforcement ends minimum 6 inches (152.4 mm).

E. Cut or interrupt joint reinforcing at control and expansion joints.

F. At corners, install horizontal joint reinforcement with prefabricated “L” intersections.

G. At intersecting and abutting walls, unless vertical expansion or control joints are shown at juncture, install horizontal joint reinforcement with prefabricated “T” intersections.

H. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch (12.7 mm) of dimensioned position.

I. Install anchors attached to concrete and steel structural members:
   1. Leave an open space not less than 1 inch (25.4 mm) in width between back of masonry and face of structural member. Keep open space free of mortar or other rigid materials.
   2. Install anchors at maximum 16 inches (406.4 mm) o.c. vertically and horizontally.

J. Install Wall Ties at CMU Backup Walls:
   1. Install wall ties at 16 inches (406.4 mm) oc vertically and maximum 16 inches oc horizontally.
   2. Coordinate ties to accommodate installation of 16 inch (406.4 mm) widths of cavity wall insulation specified in Section 07 21 13.
   3. Place additional wall ties within 12 inches (304.8 mm) of openings at intervals not exceeding 36 inches (914.4 mm).

3.05 MASONRY FLASHINGS:

A. Provide concealed flashing in masonry work at or above shelf angles, lintels, ledges and other obstructions to the downward flow of water in the wall so as to divert such water to the exterior.

B. Form flashings from the following materials:
   1. Exposed flashings: Stainless steel.
   2. Concealed flashings: Asphalt-coated copper or rubberized asphalt, at contractor’s option.

C. Prepare masonry surfaces smooth and free from projections which could puncture flashing. Place through-wall flashing on sloping bed of mortar and cover with mortar. Seal penetrations in flashing with mastic before covering with mortar.

D. Extend flashings horizontally through exterior face of masonry and turn down 1/4 inch (6.35 mm) to form drip.

E. Turn flashing up minimum 8 inches (203.2 mm) and bed into mortar joint of CMU backup wall or seal to sheathing over CFMF stud backup wall.

F. Lap end joints minimum 6 inches (152.4 mm) and seal watertight.

G. Extend flashing the full length of lintels and shelf angles and minimum of 4" into masonry each end; turn up ends not less than 2" to form end dams as recommended by BIA and illustrated in BIA Technical Note 7, Figure 21, current edition.

H. Turn flashing, fold, and seal at corners, bends, and interruptions.

I. Lintels:
   1. Install loose steel lintels over openings more than 12 inches (304.8 mm) wide in brick walls.

2. Install reinforced unit masonry lintels over openings more than 24 inches (609.6 mm) wide in CMU walls.
    a. Reinforce lintels as indicated on Drawings.
    b. Do not splice reinforcing bars.
    c. Support and secure reinforcing bars from displacement.
    d. Place and consolidate grout fill without displacing reinforcing.
    e. Allow masonry lintels to attain specified strength before removing temporary supports.
3. Maintain minimum 8 inch (203.2 mm) bearing on each side of opening.

J. Grouted Components:
1. Reinforce bond beams and pilasters as indicated on Drawings.
2. Splice reinforcement in accordance with Section 03 20 00.
3. Support and secure reinforcing bars from displacement.
4. Place and consolidate grout fill without displacing reinforcing.
5. At bearing locations, fill masonry cores with grout for minimum 12 inches (304.8 mm) both sides of opening.
6. Fill cores in hollow concrete masonry units with grout 24 inches (609.6 mm) under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

K. Reinforced Masonry:
1. Lay masonry units with core cells vertically aligned and cavities between wythes clear of mortar and unobstructed.
2. Place reinforcement bars as indicated on Drawings.
3. Splice reinforcement in accordance with Section 03 20 00.
4. Support and secure reinforcement from displacement.
5. Place and consolidate grout fill without displacing reinforcing.
6. Place grout in accordance with ACI 530.1 Specification for Masonry Structures.

L. Control And Expansion Joints:
1. Install control and expansion joints at the following maximum spacings, unless otherwise indicated on Drawings:
    a. Interior Partitions: 25'-0" o.c. horizontally.
    b. Exterior Cavity Walls: 20'-0" o.c. horizontally.
    c. Steel Lintels: Provide horizontal bond breaks as detailed on Drawings at the end bearing to allow for thermal expansion and contraction.
    d. Openings in Exterior and Interior Walls: At masonry with steel lintels, provide expansion joints on each side of the opening continuing to the top and bottom of the brick wythe and as specified above. At CMU lintels, provide control joints in alignment with the outside ends of the lintel continuing to the bed joint and then with horizontal bond breaks at the end bearing.
    e. Veneer Construction: Provide horizontal pressure relieving joints beneath shelf angles as recommended by BIA Technical Note 28B current edition.
    f. At changes in wall height.
2. Do not continue horizontal joint reinforcement through control and expansion joints.
3. Form control joint with sheet building paper bond breaker fitted to one side of hollow contour end of block unit. Fill resultant core with grout fill. Rake joint at exposed unit faces for placement of backer rod and sealant.

4. Form expansion joint by omitting mortar and cutting unit to form open joint.

M. Built-In Work:
1. As work progresses, install built-in door and window frames, wood nailing strips, anchor bolts, plates, and other items to be built-in the work and furnished by other sections.
2. Install built-in items plumb and level.
3. Bed anchors of metal door and window frames in adjacent mortar joints. Fill frame voids solid with grout or mortar. Fill adjacent masonry cores with grout minimum 12 inches (304.8 mm) from framed openings.
4. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath in the joint below and rod mortar or grout into core.
5. Do not build in materials subject to deterioration.

N. Cutting and Fitting:
1. Cut and fit for chases, pipes, conduit, sleeves, grounds, and other items penetrating masonry. Coordinate with other sections of work to provide correct size, shape, and location.
2. Obtain Architect/Engineer’s approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.06 ERECTION TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Maximum Variation From Alignment of Columns and Pilasters: 1/4 inch (6.35 mm).

C. Maximum Variation From Unit to Adjacent Unit: 1/16 inch (1.59 mm).

D. Maximum Variation from Plane of Wall: 1/4 inch (6.35 mm) in 10 ft and 1/2 inch (12.7 mm) in 20 ft or more.

E. Maximum Variation from Plumb: 1/4 inch (6.35 mm) per story non-cumulative; 1/2 inch (12.7 mm) in two stories or more.

F. Maximum Variation from Level Coursing: 1/8 inch (3.18 mm) in 3 ft; 1/4 inch (6.35 mm) in 10 ft; 1/2 inch (12.7 mm) in 30 feet (914.4 cm)

G. Maximum Variation of Joint Thickness: 1/8 inch (3.18 mm) in 3 feet (91.44 cm)

H. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch (6.35 mm).

I. Maximum Variation for Steel Reinforcement:
1. Install reinforcement within the tolerances specified in ACI 530.1 for foundation walls.
2. Plus or minus 1/2 inch (12.7 mm) when distance from centerline of steel to opposite face of masonry is 8 inches (203.2 mm) or less.
3. Plus or minus 1 inch (25.4 mm) when distance is between 8 and 24 inches (609.6 mm).
4. Plus or minus 1-1/4 inch (32 mm) when distance is greater than 24 inches (609.6 mm).
5. Plus or minus 2 inches (50.8 mm) from location along face of wall.

3.07 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Remove excess mortar and mortar smears as work progresses.

C. Replace defective mortar. Match adjacent work.

D. Clean soiled surfaces with cleaning solution.

E. Use non-metallic tools in cleaning operations.

F. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
   1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
   2. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent, polyethylene film or waterproof masking tape.
   3. Saturate wall surfaces with water prior to application of cleaners; remove cleaners promptly by rinsing thoroughly with clear water.
   4. Clean brick by the bucket-and-brush hand-cleaning method described in BIA Technical Notes No. 20, using job-mixed detergent solution, or clean masonry with approved cleaner applied according to the brick and the cleaning manufacturer's written instructions and approval.
   5. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2 applicable to type of stain on exposed surfaces.
   6. Do not use high-pressure washing methods (greater than 700psi as described in BIA Technical Notes No. 20) on single wythe construction, on concrete masonry incorporating integral or applied water repellents, or on sand-finished face brick.

3.08 DEFECTIVE CONSTRUCTION

A. Correct defects appearing in the finished work for a period of one year after the date of Substantial Completion.

B. Defects shall include, but not be limited to, cracking, separating or color leaching of mortar, cracking, discoloration, or deterioration of masonry units, efflorescence in masonry units or joints, and water penetration through face brick or joints under normal exposure.

3.09 PROTECTION OF FINISHED WORK

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protecting finished Work.

B. Protect exposed external corners subject to damage.

C. Protect base of walls from mud and mortar splatter.

D. Protect masonry and other items built into masonry walls from mortar droppings and staining caused by mortar.

E. Protect tops of masonry work with waterproof coverings secured in place without damaging masonry. Provide coverings where masonry is exposed to weather when work is not in progress.

END OF SECTION

SECTION 04 29 00 - ENGINEERED UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes furnishing all labor, materials, and services incidental to the installation of steel reinforcing for CMU, brick, and stone masonry:

B. Related Sections:
   1. Section 01 40 00 – Quality Requirements: Materials testing.
   2. Section 04 20 00 – Unit Masonry Assemblies.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to work of this Section.

B. Requirements of Division 4 Section "Unit Masonry Assemblies" apply to Work of this Section.

1.3 SUMMARY

A. This Section consists of furnishing all the labor, materials, and services incidental to the installation of reinforced unit masonry.

1.4 DESCRIPTION OF WORK

A. Extent of each type of reinforced unit masonry work is indicated on drawings and in schedules.

1.5 SUBMITTALS

A. Shop Drawings: Submit shop drawings for fabrication, bending, and placement of reinforcement bars. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures". Show bar schedules, diagrams of bent bars, stirrup spacing, lateral ties and other arrangements and assemblies as required for fabrication and placement of reinforcement for unit masonry work. Submit shop drawings showing wall elevations with all masonry openings, reinforcement, and control joints.

B. Material certificates in lieu of material laboratory test reports when permitted by Architect/Engineer. Material certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with or exceeds specified requirements. Provide certification from admixture manufacturers that chloride content complies with specification requirements.

C. Testing Reports: The independent testing laboratory shall submit laboratory test reports for materials used directly to the Architect/Engineer with copy to others in accordance with the provisions of Division 1 Section "Quality Control Services." State in each report whether or not the test specimens comply to the specified requirements and indicate any deviations therefrom.

PART 2 - PRODUCTS

2.1 UNIT MASONRY

A. General: Refer to Division 4 Section "Unit Masonry Assemblies" for masonry materials and accessories not included in this Section.

B. Masonry Compressive Strengths:

1. Minimum masonry compressive strength (Fm) = 2000 psi.
2. Concrete Masonry Units: ASTM C 90, with a minimum compressive strength of 2500 psi, minimum average of three units on the net area.
3. Mortar : ASTM C 270, Type S.
4. Grout : ASTM C 476, with a minimum compressive strength of 2500 psi.

2.2 REINFORCEMENT BARS

A. General: Provide deformed bars to following grades complying with ASTM A 615, except as otherwise indicated.

1. Provide Grade 40 for bars No. 3, except as otherwise indicated.
2. Provide Grade 60 for bars No. 4 to No. 18, except as otherwise indicated.
3. Shop-fabricate reinforcement bars which are shown to be bent or hooked.

PART 3 - EXECUTION

3.1 PLACING REINFORCEMENT

A. General: Clean reinforcement loose rust, mill scale, earth, ice or other materials which will reduce bond to mortar or grout. Do not use reinforcement bars with kinks or bends not shown on drawings or final shop drawings, or bars with reduced cross-section due to excessive rusting or other causes.

B. Position reinforcing accurately at the spacing indicated. Support secure vertical bars against displacement. Horizontal reinforcing may be placed as the masonry work progresses. Where vertical bars are shown in close proximity, provide a clear distance between bars of not less than the nominal bar diameter or 1" (whichever is greater). Minimum clearance between masonry and reinforcement shall be 1/2".

1. For columns, piers and pilasters, provide a clear distance between vertical bars as indicated, but not less than 1-1/2 times the nominal bar diameter or 1-1/2", whichever is greater. Provide lateral ties as indicated. Refer to the general notes on the drawings for minimum clearance between the main reinforcement and the masonry.

C. Splice reinforcement bars where shown; do not splice at other points unless acceptable to the Architect. Provide lapped splices, unless otherwise indicated. In splicing vertical bars or attaching to dowels, lap ends, place in contact and wire tie.

D. Embed metal ties in mortar joints as work progresses, with a minimum mortar cover of 5/8" on exterior face of walls and 1/2" at other locations.

E. Embed prefabricated horizontal joint reinforcement as the work progresses, with a minimum cover of 5/8" on exterior face of walls and 1/2" at other locations. Lap units not less than 6" at ends. Use prefabricated "L" and "T" units to provide continuity at corners and

intersections. Cut and bend units as recommended by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures and other special conditions.

F. Anchoring: Anchor reinforced masonry work to supporting structure as indicated.
   1. Anchor reinforced masonry walls to non-reinforced masonry where they intersect.

G. Foundation dowels: Dowels in the foundation shall be placed to align with cores containing reinforcement.

3.2 INSTALLATION, GENERAL

A. Refer to Division 4 Section "Unit Masonry Assemblies" for general installation requirements to unit masonry.

B. Temporary Formwork: Provide formwork and shores as required for temporary support of reinforced masonry elements.

   1. Construct Formwork to conform to shape, line and dimensions shown. Make sufficiently tight to prevent leakage of mortar grout, or concrete (if any). Brace, tie and support as required to maintain portion and shape during construction and curing of reinforced masonry.

C. Do not remove forms and shores until reinforced masonry member have hardened sufficiently to carry their own weight and all other reasonable temporary loads that may be placed on them during construction.

   1. Allow not less than the following minimum time to elapse after completion of members before removing shores or forms, provided suitable curing conditions have been obtained during the curing period.
      a. 10 days for girders and beams.

3.3 INSTALLATION OF REINFORCED BRICK MASONRY

A. Mortar Jointing and Bedding:
   1. Pattern Bond: Lay exterior wythes in the pattern bond shown, or if not shown, lay in 1/2-running bond with vertical joints in each course centered on units in courses above and below. Lay inner wythes (if any) with all units in a wythe bonded by lapping not less than 2". Bond and interlock each course of each wythe at corners and intersections. Do not use units with less than 4" nominal horizontal face dimension at corners or jambs.
   2. Lay exterior wythes with bed (horizontal) and head (vertical) joints between units completely filled with mortar. Top of bed joint mortar may be sloped toward center of walls. Butter ends of units with sufficient mortar to completely fill head joints and shove into place. Do not furrow bed joints or slush head joints. Remove any mortar fins which protrude into grout space.

      a. Maintain joint widths shown for head and bed joints, but adjust thickness of bed joints, if required, to allow for not less than 1/4" thickness of mortar between reinforcement and masonry units, except 1/4" bars (if any) may be laid in 1/2" thick bed joints and No. 6 gage or smaller wire reinforcing (if any) may be laid in 3/8" thick bed joints.

B. Two-Wythes Wall Construction: Lay both wythes as previously specified for exterior wythes. Maintain grout space (collar or continuous vertical joint between wythes) of width indicated, but adjust, if required, to provide grout space not less than 1/2" wider than the sum of the vertical and horizontal (if any) reinforcement bars shown to be placed in grout space. Do not parge or fill grout space with mortar.

C. Limit extent of masonry construction to sections which do not exceed the maximum pour requirements specified hereafter. Provide temporary dams or barriers to control horizontal flow of grout at ends of wall sections. Build dams full height of grout pour. If masonry units are used, do not bond into permanent masonry wythes. Remove temporary dams after completion of grout pour.

D. Low-Lift Grouting:
   1. Use Low-Lift grouting technique with "Fine Grout" per ASTM C 476 for the following:
      a. Two-wythe walls with grout space of 2" or less in width.

   2. Use Low-Lift grouting technique with "Coarse Grout" per ASTM C 476 for the following:
      a. Columns, piers or pilasters where masonry units are shown in core areas enclosed by exterior masonry units.

   3. Construct low-lift masonry by placing reinforcement, laying masonry units and pouring grout as the work progresses.

   4. Place vertical reinforcement bars and supports prior to laying of masonry units. Extend above elevation of maximum pour height as required to allow for splicing. Horizontal reinforcement bars may be placed progressively with laying of masonry units.

   5. Limit grout pours as required to prevent displacement of masonry by grout pressures (blowout), but do not exceed 12" pour height.

   6. Lay masonry units prior to each grout pour, but do not construct more than 12" above maximum grout pour height in one exterior wythe and 4" above in other exterior wythe. Provide metal wall ties if required to prevent blowouts.

   7. Pour grout using container with spout and consolidate immediately by rodding or puddling; do not use trowels. Place grout continuously; do not interrupt pouring of grout for more than one hour. If poured in lifts, place from center-to-center of masonry courses. Terminate pour 1-1/2" below top of highest course in pour.

3.4 INSTALLATION OF REINFORCED CONCRETE UNIT MASONRY

A. Do not wet concrete masonry units (CMU).

B. Lay CMU units with full-face shell mortar beds. Fill vertical head joints (end joints between units) solidly with mortar from face of unit to a distance behind face equal to not less than the thickness of longitudinal face shells. Solidly bed cross-webs of starting courses in mortar. Maintain head and bed joint widths shown, or if not shown, provide 3/8" joints.

   1. Where solid CMU units are shown, lay with full mortar head and bed joints.

C. Walls:

   1. Pattern Bond: Lay CMU wall units in 1/2 running bond with vertical joints in each course centered on units in courses above and below, unless otherwise indicated. Bond and interlock each course at corners and intersections. Use special-shaped units where shown, and as required for corners, jambs, sash, control joints, lintels, bond beams and other special conditions.

   2. Maintain vertical continuity of core or cell cavities, which are to be reinforced and grouted, to provide minimum clear dimensions indicated and to provide minimum

clearance and grout coverage for vertical reinforcement bars. Keep cavities free of mortar. Solidly bed webs in mortar where adjacent to reinforced cores or cells.

3. Where horizontal reinforced beams (bond beams) are shown, use special units or modify regular units to allow for placement of continuous horizontal reinforcement bars. Place small mesh expanded metal lath or wire screening in mortar joints under bond beam courses over cores or cells of non-reinforced vertical cells, or provide units with solid bottoms.

4. Columns, Piers and Pilasters:
   a. Use CMU units of the size, shape and number of vertical core spaces shown. If not shown, use units which provide minimum clearances and grout coverage for number and size of vertical reinforcement bars shown.
   b. Provide pattern bond shown, or if not shown, alternate head joints in vertical alignment.
   c. Lay wall and pilaster units together to maximum pour height specified.

D. Grouting:
   1. Use “Fine Grout" per ASTM C 476 for filling spaces less than 4" in one or both horizontal directions and bond beams.
   2. Use "Coarse Grout" per ASTM C 476 for filling 4" spaces or larger in both horizontal directions and formed beams.

E. Low-Lift Grouting:
   1. Use Low-Lift grouting technique for all walls and bond beams.

   2. Provide minimum clear dimension of 2" and clear area of 8 sq. in. in vertical cores to be grouted.

   3. Place vertical reinforcement prior to laying of CMU. Extend above elevation of maximum pour height as required for splicing. Support in position at vertical intervals not exceeding 192 bar diameters nor 10 ft.

   4. Place horizontal beam reinforced as the masonry units are laid.

   5. Lay CMU to maximum pour height. Do not exceed 5' height, or if bond beam occurs below 5' height stop pour at course below bond beam.

   6. Pour grout using chute or container with spout. Rod or vibrate grout during placing. Place grout continuously; do not interrupt pouring of grout for more than one hour. Terminate grout pours 1-1/2" below top course of pour.

   7. Bond Beams: Stop grout in vertical cells 1-1/2" below bond beam course. Place horizontal reinforcing in bond beams; lap at corners and intersections as shown. Place grout in bond beam course before filling vertical cores above bond beam.

F. High-Lift Grouting:
   1. High-lift grouting technique may be used for the following masonry construction:
      a. Columns, piers, pilasters, or formed beams.

   2. Provide cleanout holes in first course of each grout pour at all vertical cells which are to be filled with grout.
      a. Use units with one face shell removed and provide temporary supports for units above, or use header units with concrete brick supports, or cut openings in one face shell.

3. Construct masonry to full height of maximum grout specified, prior to placing grout.
   a. Limit grout lifts to a maximum height of 5' and grout pour to a maximum height of 12', unless otherwise indicated.

4. Place vertical reinforcement before grout placement. Place before or after laying masonry units, as required by job conditions. Tie vertical reinforcement to dowels at base of masonry where shown and thread CMU over or around reinforcement. Support vertical reinforcement at intervals not exceeding 192 bar diameters nor 10'.
   a. Where individual bars are placed after laying masonry, place wire loops extending into cells as masonry is laid and loosen before mortar sets. After insertion of reinforcing bar, pull loops and bar to proper position and tie free ends.

5. Where reinforcement is prefabricated into cage units before placing, fabricate units with vertical reinforcement bars and lateral ties of the size and spacing indicated.

6. Embed lateral tie reinforcement in mortar joints where indicated. Place as masonry units are laid, at vertical spacing shown.

   a. Where lateral ties are shown in contact with vertical reinforcement bars, embed additional lateral tie reinforcement in mortar joints. Place as shown, or if not shown, provide as required to prevent grout blowout or rupture of CMU face shells, but provide not less than No. 2 bars or 8 gage wire ties spaced 16" o.c. for members with 20" or less side dimensions, and 8" o.c. for members with side dimensions exceeding 20".

7. Preparation of Grout Spaces: Prior to placement, inspect and clean grout spaces. Remove dust, dirt, mortar droppings, loose pieces of masonry and other foreign materials from grout spaces. Clean reinforcing and adjust to proper position. Clean top surface of structural members supporting masonry to ensure bond. After final cleaning and inspection, close cleanout holes and brace closures to resist grout pressures.

   a. Do not place grout until entire height of masonry to be poured has attained sufficient strength to resist displacement of masonry units and breaking of mortar bond. Install shores and bracing, if required, before starting grouting operations.

   b. Place grout by pumping into grout spaces unless alternate methods are acceptable to the Architect.

   c. Limit grout pours to sections which can be completed in one working day with not more than one hour interruption of pouring operation. Place grout in lifts which do not exceed 5'. Allow not less than 30 minutes, nor more than one hour between lifts of a given pour. Rod or vibrate each grout lift during pouring operation.

   d. When more than one pour is required to complete a given section of masonry, extend reinforcement beyond masonry as required for splicing. Pour grout to within 1-1/2" of top course of first pour. After grouted masonry is cured, lay masonry units and place reinforcement for second pour section. Repeat sequence if more pours are required.

3.5 FIELD QUALITY CONTROL

A. General: An independent testing agency shall perform tests and to submit test reports.

B. Minimum Tests and Submittals:
   1. Certificate for materials used in masonry construction indicating compliance with contract documents.

2. Verification of Minimum masonry compressive strength (f'm) prior to construction and every 5000 sq. ft during construction. Perform compressive strength "Prism Test" per ASTM C1314.

3. Verification of proportions of materials and grout as delivered to the site.

4. Test mortar in accordance with the property specification of ASTM C 270 or evaluate with ASTM C 780.

5. Sample and test grout in accordance with ASTM C 1019 for each 5000 sq. ft.

C. Minimum Inspection:

1. From the masonry construction and continuously during construction of masonry, verify the following are in compliance:
   a. Proportion of site-mixed mortar and grout.
   b. Placing of masonry units and construction of mortar joints.
   c. Placement of reinforcement and connectors.
   d. Grout space prior to grouting.
   e. Placement of grout.

2. Observe preparation of grout specimens, mortar specimens, and/or prisms.

3. Verify compliance with the required inspection provisions of the contract documents and the approved submittals.

D. Test results will be reported in writing to Architect, Structural Engineer, and Contractor within 24 hours after tests. Reports of tests shall contain the Project identification name and number, date of test, name of testing service, mortar or grout type and class, location of mortar or grout batch in structure, design compressive strength at 28 days, mortar or grout mix proportions and materials, compressive breaking strength, and type of break for both 7-day tests and 28-day tests. If any breaks are below specified or expected strengths, the Testing Laboratory shall report any visible anomalies.

E. Additional Tests: The testing agency will make additional tests of in-place masonry when test results indicate specified strengths and other characteristics have not been attained in the structure, as directed by Architect/Engineer. Testing agency may conduct tests to determine adequacy of materials by cored cylinders complying with ASTM C 42, or by other methods as directed.

END OF SECTION 04 29 00

SECTION 04 73 00

MANUFACTURED STONE MASONRY

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:
   1. Manufactured Stone Masonry: Calcium silicate product; may be identified as “Cast Stone” on the drawings.
   2. Miscellaneous masonry ties, anchors, and accessories related to manufactured stone masonry.

B. Related Sections:
   1. Section 04 05 03 - Masonry Mortaring and Grouting: Mortar and grout for Cast Stone.
   2. Section 04 20 00 – Unit Masonry Assemblies.
   3. Section 07 90 00 - Joint Protection: Rod and sealant at control and expansion joints.

1.02 REFERENCES

A. American Society for Testing and Materials
   1. ASTM C73-14 – Standard Specification for Calcium Silicate Brick (Sand-Lime Brick).

B. American Concrete Institute:
   1. ACI 530 - Building Code Requirements for Masonry Structures.
   2. ACI 530.1 - Specifications for Masonry Structures.

C. Masonry Institute:
   1. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures.

1.03 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal requirements.

B. Product Data:
   1. Submit data for manufactured stone masonry units, fabricated wire reinforcement, wall ties, anchors, and other accessories.
   2. Submit data for cleaning solutions, including detailed description of methods, materials, equipment and site cleanup procedures to be used. Provide with letters of approval from manufacturer regarding the compatibility of proposed use of products together for cleaning purposes.

C. Samples:
   1. Submit four samples of each type of manufactured stone masonry to illustrate color, texture and extremes of color range. Furnish additional samples when necessary to fully illustrate the complete range of highly variable materials.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.04 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 530 Building Code Requirements for Masonry Structures and ACI 530.1 Specification for Masonry Structures.

1.05 QUALIFICATIONS

A. Installer: Company specializing in performing Work of this section with minimum three years' documented experience.

1.06 MOCKUP

A. Section 01 40 00 - Quality Requirements: Mockup requirements.

B. Construct mockup minimum 4 ft. x 4 ft. unless detailed otherwise in the drawings, including masonry, mortar and accessories, structural backup, flashings, wall insulation, and weeps.
   1. Structural backup wall to consist of CMU and cold formed metal framing.
   2. Include a sealant-filled control joint.
   3. Omit masonry above flashing to leave a 12 inch length of the flashing exposed to view.
   4. Clean face of mockup with masonry cleaner using methods anticipated for the work.

C. Furnish removable cover to protect completed mock-up from rain or other environmental or site conditions that may alter its appearance.

D. Locate in well-lit area where approved Architect/Engineer.

E. Remove mockup when directed by Architect/Engineer, unless part of permanent construction.

1.07 PRE-INSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Accept masonry units and accessories on site. Inspect for damage.

1.09 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

B. Cold Weather Requirements: In accordance with ACI 530.1 when ambient temperature or temperature of masonry units is less than 40 degrees F.

C. Hot Weather Requirements: In accordance with ACI 530.1 when ambient temperature is greater than 100 degrees F or ambient temperature is greater than 90 degrees F with wind velocity greater than 8 mph.

D. Bracing of Work in Progress:

1. Where masonry erection may be exposed to high winds, installation shall be adequately braced until masonry construction has attained sufficient strength to resist wind forces.
2. Shores and forms shall not be removed until masonry construction has attained sufficient strength to support its own weight and all other construction or environmental loads

1.10 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Coordinate work with work of other trades built into or adjoining masonry work.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Manufacturers:
1. Arriscraft International, distributed by Upchurch Kimbrough Company, www.arriscraft.com.
2. Substitutions: Section 01 60 00 – Product Requirements.

B. Manufactured Stone Masonry Units: ASTM C1364, architectural manufactured stone masonry units fabricated by dry casting methods, with fine grained texture, simulating natural cut stone.
1. Type: Calcium silicate masonry units meeting requirements of ASTM C73, Grade SW; solid units that have been pressure-formed and autoclaved to standard and special shapes.
2. Size(s): As indicated in the drawings.
3. Reinforce units as indicated and as required by ASTM C1364. Use galvanized or epoxy-coated reinforcement when covered with less than 1-1/2 inches of material.
4. Curing: Cure units to develop concrete quality, and to minimize appearance blemishes including non-uniformity, staining, or surface cracking.
5. Colors and Textures: As scheduled.
6. Mortar Color: As selected by the Architect.

2.02 ANCHORS, TIES AND REINFORCEMENT

A. Manufacturers:
1. AA Wire Products
2. Heckman Building Products (Dur-O-Wall), www.heckmannbuildingprods.com
3. Hohmann & Barnard, www.h-b.com
4. Masonry Reinforcing Corp. of America (Wire-Bond)
5. Substitutions: Section 01 60 00 - Product Requirements.

B. Strap Anchors: Bent steel, 1-1/2 inches wide x 24 inches long x 1/4 inch thick, with ends turned up not less than 2 inches; ASTM A153/A153M hot dip galvanized.

C. Veneer Ties for CFMF Stud Backup Walls: Rib-stiffened sheet metal plate anchors with screw holes top and bottom and projecting tabs with slotted holes for receiving vertical legs of adjustable wire ties; ASTM A153/A153M hot dip galvanized.
1. Anchor Size: 2-3/4 inches wide by 3 inches high.

2. Tie Size: 0.1875 inch diameter wire, length as required to extend to within 1 inch of veneer face.
3. Tie Shape: Rectangular
4. Fasteners: Steel drill screws, #10 diameter x length required to penetrate steel stud flange by not less than 3 exposed threads, complying with ASTM C954 except with hex washer head and neoprene washer, cadmium-plated.
5. Basis of Design: Hohmann & Barnard HB-200/DA-213.

D. Veneer Ties for CMU Backup Walls: ASTM A82; ladder type joint reinforcement with adjustable eye and pintle type wire ties; ASTM A153/A153M hot dip galvanized.
1. Tie Size: 0.1875 inch diameter wire, length as required to extend to within 1 inch of veneer face.
2. Tie Shape: Rectangular
3. Basis of Design: Hohmann & Barnard, #270 Ladder Eye-Wire.

E. Veneer Ties for Grade Beams and Concrete Backup Walls: Zinc-alloy barrel section with flanged head and eye, fastened with corrosion-resistant, self-drilling screw. Eye designed to receive tie and to serve as head for drilling fastener into concrete. Provide barrel length to suit cavity wall insulation thickness, allowing screw to seat directly against the concrete wall with flanged head covering hole in insulation.
1. Tie Size: 0.1875 inch diameter wire, length as required to extend to within 1 inch of veneer face.
2. Tie Shape: Triangular
3. Basis of Design: Heckman Building Products, Pos-i-Tie.

F. Dovetail Anchors: Bent steel strap formed from 0.1046 inch thick steel, with 0.1875 inch diameter triangular-shaped wire tie sized to extend within 1 inch of masonry face; ASTM A153/A153M hot dip galvanized.

G. Steel Beam and Column Anchors: Crimped 1/4 inch diameter wire anchor welded to steel member, with 0.1875 inch diameter triangular-shaped wire tie for solid masonry and rectangular-shaped wire tie for hollow masonry, sized to extend within 1 inch of masonry face; ASTM A153/A153M hot dip galvanized.

2.03 EMBEDDED FLASHING MATERIALS

A. Stainless Steel: Reference Section 07 62 00 Sheet Metal Flashing and Trim for material requirements.
1. Flexible Flashing: Reference Section 07 11 00 Dampproofing and Flexible Flashing.

B. Pre-Coated Galvanized Steel or Aluminum Sheet: Not allowed for embedment in masonry walls.

C. Galvanized or Precoated Steel Sheet: Not allowed for embedment in masonry walls.

2.04 ACCESSORIES

A. Expansion Joint Filler: ASTM D1056, Grade 2A1, closed cell neoprene; oversized 50 percent to joint width; self-expanding.
1. Weeps: Open head joints, maximum 3 inches high.
2. Cleaning Solutions:

3. Job-Mixed Detergent Solution: Solution of 1/2-cup (0.14-L) dry measure tetrasodium polyphosphate and 1/2-cup (0.14-L) dry measure laundry detergent dissolved in 1 gal. (4 L) of water.
4. Proprietary Acidic Cleaner: Standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry and pigmented mortar surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
5. Manufacturers:
    a. AHI Supply, www.ahi-supply.com.
    b. Diedrich Technologies, Inc., www.diedrichtechnologies.com.
    c. EaCo Chem, Inc., www.eacochem.com.
    d. ProSoCo, Inc., www.prosoco.com.
    e. Substitutions: Section 01 60 00 - Product Requirements.

B. Steel Lintels: Size as indicated on Drawings, hot-dip galvanized.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: coordination and project conditions.

B. Verify field conditions are acceptable and are ready to receive manufactured stone masonry work.

C. Verify items provided by other sections of work are properly sized and located.

D. Verify built-in items are in proper location, and ready for roughing into masonry work.

3.02 PREPARATION

A. Direct and coordinate placement of metal anchors supplied to other sections.

B. Furnish temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent support.

3.03 INSTALLATION

A. Establish lines, levels, and coursing indicated. Protect from displacement.

B. Maintain masonry courses to uniform dimension. Form bed and head joints of uniform thickness.

C. Placing And Bonding:
1. Lay solid manufactured stone masonry units in full bed of mortar, with full head joints.
2. Buttering corners of joints or excessive furrowing of mortar joints are not permitted.
3. Remove excess mortar as work progresses.
4. Do not shift or tap units after mortar has achieved initial set. Where adjustment is required, remove mortar and replace.

5. Perform job site cutting of units with motor-driven saws to assure straight, clean, unchipped edges. Prevent broken masonry unit corners or edges. Where possible, use full-size units without cutting.
6. Install cut units with cut surfaces and edges concealed.
7. Select and arrange exposed units to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.

D. Weeps and Vents: Furnish weeps and vents in outer wythe at maximum 24 inches oc horizontally above through-wall flashing, above shelf angles and lintels, at bottom of walls, and above other obstructions of wall cavity continuity.

E. Stain Prevention: As work progresses, prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
1. Protect base of walls from rain-splashed mud and from mortar splatter by coverings spread on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

F. Protection of manufactured stone masonry units: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

3.04 TIES AND ANCHORS

A. Install anchors attached to concrete and steel structural members:
1. Leave an open space not less than 1 inch in width between back of masonry and face of structural member. Keep open space free of mortar or other rigid materials.
2. Install anchors at maximum 16 inches o.c. vertically and horizontally.

B. Install Wall Ties at CMU Backup Walls:
1. Install wall ties at 16 inches oc vertically and maximum 16 inches oc horizontally.
2. Coordinate ties to accommodate installation of 16 inch widths of cavity wall insulation specified in Section 07 21 13.
3. Place additional wall ties within 12 inches of openings at intervals not exceeding 36 inches.

C. Install Wall Ties at CFMF Backup Walls:
1. Install wall tie anchor plates at 16 inches oc vertically and maximum 16 inches oc horizontally.
2. Coordinate anchor plates to accommodate installation of 16 inch widths of cavity wall insulation specified in Section 07 21 13.
3. Place additional wall ties within 12 inches of openings at intervals not exceeding 36 inches.
4. Secure wall tie anchor plates through sheathing to CFMF studs.

3.05 EMBEDDED FLASHINGS

A. Flexible Flashings: Ensure flexible flashing is properly installed at or above shelf angles, lintels, ledges and other obstructions to the downward flow of water in the wall so as to divert such water to the exterior through masonry weep openings.

B. Sheet Metal Flashings: Coordinate with Division 7 section Sheet Metal Flashing and Trim for sheet metal flashings to be built-in to masonry work. Only specified stainless steel is approved to be built-in to masonry work unless otherwise specifically approved in writing by the Architect.

C. Prepare masonry surfaces smooth and free from projections which could puncture flashing. Place through-wall flashing on sloping bed of mortar and cover with mortar. Seal penetrations in flashing with mastic before covering with mortar.

D. Extend flexible flashings horizontally to exterior face of masonry and neatly trim flush below weep holes.

E. Extend stainless steel flashings horizontally through exterior face of masonry and turn down to form counterflashing to roofing flashing or other flashing materials as indicated in the drawings. .

F. Turn flashings up minimum 8 inches and bed into mortar joint of CMU backup wall. Ensure that vertical leg of flexible flashings are properly sealed to sheathing over CFMF stud backup wall.

G. Lap end joints of flashings minimum 6 inches and seal watertight.

H. Ensure flashings are extended the full length of lintels and shelf angles and minimum of 4" into masonry each end; turn up ends not less than 2" to form end dams as recommended by BIA and illustrated in BIA Technical Note 7, Figure 21, current edition.

I. Turn flashings, fold, and seal at corners, bends, and interruptions.

3.06 LOOSE LINTELS

A. Install loose steel lintels for manufactured stone masonry unis for openings more than 12 inches wide.

B. Maintain minimum 8 inch bearing on each side of opening.

3.07 MISCELLANEOUS

A. Control and Expansion Joints: Continue masonry control and expansion joints through manufactured stone masonry units.

B. Built-In Work:
   1. As work progresses, install built-in door and window frames, wood nailing strips, anchor bolts, plates, and other items to be built-in the work and furnished by other sections.
   2. Install built-in items plumb and level.
   3. Bed anchors of metal door and window frames in adjacent mortar joints. Fill frame voids solid with grout or mortar. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.
   4. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath in the joint below and rod mortar or grout into core.

5. Do not build in materials subject to deterioration.

C. Cutting And Fitting:
1. Cut and fit for chases, pipes, conduit, sleeves, grounds, and other items penetrating masonry. Coordinate with other sections of work to provide correct size, shape, and location.
2. Obtain Architect/Engineer's approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.08 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Remove excess mortar and mortar smears as work progresses.

C. Replace defective mortar. Match adjacent work.

D. Clean soiled surfaces with cleaning solution.
1. Use non-metallic tools in cleaning operations.

3.09 DEFECTIVE CONSTRUCTION

A. Correct defects appearing in the finished work for a period of one year after the date of Substantial Completion.

B. Defects shall include, but not be limited to, cracking, separating of mortar, cracking, discoloration, or deterioration of masonry units, efflorescence in masonry units or joints, and water penetration through manufactured stone masonry or joints under normal exposure.

3.10 PROTECTION OF FINISHED WORK

1. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protecting finished Work.
2. Protect exposed external corners subject to damage.
3. Protect base of walls from mud and mortar splatter.
4. Protect masonry and other items built into masonry walls from mortar droppings and staining caused by mortar.
5. Protect tops of masonry work with waterproof coverings secured in place without damaging masonry. Provide coverings where masonry is exposed to weather when work is not in progress.

END OF SECTION

SECTION 05 12 00 - STRUCTURAL STEEL FRAMING

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. Structural steel.
2. Field-installed shear connectors.
3. Shop and Field Welding.
4. Galvanizing.
5. Prime Painting.

B. Related Requirements:
1. Section 03 62 00 “Non-Shrink Grout” for structural steel bearing and base plate connections.
2. Section 05 21 00 “Steel Joist Framing” for field installation of joists on supporting steel.
3. Section 05 31 00 "Steel Decking" for field installation of shear connectors through deck.
4. Section 05 50 00 "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame, miscellaneous steel fabrications, and other steel items not defined as structural steel.
5. Section 05 12 13 “Architecturally Exposed Structural Steel” for critical exposed steel member requirements (refer to S002 for additional information).

1.3 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

B. Heavy Sections: Rolled and built-up sections as follows:

1. Shapes included in ASTM A 6/A 6M with flanges thicker than 1-1/2 inches.
2. Welded built-up members with plates thicker than 2 inches.
3. Column base plates thicker than 2 inches.

C. Protected Zone: Structural members or portions of structural members indicated as "Protected Zone" on Drawings. Connections of structural and nonstructural elements to protected zones are limited.

D. Demand Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the Seismic-Load-Resisting System and which are indicated as "Demand Critical" or "Seismic Critical" on Drawings.

1.4 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written 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.

1.5 PREINSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference prior to any work beginning by trade. Time, date and location as determined by a construction manager.

1.6 ACTION SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections. In addition to Division 1 requirements, provide one half-size hard copy (paper) of any drawings submitted in the electronic files.

B. Product Data: For each type of product.

C. Shop drawings prepared under supervision of a Registered Professional Structural Engineer licensed in the state in which the project is constructed, including complete details and schedules for fabrication and assembly of structural steel members, procedures, and diagrams.
1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment Drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pre-tensioned and slip-critical, high-strength bolted connections.
5. Provide setting drawings, templates, and directions for installation of anchor bolts and other anchorages to be installed as work of other Sections.
6. Original contract documents shall not be reproduced for use as a portion of the Shop Drawings.
7. Indicate locations and dimensions of protected zones.
8. Identify demand critical welds.

D. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for each welded joint whether prequalified or qualified by testing, including the following:

1. Power source (constant current or constant voltage).
2. Electrode manufacturer and trade name, for demand critical welds.

E. Delegated-Design Submittal: For structural-steel connections indicated to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, fabricator, testing agency.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Mill test reports for structural steel, including chemical and physical properties, and country of origin (must be domestic, including Canada).

E. Product Test Reports: For the following:

1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
2. Direct-tension indicators.
3. Tension-control, high-strength, bolt-nut-washer assemblies.
4. Shear stud connectors.
5. Shop primers.
6. Non-shrink grout.

F. Survey of existing conditions.

G. Source quality-control reports.

H. Field quality-control and special inspection reports.

1.8 QUALITY ASSURANCE

A. Source Limitations:
1. Steel shapes shall be domestically milled and manufactured. Foreign milled steel shall not be used.
2. To the greatest extent possible steel shapes shall be manufactured with recycled material and shall be manufactured locally or within the State of Texas.

B. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD, or is accredited by the IAS Fabricator Inspection Program for Structural Steel (AC 172).
1. Fabricators not meeting the requirements noted above may be submitted for consideration in writing as a substitution request DURING BIDDING PHASE ONLY. Refer to Section 4.1 for substitution request requirements. This request will be evaluated on a case-by-case basis and is subject to Owner approval.

C. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Steel Erector, CSE.

D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
1. Provide certification that welders to be employed in work have satisfactorily passed AWS qualification tests.
2. If recertification of welders is required, retesting will be Contractor's responsibility.

3. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by

AWS D1.8/D1.8M. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

E. Comply with applicable provisions of the following specifications and documents:

1. AISC 303.
2. AISC 341 and AISC 341s1.
3. AISC 360.
4. RCSC's "Specification for Structural Joints Using High-Strength Bolts."

F. Correct deficiencies in structural steel work that inspections and laboratory test reports have indicated to be not in compliance with requirements. Perform additional tests, at Contractor's expense, as necessary to reconfirm any non-compliance of original work and to show compliance of corrected work.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to site at such intervals to ensure uninterrupted progress of work.

B. Deliver anchor bolts and anchorage devices, which are to be embedded in cast in place concrete or masonry, in ample time to not to delay work.

C. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

D. 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. Clean and re-lubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Connections: Provide details of connections required by the Contract Documents to be selected or completed by structural-steel fabricator, including comprehensive engineering analysis by a qualified professional engineer, to withstand loads indicated and comply with other information and restrictions indicated.
1. Select and complete connections using schematic details indicated and AISC 360. Details shown are typical; similar details apply to similar conditions, unless otherwise indicated. Verify dimensions at site whenever possible without causing delay in the work.

a. Promptly notify Architect/Engineer whenever design of members and connections for any portion of structure are not clearly indicated.

2. Use Allowable Stress Design; data are given at service-load level.

B. Moment Connections: Type FR, fully restrained.

2.2 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A 992/A 992M, Grade 50 or ASTM A572 Grade 50.

B. Channels, Angles, M, S-Shapes: ASTM A 36/A 36M.

C. Plate and Bar: ASTM A 36/A 36M

D. Baseplates: ASTM A572 Grade 50

E. Cold-Formed Hollow Structural Sections: ASTM A 500/A 500M, Grade B, structural tubing.

F. Steel Pipe: ASTM A 53/A 53M, Type E or Type S, Grade B.
1. Finish: Black except where indicated to be galvanized.

G. Welding Electrodes: Comply with AWS requirements.

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, Grade C, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers; all with plain finish.
1. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with plain finish.

B. High-Strength Bolts, Nuts, and Washers: ASTM A 490, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers with plain finish.
1. Direct-Tension Indicators: ASTM F 959, Type 490, compressible-washer type with plain finish.

C. Zinc-Coated High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade DH heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers.

1. Finish: Hot-dip or mechanically deposited zinc coating.
2. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with mechanically deposited zinc coating finish.

D. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.

1. Finish: Mechanically deposited zinc coating.

E. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

F. Unheaded Anchor Rods: ASTM F 1554, Grade 36, 55 (S1) & 105

1. Configuration: Straight, unless otherwise indicated.
2. Nuts: ASTM A 563 heavy-hex carbon steel.
3. Plate Washers: ASTM A 36/A 36M carbon steel.
4. Washers: ASTM F 436, Type 1, hardened carbon steel.
5. Finish: Plain, unless otherwise indicated on the Contract Documents.

G. Headed Anchor Rods: ASTM F 1554, Grade 36, straight.

1. Nuts: ASTM A 563 heavy-hex carbon steel.
2. Plate Washers: ASTM A 36/A 36M carbon steel.
3. Washers: ASTM F 436, Type 1, hardened carbon steel.
4. Finish: Plain, unless otherwise indicated on the Contract Documents.

H. Threaded Rods: ASTM A 36/A 36M.

1. Nuts: ASTM A 563 hex carbon steel.
2. Washers: ASTM A 36/A 36M carbon steel.
3. Finish: Plain, unless otherwise indicated on the Contract Documents.

I. Clevises and Turnbuckles: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1035.

J. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1030.

K. Sleeve Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1018.

L. Structural Slide Bearings: Low-friction assemblies, of configuration indicated, that provide vertical transfer of loads and allow horizontal movement perpendicular to plane of expansion joint while resisting movement within plane of expansion joint, as specified in Division 5 section "Teflon Bearing Pads".

2.4 PRIMER

A. Primer: Exposed structural steel shall comply with Section 099000 "Painting and Coating."

B. Primer: Fabricator's standard lead- and chromate-free, non-asphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

C. Galvanizing Repair Paint: ASTM A 780/A 780M.

2.5 GROUT

A. Grout for use under steel bearing or base plates shall be a high strength, non-bleeding, non-shrink grout of high durability, as specified in Division 3 section "Non-shrink Grout".

2.6 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," and to AISC 360.

1. Camber structural-steel members where indicated.

2. Fabricate beams with rolling camber up.
3. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
4. Mark and match-mark materials for field assembly.
5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 1, "Solvent Cleaning" and SSPC-SP 2, "Hand Tool Cleaning."

F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.

1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.7 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened, unless otherwise indicated on the Contract Documents.
2. All bolts shall have threads excluded from the shear plane.
3. Torque wrenches shall be used to tighten high strength fasteners unless prior written approval has been obtained from the Architect/Engineer.
4. If for any reason a high strength bolt has to be removed after being stressed to "Proof Load", it shall not be reused.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.8 SHOP PRIMING

A. Shop prime steel surfaces except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
2. Surfaces to be field welded.
3. Surfaces of high-strength bolted, slip-critical connections.
4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
5. Galvanized surfaces.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:

1. SSPC-SP 2, "Hand Tool Cleaning."
2. SSPC-SP 3, "Power Tool Cleaning."
3. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 2 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

D. Structural steel delivered to the job site showing evidence of rust, mill scale, spatter, slag or flux deposits shall be either returned to the shop for proper cleaning and repriming, or sand blasted clean and reprimed at the job site.

2.9 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.

1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.

B. Minimize distortion and warpage of steel members being galvanized by following recommendations according to ASTM A 384/A 384 M.

1. Do not apply galvanizing using double- dip or progressive processes without Architect’s or Engineer’s written approval.
2. Galvanize lintels and exposed plates, angles, tubes, shelf angles and rolled shapes attached to structural-steel frame and located in exterior walls.

2.10 SOURCE QUALITY CONTROL

A. General: Materials and fabrication procedures are subject to inspection and tests in mill, shop, and field, conducted by a qualified inspection agency. Such inspections and tests will not relieve Contractor of responsibility for providing materials and fabrication procedures in compliance with specified requirements.

1. Promptly remove and replace materials or fabricated components that do not comply.

B. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.
   1. Testing agency shall conduct and interpret tests, state in each report whether test specimens comply with requirements, and specifically state any deviations therefrom.

   2. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

A. Bolted Connections: Inspect and test shop-bolted connections according to RCSC's "Specification for Structural Joints Using High-Strength Bolts."

   1. Verify that gaps of installed Direct Tension Indicators are less than gaps specified in ASTM F 959, Table 2.

B. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1/D1.1M. In addition to visual inspection, provide non-destructive testing as indicated by AISC 360 and the contract documents, whichever is more stringent. Test and inspect field welds according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

   1. Liquid Penetrant Inspection: ASTM E 165.
   2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
   3. Ultrasonic Inspection: ASTM E 164.
   4. Radiographic Inspection: ASTM E 94.

C. In addition to visual inspection, test and inspect shop-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:

   1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
   2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete and masonry bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Shoring shall have the effect of being continuous down to foundation level unless written approval is obtained from Architect/Engineer to do otherwise. Point loads from shoring shall be distributed to main structural members as necessary to prevent localized

overstressing of supporting members. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

B. Temporary Planking: Provide temporary planking and working platforms as necessary to effectively complete work.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

B. Baseplates, Bearing Plates, and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of baseplate.
3. 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 packing with grout.
4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Maintain erection tolerances of structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

D. Cranes or other erection machinery shall not be permitted on the foundation slab. The construction shall be scheduled so the structural steel is not erected from the foundation slab.

E. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

F. Splice members only where indicated. Splices will be permitted only with prior written approval of the Architect/Engineer.

G. Do not use thermal cutting during erection for correcting fabrication errors in primary structural framing. Cutting will be permitted only on secondary members that are not under stress, as acceptable to Architect/Engineer. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.

H. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

I. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

J. Erection Bolts: On exposed welded construction, remove erection bolts, fill holes with plug welds, and grind smooth at exposed surfaces.

1. Comply with AISC Specifications for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened, unless otherwise indicated on the Contact Documents.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.
3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," for mill material.
4. Where fillet welding of members thicker than one half inch is indicated on the drawings, preheating of members shall be accomplished as directed by the Testing Laboratory prior to welding.
5. Where one of the members is embedded in concrete, extreme care shall be taken not to overheat the concrete so as to cause cracking or spalling. Adequate time shall be allowed between multiple passes to allow cooling of the concrete adjacent to the welded members.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Verify structural-steel materials and inspect steel frame joint details.
2. Verify weld materials and inspect welds.
3. Verify connection materials and inspect high-strength bolted connections.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

C. Testing agency shall conduct and interpret tests, state in each report whether test specimens comply with requirements, and specifically state any deviations therefrom.

D. Bolted Connections: Inspect and test bolted connections according to RCSC's "Specification for Structural Joints Using High-Strength Bolts."

1. Verify that gaps of installed Direct Tension Indicators are less than gaps specified in ASTM F 959, Table 2.

E. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M.

1. In addition to visual inspection, provide non-destructive testing as indicated by AISC 360 and the contract documents, whichever is more stringent. Test and inspect field welds according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

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 are not accepted.
c. Ultrasonic Inspection: ASTM E 164.
d. Radiographic Inspection: ASTM E 94.

F. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:

1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

3.6 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780/A 780M.

B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

C. Field Rusting: Special steps shall be taken after erection of steel members to prevent rusting. Any rust appearing on any structural member shall be removed by wire brushing, sand blasting, or other approved techniques. The area shall then be repainted per above. This process shall be continued until the steel member is enclosed in its final waterproof or architectural covering. The Contractor shall notify the Architect/Engineer so that all structural steel may be inspected not more than 36 hours prior to attachment of blocking, sheathing, and/or other covering materials.

PART 4 - SUBSTITUTION REQUESTS

4.1 STRUCTURAL STEEL FABRICATORS

A. The following items are required to be inspected by the Owner's special inspection laboratory (or their subcontractor) at the expense of the Contractor if specification section 051200 – Structural Steel Framing (1.8.B Quality Assurance – Fabricator Qualifications) cannot be met:

1. Direction and Leadership

Management review requirements will be defined by the Fabricator and include a specific method to obtain, appropriately assess and analyze, and then report the following:

- Results of internal and external audits
- Customer feedback (surveys, letters of recognition, personal interviews, etc.)
- The level of qualification training of personnel
- Channels for communication to address and resolve all quality issues
- Product nonconformance of manufactured product (in process or final)

2. Personnel

Name and title of qualified management team assigned to the project including (but not limited to):

- Management representative
- Detailing manager (minimum three years experience)
- Purchasing manager (minimum three years experience)
- Fabrication process manager (minimum three years experience)
- Quality assurance (minimum five years experience)
- Quality control manager (minimum five years experience)
- ASNT-TC-1A certified staff (minimum one of each on staff or available under contract)
    - Certified Level II technician for each NDT method performed in shop

3. Facility

A fabrication facility shall consist of areas and buildings that provide space for the routine functions considered to be part of steel fabrication. The areas and buildings shall be conducive to achieving a consistent high quality of work meeting the requirements of the contract documents.

4. Fabrication Process Equipment

The fabricator shall have under their control the equipment and software necessary to perform the functions common to fabrication consistent with the specifications and standards common to the work being performed and consistent with meeting the requirements of the contract documents.

5. Documentation Requirements

The Quality Management System documentation shall include (but not be limited to) and be signed/dated by the highest ranking organizational individual responsible for the facility:

- A Quality Manual
  - Applicable reference documents
  - Industry and government regulations, codes and contract requirements
  - Organizational chart describing responsibility, authority and interrelationship of functional positions that manage, perform and verify work regarding quality
  - Job descriptions and required qualifications for key personnel and functions
  - Facility plan
  - Equipment list (including maintenance records)
  - Established documented procedures
  - Description of the interaction and communication between the processes of the Quality Management System used by the Fabricator to produce products of the required quality
- A statement of a quality policy and quality objectives
- Procedures and their associated Quality Records

6. Contract and Project Specification Review and Communication

The fabricator shall develop a documented procedure for contract and project specification review. The procedure shall require that a contract and project specification review be completed for each structural steel project performed. The review shall begin no later than the fabricator's acceptance of responsibility for performing the work.

The review shall identify, determine, plan, and record the specific project requirements as well as define distribution of the recorded specific project requirements to the responsible individuals in the fabricator's organization. This review will consider any issue that affects the fabricator's capability to perform the work.

The procedure shall provide for review of the original contract documents, revised contract documents and changes received through clarification (e.g. requests for information or other sources) to assure that the fabricator fully understands the contract requirements. Evidence of contract review can take the form of technical summaries, signoffs, change orders, schedules and allocation of adequate resources.

7. Design and Detailing

The shop and erection drawings produced shall incorporate all customer requirements, specifications, codes, and relevant standards to adequately procure materials, fabricate, and erect the structural steel frame and provide in instructions to the erector for location of shipping pieces in the completed structure.

To ensure and verify this, a documented procedure for preparation of shop and erection drawings shall be developed, which describes:

- How project requirements are reviewed and incorporated.
- How the fabricator coordinates, clarifies, resolves, and tracks information with the Customer (e.g., construction change documents, Requests for Information [RFI]) and how the associated resolutions are tracked and controlled).

For products that are standard components, the manufacturer shall have on file and available to the customer a set of design calculations reviewed and stamped by a professional engineer to signify that the designed product meets the current applicable code requirements for its intended use. Any design tables or design processes published with the product literature shall also be reviewed and stamped by a professional engineer. Shop drawings for these components shall include a statement that the component details are based on designs that have been reviewed and stamped by a professional engineer and are on file with the manufacturer.

For products that are job-specific, the manufacturer shall retain the services of a professional engineer to review and stamp the site-specific design of the component. The engineer shall also review the shop drawings produced for the component and verify their consistency with the design. The results of this review shall be indicated on the component shop drawings.

8. Detailing Standards

The fabricator will prepare and utilize detailing standards describing technical preferences and requirements customarily used in the shop. These standards will show special information required on advance bills such as allowances for cuts, camber, or supplementary requirements. The detailing standards will include how mill order lists are prepared which, at a minimum, include:

- Sizes and quantities
- Appropriate ASTM specification references
- Special ordering information
- Any allowances or tolerances

The detailing standards shall describe the fabricator’s preferred methods of drawing layout, including but not limited to:

- Sections and views
- Title block information
- Piece marking system
- Dimensional preferences
- Commonly used shop abbreviations
- Showing bolt placement lists (including bolt type and installation requirements)
- Information required on weld symbols including any special NDT requirements

The detailing standards shall describe the fabricator’s preferred method for:

- Selection of connection geometry and material (including sizes and specifications)
- Detailing holes, fasteners, washers, cuts, and copes
- Assignment of appropriate welding symbols (shop and field welds)
- Selecting bolt type and installation method
- Showing surface preparation (including specification of surface finish)
- Designating coating requirements (including coating materials and dry film thickness)
- Showing any necessary special instructions to fabricate and erect the structural steel frame

9. Shop and Erection Drawings

The fabricator shall develop a documented procedure to provide for checking of all shop and erection drawings and to describe the approval method used to release shop drawings for fabrication.

10. Checking of Shop and Erection Drawings

The documented procedure for checking of shop and erection drawings shall describe the method by which the fabricator or its subcontractor performs and records final check of shop and erection drawings to ensure compliance with contract documents before release for fabrication and erection. Such methods may include signatures, stamps, logs, files, or lists. Records shall provide means for identification of the individual checker who performed the final check of each shop or erection drawing. When detailing is performed by a subcontractor, the procedure will define the extent of review by detailing management and checking of received detailing products before release for fabrication.

11. Approval of Shop Drawings

The procedure for checking of shop and erection drawings shall describe the method used to document approval of shop drawings released for fabrication. Such methods may include signatures, stamps, logs, files, or lists. The method shall have provisions for recording Owner's designated representatives for design and construction approval of shop drawings—whether produced in house or by a subcontractor. The procedure shall require that waiver of approval from the Owner's designated representative for design or from the Owner's designated representative for construction be in writing.

12. Detailing Resource Material

The fabricator shall maintain as a minimum, a library of the required references as follows:

- AISC Steel Construction Manual, which includes the following specifications, codes, and standards:
- AISC Specification for Structural Steel Buildings
- RCSC Specification for Structural Joints Using ASTM A325 or A490 Bolts
- AISC Code of Standard Practice for Steel Buildings and Bridges
- ANSI/AWS D1.1 Structural Welding Code–Steel
- AISC Selected ASTM Standards for Structural Steel Fabrication

13. Detailing Management

Responsibilities for personnel performing detailing management shall include:

- Overseeing the production of shop and erection drawings
- Liaising with designers
- Scheduling
- Developing and maintaining company detailing standards and detailing procedures
- Transmittals related to Owner's designated representative for design and construction approvals and connection consultation subcontracting
- Coordinating and incorporating construction requirements
- Training detailers and checkers

Qualification requirements for detailing management personnel shall include one or more of the following:

- Experience in detailing and checking shop and erection drawings that have met the approval of the Owner's representative for design for a variety of structures representative of projects the company provides. The fabricator shall determine and describe a way to demonstrate competence.
- Graduate engineer with experience related to structural steel fabrication.
- Licensed P.E. or S.E., with experience related to structural steel fabrication.

14. Connection Consultation

Qualification requirements for personnel providing connection development guidance to detailers performing connection detailing shall include one or more of the following:

- Experience in connection development and in detailing and checking of shop and erection drawings for steel that have met the approval of the Owner's representative for design for a variety of structures representative of projects the company provides. The fabricator shall determine and describe a way to demonstrate competence.
- Graduate engineer with experience related to structural steel fabrication.
- Licensed P.E. or S.E., with experience related to structural steel fabrication.

In lieu of employed staff personnel, subcontractors may be used for the following functions: detailing, connection consultation, checking of shop and erection drawings, training of detailers and checkers. However, the fabricator retains the responsibility for compliance.

15. Control of Quality Records

The fabricator shall develop a documented procedure for quality records that provides for:

- Identification, collection, storage, maintenance, retention, and disposition

All quality records shall be legible and shall be stored and retained in such a way that they are retrievable from facilities that provide a suitable environment to prevent damage, deterioration or loss. Quality records typically include, but are not limited to:

- Inspection records, NDT reports, drawing logs, MTRs, C of Cs, design changes, RFIs
- Contract review, contract clarifications, design change records, including contract construction changes and addendums
- Mill and consumable purchase orders, records or summaries of nonconformance reports
- Corrective action requests, training records, subcontractor and supplier evaluations
- Internal and external quality management system audits

Retention times shall be established and recorded for records retained for any purpose. The retention periods will be at least long enough to permit evaluation of the records during the course of project construction.

16. Purchasing Data

The fabricator shall clearly describe subcontracted work and the purchased products, materials, and services ordered in written purchasing documents. This shall include but not be limited to:

- The type of service, material, class, grade, and other unique identification.
- The applicable specifications, drawings, process requirements, and inspection instructions and any witness points.
- Delivery instructions and date.
- Required C of Cs, MTRs, and NDT reports.

Purchasing documents for materials furnished to ASTM specifications shall include the information required in the *"Order Information"* section of the ASTM Standard.

17. Verification of Purchased Product, Materials and Services

The fabricator's procedure for purchasing shall define the extent of control necessary to conform to the project requirements. This may be dependent upon the type of product, the impact of subcontracted product on the quality of the final product or the records available for the demonstrated capability and performance of previous projects. Test reports, C of Cs, or other evidence of quality control shall be kept on file as defined in the fabricator's procedure requirements.
The Owner and/or Owner's representative shall be allowed the right to verify the conformance of the final product to the project requirements at the fabricator's premises.

18. Material Identification

The documented procedure shall describe how the fabricator marks or maintains the identification of base materials from the point of receipt to the point of the first fabricating operation (or beyond, if required; see Section 11.2) to assure incorporation of the correct materials into the product.

- Structural steel material shall be identified as stated in contract documents.
- Welding consumables shall be identified in accordance with the appropriate ANSI/AWS specification.
- Coating materials (excluding metallic coating) shall be identified on the container by, at a minimum, color (pigment description and federal standard number, or manufacturer's number), lot/batch number, ID/stock number, quantity of coating in container, date of manufacture, date of expiration, and manufacturer's name and address.
- Metallic coatings shall be identified by, at a minimum, composition and the appropriate ASTM specification, including hot dip or mechanical galvanizing and metallizing.
- Fasteners shall be stored in containers clearly identified by type, grade, size and lot number(s).

Records that provide a basis for material identification (e.g., MTRs and C of Cs for base materials, fasteners, welding consumables, and coatings) shall be filed and retained as defined in the fabricator's documented procedures.

19. Fabrication Process Control

The fabricator shall develop documented procedures for process control necessary to produce a consistent acceptable level of quality of the furnished product in accordance with the applicable codes or specifications. Fabrication processes include (but are not limited to) thermal and mechanical cutting, fitting and assembly, welding, drilling, bolting, milling, and coating. The fabricator will include additional “special procedures” that cover fabrication processes done at the facility (e.g., cambering).

20. Welding

The fabricator’s welding procedure shall include (but not be limited to):

- WPSs (in close proximity to and used by the welders)
- Preheat requirements
- PQRs (when required)
- Welder, welding operator, and tack welder qualifications and qualification test records
- Welder, welding operator, and tack welder performance records - to provide objective evidence that the “period of effectiveness” has not been exceeded for welder, welding operator, and tack welder qualifications
- Traceability of welds to the welders who produce them

21. Bolt Installation

The fabricator’s documented bolting procedure shall include storage, rotational capacity testing, pre installation verification, installation, and inspection of fastener assemblies for snug-tightened, pretensioned and slip-critical joint types. The documented procedure shall meet the requirements of the RCSC *Specification for Structural Joints Using High-Strength Bolts*.

22. Equipment Maintenance

The fabricator shall develop a documented procedure defining an equipment maintenance program to produce the required quality. The procedure shall define preventative maintenance for, at minimum, equipment critical to product quality and delivery requirements.

23. Inspection and Testing

The fabricator shall develop a documented procedure for inspection and testing activities to verify that the product quality meets the project requirements. The inspection and testing procedure shall define receipt, in-process, and final inspection of all product furnished to a project. Product determined during inspection and testing to be nonconforming shall be addressed by the fabricator’s nonconformance procedure.
For each type of inspection less than 100 percent, the procedure shall describe the methods for establishing sampling plans and for adjusting the level and frequency of inspection to assure expected contract quality. The fabricator’s methods will adjust the level and frequency of inspection at any time the required level of quality is not met. The level or frequency of an inspection sampling plan shall not be zero where a nonconformance has been identified and corrective action has not been fully implemented and verified as effective.

24. Assignment of QC Inspections and Monitoring

The inspection procedure shall define inspection and testing and the required records to meet the project requirements and shall assign QC inspection and QC monitoring duties. Qualification requirements for QC inspectors shall be defined and documented. QC inspectors shall be assigned on the basis of qualification, evidenced by experience, training, and education. Qualification standards and certifications granted by recognized industry organizations related to structural steel fabrication can be used as a basis for qualification. QC inspectors shall be periodically monitored by QA (either by repeating the QC duties or by witnessing their work).
Production personnel shall be assigned to QC inspection duties under the following conditions:

- They shall be trained both in knowledge and practice in proper inspection methods and acceptance criteria specified for the material they are inspecting.
- They are aware of their responsibilities and are given time to perform their inspection responsibilities.
- They do not inspect their own work.
- Their inspections are monitored by qualified QC personnel.

25. Inspection Procedure

The fabricator's procedure shall include (but not be limited to) provisions for the following:

- Material Receipt Inspection:
  Materials received shall be compared to the purchase order requirements. The receiver shall identify the material, grade, and quantity and look for visible shipping damages. The receiver shall inspect shapes and plates for obvious deviations from the requirements of purchase order specifications.

- In-process Inspection:
  The fabricator shall conduct in-process inspection. In-process inspection plans and practices will provide a level of compliance assurance for specified process requirements and inspection acceptance criteria that are not verifiable at final inspection or that can hinder assembly. In-process inspection is appropriate for welds that will be hidden or out of reach during the final inspection, visual examination of fit-up tolerances that will not be visible after welding, areas requiring coatings that will not be accessible during final inspection. Materials shall be inspected for specification and grade, workmanship, and tolerances using appropriate codes, standards, or a documented plan before fabrication begins. Compliance with documented bolting procedures and welding procedures (WPSs, preheat and welding personnel qualifications) shall be monitored. Production personnel should be capable of inspecting the product or subassembly before sending it to the next process.

- Final Inspection:
  The fabricator shall conduct final inspection. QC inspectors qualified and responsible for final inspection shall perform the final inspection of structural steel products after the fitting, welding, and coating operations, but prior to delivery. Qualification requirements for personnel performing final inspection shall be defined and documented. Competency of staff-employed and subcontracted individuals performing final inspection shall be verifiable and evidenced by experience, training, and education.

- Inspection Records:
  The inspection procedure shall indicate what records and marks are used to document inspections. In-process inspections shall be verifiable until the final in-

spection of the piece. Final inspections shall be documented. The quality records produced shall be filed and retained as defined in the fabricator's procedure. Inspection records shall clearly show the products and product aspects that were inspected and who performed the inspection.

26. Calibration of Inspection, Measuring and Test Equipment

The Fabricator shall develop a Documented Procedure to control, calibrate, and maintain inspection, measuring, and test equipment used to demonstrate the compliance of products and processes to the specified requirements. Tools with devices for measuring properties of fabricated pieces or process variables are included in this requirement when they are used to demonstrate the compliance of products and processes to the specified requirements.
The documented procedure shall define equipment calibration frequency. However, the volt/amp meters used to verify compliance with WPS parameters (may be welding machine volt and amp meters or auxiliary volt/amp meters) shall be calibrated whenever the accuracy of the meter is in question and at a minimum every twelve months.
Inspection, measuring and test equipment shall be used in a manner consistent with the required measurement. The precision capability of the equipment used shall support reliable determination of compliance with acceptance criteria. When specifically required, technical data pertaining to the measurement equipment shall be made available for verification that the measuring equipment is performing properly.
For inspection, measuring, and test equipment used to demonstrate the compliance of products and processes to the specified requirements, the documented procedure shall include (but not be limited to):

- An equipment list that provides a means for unique identification of each piece of equipment
- Service use for each piece of equipment including the required precision for the types of inspections, measurements or tests made
- Handling, preservation, and storage of inspection, measuring, and test equipment to maintain accuracy and fitness for use
- Calibration frequency for each piece of equipment based upon service use, requirements of this standard, manufacturer's recommendations, project requirements, specification requirements
- Identification of standards or certified equipment having a known valid relationship to internationally or nationally recognized standards used to calibrate each listed piece of equipment. Where such standards do not exist, the basis used for calibration shall be documented
- The calibration procedure for each piece of equipment calibrated at the fabricator's facility
- The calibration accuracy acceptance criteria for each piece of equipment
- The action to be taken when equipment does not meet the calibration requirements. This action includes disposition of the measuring device and an evaluation of the impact to product that was measured using the device.
- Calibration quality record maintenance as defined in the fabricator's procedure
- Method of preventing inadvertent use of equipment that is not calibrated where calibrated equipment is required

27. Control of Nonconformances

The fabricator shall develop a documented procedure to identify and control nonconformances. These nonconformances may be identified by the fabricator's inspection program, process monitoring, and during internal and external audits, which are then addressed by the corrective action procedure.

28. Nonconforming Product

Nonconforming product shall be documented to ensure that final product not conforming to specified requirements is prevented from reaching the customer. This procedure shall provide for identification, documentation, evaluation, segregation (when practical), treatment of nonconforming product, and for notification of the relevant functions concerned. Nonconforming product shall be clearly marked as soon as practical after it is discovered. Records shall be kept of the pieces affected, the nature of the nonconformance, the treatment selection, authorization, and reinspection results if applicable.
The responsibility for review, authority, and required qualifications for the personnel selecting treatment of nonconforming product shall be defined by the procedure. If the treatment is rework or repair, the result will be inspected per drawing, specification, project requirements, and the fabricator's inspection procedure. The treatment of nonconforming product may be:

- Reworked
- Repaired
- Use as is (after more detailed analysis or acceptance by the fabricator's engineering or management)
- Customer-approved nonconforming product
- Scrapped

Approval from the Owner's designated representatives for design and construction may be required by contract for treatment of nonconformances. These approvals shall be in writing for treatments resulting in "use as is," "repaired," or "reworked."

29. Corrective Action

The fabricator shall develop a documented procedure for corrective action. Any corrective action taken shall be to the degree appropriate to the magnitude of problems and commensurate with the risks to product quality.
The corrective action procedure shall include periodic review of records or summaries of nonconformances and of internal and external quality audit reports for determination and initiation of corrective actions. Corrective action may be applied when:

- There is a nonconformance that is repetitive in nature. This can be identified by periodically reviewing nonconformance reports or summaries for negative trends
- Process nonconformances are found during the internal and external quality audits indicating that the quality management system may not be implemented and functioning as stated in the quality manual
- Nonconformance with the quality management system is found during the day-to-day execution of the system
- Nonconformance is unacceptable due to cost or severity
- A customer complaint has been received
- A complaint has been received from an owner, general contractor or erector

The Corrective Action Procedure shall address these steps:

1. Document a Corrective Action Request (CAR) that includes the nonconformance to be addressed by the corrective action and the requirement that has not been met. The corrective action procedure shall define the functional positions authorized to issue a CAR and initiate the corrective action process.
2. Assign responsibility and establish a timeframe for the response to a CAR.
3. Investigate and document the scope of the nonconformance, root causes, corrective measures taken, and list the actions to be taken to prevent recurrence.
4. Communicate the CAR and resolution to the management team and appropriate members of the organization.
5. Follow up the corrective action taken with periodic monitoring to assure the corrective action is implemented and is effective.

30. Handling, Storage and Delivery of Product and Materials

Material shall be stored, loaded, and shipped to avoid damage and deterioration. Material shall be marked with its identification and shall be listed on a manifest or shipping documents.
Delivery instructions and any shipping agreements (e.g., sequencing that complies with erection needs) between the fabricator, the customer, the fabricator's subcontractors, or the fabricator's suppliers shall be included in written purchasing documents. Shipments by subcontractors and suppliers shall be coordinated and monitored for compliance with shipping and delivery instructions.

31. Internal Audit

The fabricator shall perform an internal audit of each element of the quality management system at least once a year to evaluate their compliance and the effectiveness of implementation. The management representative or a qualified individual, independent of the function being audited, shall perform the audit and provide a written record of the audit result from each element.

END OF SECTION 05 12 00

SECTION 051213 - ARCHITECTURALLY EXPOSED STRUCTURAL STEEL FRAMING

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 architecturally exposed structural-steel (AESS).

1. Requirements in Section 051200 "Structural Steel Framing" also apply to AESS.

B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for additional requirements applicable to AESS.
2. Section 055000 "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame, miscellaneous steel fabrications, and other metal items not defined as structural steel.
3. Section 078100 Applied Fireproofing: Intumescent Paint for surface preparation and priming requirements.

1.3 DEFINITIONS

A. AESS: Structural steel designated as "architecturally exposed structural steel" or "AESS" in the Contract Documents.

B. Category 1 AESS: AESS that is within 96 inches vertically and 36 inches horizontally of a walking surface and that is visible to a person standing on that walking surface or is designated as "Category 1 architecturally exposed structural steel" or "AESS-1" in the Contract Documents.

C. Category 2 AESS: AESS that is within 20 feet vertically and horizontally of a walking surface and that is visible to a person standing on that walking surface or is designated as "Category 2 architecturally exposed structural steel" or "AESS-2" in the Contract Documents.

D. Category 3 AESS: AESS that is not defined as Category 1 or Category 2 or that is designated as "Category 3 architecturally exposed structural steel" or "AESS-3" in the Contract Documents.

1.4 COORDINATION

A. Coordinate installation of anchors for AESS members that connect to the work of other trades. Furnish setting drawings, templates, and directions for installing anchors, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to the project site in time for installation. [Anchorage concepts shall be as indicated on drawings and approved on final shop drawings.]

B. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings." As a minimum, the meeting shall include the General Contractor, Fabricator, Erector, the finish-painting subcontractor, and the Architect. Coordinate requirements for shipping, special handling, attachment of safety cables and temporary erection bracing, touch up painting and other requirements for AESS.

1.6 ACTION SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections. In addition to Division 1 requirements, provide one half-size hard copy (paper) of any drawings submitted in the electronic files.

B. Shop Drawings: Show fabrication of AESS components. Shop Drawings for structural steel may be used for AESS provided items of AESS are specifically identified and requirements below are met for AESS.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include details that clearly identify all of the requirements listed in the "Fabrication" Article and the "Erection" Article of this specification. Provide connections for exposed AESS consistent with concepts shown on the architectural or structural drawings.
3. Include embedment Drawings.
4. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain. Indicate grinding, finish, and profile of welds.
5. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections. Indicate orientation of bolt heads.
6. Indicate exposed surfaces and edges and surface preparation being used.
7. Indicate special tolerances and erection requirements.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification data for firms and persons specified in the 'Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects names and address, names and addresses of architects and owners, and other information specified. For each project, submit photographs showing detail of installed AESS.

B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

1.8 QUALITY ASSURANCE

A. Fabricator Qualifications: In addition to those qualifications listed in Division 5 Section 'Structural Steel,' engage a firm experienced in fabricating AESS similar to that indicated for this Project with a record of successful in-service performance, as well as sufficient production capacity to fabricate AESS without delaying the Work.

B. Installer Qualifications: In addition to those qualifications listed in Division 5 Section 'Structural Steel,' engage an experienced Erector who has completed AESS work similar in material, design, and extent to that indicted for this Project and with a record of successful in-service performance.

C. Mockups: At least four weeks prior to fabricating AESS, the contractor shall construct mockups to demonstrate aesthetic effects as well as qualities of materials and execution. Mockups shall be built by the Contractor or Subcontractor responsible for the Project Work. Build mockups to comply with the following requirements, using all conditions and materials indicated for completed unit of Work.
   1. Locate mockups on-site or in the fabricator's shop as directed by Architect. Mockups shall be full-size pieces unless the Architect approves smaller models.
   2. Notify the Architect 7 days in advance of the dates and times when mockups will be available for review.
   3. Demonstrate the proposed range of aesthetic effects regarding each element listed under the fabrication heading below.
   4. Mockup will have finished surface (including surface preparation and paint system).
   5. Obtain Architect's approval of mockups before start of fabrication of final units.
   6. Retain and maintain mockups during construction in an undisturbed condition as a standard for judging the completed work.
   7. Coordinate painting requirements with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
   8. Coordinate high-performance coatings requirements with Section 099600 "High-Performance Coatings."
   9. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Use special care in handling to prevent twisting, warping, nicking, and other damage. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

   1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.10 FIELD CONDITIONS

A. Field Measurements: Where AESS is indicated to fit against other construction, verify actual dimensions by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the work.

PART 2 - PRODUCTS

2.1 BOLTS, CONNECTORS, AND ANCHORS

A. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, round-head assemblies, consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.

   1. Finish: Mechanically deposited zinc coating.

B. Corrosion-Resisting (Weathering Steel), Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 3, round-head assemblies, consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.

2.2 FILLER

A. Filler: Polyester filler intended for use in repairing dents in automobile bodies.

2.3 PRIMER

A. Primer: Comply with Section 078100 Applied Fireproofing: Intumescent Paint.

B. Etching Cleaner for Galvanized Metal: MPI#25.

C. Galvanizing Repair Paint: ASTM A 780/A 780M.

D. Shop Primer for Galvanized Steel: MPI#26, cementitious galvanized metal primer, MPI#80, vinyl wash primer, or MPI#134, water-based galvanized metal primer.

2.4 FABRICATION

A. Shop fabricate and assemble AESS to the maximum extent possible. Locate field joints at concealed locations if possible. Detail assemblies to minimize handling and to expedite erection.

B. In addition to special care used to handle and fabricate AESS, comply with the following:

1. Fabricate with exposed surfaces smooth, square, and free of surface blemishes including pitting, rust, scale, and roughness.
2. Grind sheared, punched, and flame-cut edges of Category 1 AESS to remove burrs and provide smooth surfaces and edges.
3. Fabricate Category 1 AESS with exposed surfaces free of mill marks, including rolled trade names and stamped or raised identification. Mill marks shall be omitted by cutting of mill material to appropriate lengths where possible. Where not possible, the fabricator can fill and/or grind to a surface finish consistent with the approved mock up.
4. Fabricate Category 1 and Category 2 AESS with exposed surfaces free of seams to maximum extent possible.
5. Remove blemishes by filling or grinding or by welding and grinding, before cleaning, treating, and shop priming.
6. Fabricate with piece marks fully hidden in the completed structure or made with media that permits full removal after erection.
7. Fabricate Category 1 AESS to the tolerances specified in AISC 303 for steel that is designated AESS.
8. Fabricate Category 2 and Category 3 AESS to the tolerances specified in AISC 303 for steel that is not designated AESS.
9. Seal-weld open ends of hollow structural sections with 3/8-inch closure plates for Category 1 AESS.

C. Curved Members: Fabricate indicated members to curved shape by rolling to final shape in fabrication shop.

1. Distortion of webs, stems, outstanding flanges, and legs of angles shall not be visible from a distance of 20 feet under any lighting conditions.
2. Tolerances for walls of hollow steel sections after rolling shall be approximately 1/2 inch.

D. Coping, Blocking, and Joint Gaps: Maintain uniform gaps of 1/8 inch with a tolerance of 1/32 inch for Category 1 AESS.

E. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces.

F. Cleaning Corrosion-Resisting Structural Steel: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.

1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.5 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
1. Joint Type: Snug tightened, unless otherwise indicated on the Contract Documents.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work, and comply with the following:

1. Appearance and quality of welds shall be consistent with the mock up.
2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding specified tolerances.
3. Use weld sizes, fabrication sequence, and equipment for AESS that limit distortions to allowable tolerances.
4. Provide continuous, sealed welds at angle to gusset-plate connections and similar locations where Category 1 AESS is exposed to weather.
5. Provide continuous welds of uniform size and profile where Category 1 AESS is welded.
6. Make butt and groove welds flush to adjacent surfaces within tolerance of plus 1/16 inch, minus zero inch for Category 1 and Category 2 AESS. Do not grind unless required for clearances or for fitting other components, or unless directed to correct unacceptable work.
7. Remove backing bars or runoff tabs; back-gouge and grind steel smooth for Category 1 and Category 2 AESS.
8. At locations where welding on the far side of an exposed connection of Category 1 and Category 2 AESS occurs, grind distortions and marking of the steel to a smooth profile aligned with adjacent material.
9. Make fillet welds for Category 1 and Category 2 AESS of uniform size and profile with exposed face smooth and slightly concave. Do not grind unless directed to correct unacceptable work.
10. Where fillet welds are indicated to be ground-contoured, or blended, oversize welds as required and grind to provide a smooth transition and to match profile on approved mock-up.

2.6 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to AESS according to ASTM A 123/A 123M.

1. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
2. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
3. Fabricate such that all connections of assemblies are made in the field with bolted connections. Provide galvanized finish or members and assemblies within the range of color and surface textures presented in the mock ups.

B. Minimize distortion and warpage of steel members being galvanized by following recommendations according to ASTM A 384/A 384 M.

1. Do not apply galvanizing using double- dip or progressive processes without Architect's or Engineer's written approval.

2.7 SHOP PRIMING

A. Shop prime steel surfaces except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
2. Surfaces to be field welded.
3. Surfaces to be high-strength bolted with slip-critical connections.
4. Surfaces to receive sprayed fire-resistive materials.
5. Galvanized surfaces.

B. Surface Preparation for Nongalvanized Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:

1. SSPC-SP 2, "Hand Tool Cleaning."
2. SSPC-SP 3, "Power Tool Cleaning."
3. AESS receiving epoxy primers, rust-inhibitive primers, or polyurethane finish coats shall receive surface preparation according to SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
    a. Coordinate the required blast profile with the approved paint submittal prior to beginning surface preparation.

C. Preparing Galvanized Steel for Shop Priming: After galvanizing, thoroughly clean steel of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.

D. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 2 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

B. Examine AESS for twists, kinks, warping, gouges, and other imperfections before erecting.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep AESS secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated. Handle, lift and align pieces using padded slings and/or other protection required to maintain the appearance of the AESS through the process of erection.

1. If possible, locate welded tabs for attaching temporary bracing and safety cabling where they will be concealed from view in the completed Work or where approved by the Architect during the pre-installation meeting. Methods of removing temporary erection devices and finishing the AESS members shall be approved by the Architect prior to erection.

3.3 ERECTION

A. Set AESS accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

1. Erect Category 1 AESS to the tolerances specified in AISC 303 for steel that is designated AESS.
2. Erect Category 2 and Category 3 AESS to the tolerances specified in AISC 303 for steel that is not designated AESS.

B. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
1. Joint Type: Snug tightened, unless otherwise indicated on the Contract Documents.
2. Orient bolt heads as indicated on the contract documents. Where bolt-head alignment is specified, the orientation shall be noted for each connection on the erection drawings. Where not noted, the bolt heads in a given connection shall be oriented to one side.

B. Weld Connections: Comply with requirements in "Weld Connections" Paragraph in "Shop Connections" Article.

1. Remove backing bars or runoff tabs; back-gouge and grind steel smooth for Category 1 and Category 2 AESS.
2. Remove erection bolts in Category 1 and Category 2 AESS, fill holes, and grind smooth.
3. Fill weld access holes in Category 1 and Category 2 AESS and grind smooth.
4. Obtain Architects approval for appearance of welds in repaired or field modified work.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect AESS as specified in Section 051200 "Structural Steel Framing." The testing agency is not responsible for enforcing requirements relating to aesthetic effect.

B. Architect will observe AESS in place and determine acceptability based on the mockup. The Testing Agency shall have no responsibility for enforcing the requirements of this section.

3.6 REPAIRS AND PROTECTION

A. Remove welded tabs that were used for attaching temporary bracing and safety cabling and that are exposed to view in the completed Work. Grind steel smooth.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

C. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

D. Touchup Painting: Cleaning and touchup painting are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

E. Touchup Priming: Cleaning and touchup priming are specified in Section 099600 "High-Performance Coatings."

END OF SECTION 051213

SECTION 05 21 00 - STEEL JOIST FRAMING

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. K-series steel joists.
2. KCS-type K-series steel joists.
3. K-series steel joist substitutes.
4. LH-series long-span steel joists.
5. Joist accessories.

B. Related Requirements:

1. Section 05 12 00 "Structural Steel Framing" for field-welded shear connectors.
2. Section 05 31 00 "Steel Decking" for roof decking.

1.3 DEFINITIONS

A. SJI's "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."

B. Special Joists: Steel joists or joist girders requiring modification by manufacturer to support nonuniform, unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

1.4 ACTION SUBMITTALS

A. Product Data: Submit manufacturer's specifications and installation instructions for each type of joist and accessories. Include manufacturer's certification that joists comply with SJI "Specifications".

B. Shop Drawings:
1. In addition to Division 1 requirements, provide one half-size hard copy (paper) of any drawings submitted in the electronic files.
2. Include layout, designation, number, type, location, and spacing of joists.
3. Include joining and anchorage details; bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.
4. Indicate locations and details of bearing plates to be embedded in other construction.
5. A highly visible statement shall appear on the joist shop drawings indicating which joists are to receive special inspection by internal quality control personnel and which are to be inspected by the independent testing laboratory.

1.5 INFORMATIONAL SUBMITTALS

A. Testing Agency Qualifications: Prior to approval of the testing agency by the Architect/Engineer, a letter indicating the qualifications of the agency and all personnel to be utilized in the inspection of the joists, a statement about the proposed techniques for inspection, and a statement that they have read and understood these specifications, shall be submitted to the Architect/ Engineer.

B. Test Reports: Submit copies of reports of tests conducted on welded connections directly to the Architect/Engineer with copy to others in accordance with the provisions of Division 1 Section "Quality Control Services." Include data on type(s) of tests conducted and test results.

C. Welding certificates.

D. Manufacturer certificates.

E. Mill Certificates: For each type of bolt.

F. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer responsible for its preparation.

G. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Source Limitations:
1. To the greatest extent possible steel shapes shall be manufactured with recycled material and shall be manufactured locally or within the State of Texas.

B. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications**."**

1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.

C. Distribution of Information: It shall be the responsibility of the general contractor and/or his steel fabrication sub-contractor to ensure that the steel joist fabricator receives a copy of the following prior to the commencement of shop drawings and fabrication.
1. Copies of the contract documents.
2. These specifications.
3. The names and addresses of the general contractor, the Architect's responsible office, and the Structural Engineer for distribution of necessary reports.

D. Acceptable Weld Quality: The quality of welds shall be visually inspected and a weld shall be accepted by visual inspection if the weld shows that:
1. The weld has no cracks.
2. Thorough fusion exists between adjacent layers of weld metal and between weld metal and the base metal at the welded connection.
3. All craters are filled to the full cross section of the weld joint.
4. All weld profiles shall be reasonably uniform. It is recognized that all web joint welds will not have a perfect profile; however, the effective throat and penetration shall be equal to the throat required by the design drawings. Visual inspection of the welds shall be made to confirm that unequal legs, excessive convexity, or overlap conditions do not detract from the effective throat of the weld.

5. Undercutting of welds is undesirable but is acceptable if the depth of undercutting does not exceed 1/32 inch. Welds that have undercutting in excess of 1/32 inch shall be repaired and re inspected.
6. Any cluster of surface porosity in the weld area is to be removed and replaced with sound weld metal.
7. The surface of the shop welds shall be reasonably clean prior to the inspection.

E. All welding procedures shall be covered by a written welding procedure specification, a copy of which shall be made available to the Architect/Engineer upon request.

F. Test Reports: The inspectors, in house or independent, shall issue written reports of the inspection results to the general contractor, structural steel supplier, and the Architect/Engineer. In the case of in house inspection, where multiple production lines and inspectors are involved, the reports may be issued by the quality control supervisor provided it can be proven by the joist manufacturer to the Architect/Engineer that this supervisor is personally involved in observing the work of the line inspectors on a regular and virtually continuous basis and is personally knowledgeable of the contents, intent, and desired results of this specification. These reports shall be issued for each shift for every day the job is in production.

G. The inspector shall observe the technique and performance of each welder and welding operator at such intervals as may be required to assure that the applicable welding requirements are met.

H. The above inspection procedures do not preclude the Architect/Engineer or Owner from employing a separate independent testing agency for the purpose of further inspection at the job site. In the event of conflict or disagreement, the decision of the Architect/Engineer or Owner will be final with regard to acceptance or rejection of the joists.

I. Welding Qualifications: Qualify field-welding procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle joists as recommended in SJI's "Specifications**."** Handle and store joists in a manner to avoid deforming members and to avoid excessive stresses.

B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Vulcraft Group, Division of Nucor Corporation; 936-687-4665; www.vulcraft.com
2. New Millennium Building Systems, LLC; 870-722-4272; www.newmill.com
3. Canam-buildings, a business unit of Canam Group; 866-466-8769; www.canam-construction.com

2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide special joists and connections capable of withstanding design loads, including wind uplift loads, as indicated on the Contract Documents.

1. Use ASD; data are given at service-load level.
2. Design special joists to withstand design loads with live-load deflections no greater than the following:

a. Roof Joists: Vertical deflection of 1/360 of the span, or as indicated on the Contract Documents, whichever is more stringent.

2.3 K-SERIES STEEL JOISTS

A. Manufacture steel joists of type indicated according to "Standard Specification for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.

1. Joist Type: K-series steel joists and KCS-type K-series steel joists.

B. Steel Joist Substitutes: Manufacture according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle or -channel members.

C. Provide holes in chord members for connecting and securing other construction to joists; however, deduct area of holes from the area of chord when calculating strength of member.

D. Top-Chord Extensions: Extend top chords of joists with SJI's Type S top-chord extensions where indicated, complying with SJI's "Specifications."

E. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated, complying with SJI's "Specifications."

F. Camber joists according to SJI's "Specifications," unless otherwise noted in Contract Documents.

G. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

H. Crimped Members: Crimped members shall be carefully inspected to detect any splits caused by the crimping process. Splits exceeding one half inch in length are not acceptable. In joists and joist girders used as part of a moment resistive frame, splits are not acceptable regardless of length. Nicks less than one eight inch in length caused by the shearing process are acceptable.

2.4 LONG-SPAN STEEL JOISTS

A. Manufacture steel joists according to "Standard Specification for Longspan Steel Joists, LH-Series and Deep Longspan Steel Joists, DLH-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members; of joist type and end and top-chord arrangements as follows: (unless otherwise indicated on the Contract Documents.)

1. Joist Type: LH-series steel joists.
2. End Arrangement: Underslung.

3. Top-Chord Arrangement: Parallel, unless otherwise indicated on the Contract Documents.

B. Provide holes in chord members for connecting and securing other construction to joists; however, deduct area of holes from the area of chord when calculating strength of member.

C. Camber long-span steel joists according to SJI's "Specifications."

D. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.5 PRIMERS

A. Primer: SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.

2.6 JOIST ACCESSORIES

A. Bridging: Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.

B. Bridging, including X-bridging, indicated on the plans where it would not normally be required, shall be provided to supplement continuity of the lateral bracing system to:
1. Support perimeter conventional framing, beams, posts for roof screens, and as indicated.
2. Offset bridging lines at roof openings, mechanical ductwork, and as indicated.

C. Fabricate steel bearing plates from ASTM A 36/A 36M steel with integral anchorages of sizes and thicknesses indicated. Shop prime paint.

D. Steel bearing plates with integral anchorages are specified in Section 055000 "Metal Fabrications."

E. Header Units: Provide header units to support tail joists at openings in floor or roof system not framed with steel shapes.

F. Furnish ceiling extensions, either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction. Extend ends to within 1/2 inch of finished wall surface unless otherwise indicated.

1. Finish: Plain, uncoated.

G. 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.

H. Welding Electrodes: Comply with AWS standards.

I. Galvanizing Repair Paint: ASTM A 780/A 780M].

J. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

2.7 CLEANING AND SHOP PAINTING

A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning, SSPC-SP 2 or power-tool cleaning, SSPC-SP 3.

B. Do not prime paint joists and accessories to receive sprayed fire-resistive materials.

C. Apply one coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Do not install joists until supporting construction is in place and secured.

B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written instructions, final shop drawings, and requirements in this Section.

1. Before installation, splice joists delivered to Project site in more than one piece.
2. Space, adjust, and align joists accurately in location before permanently fastening.
3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.

C. Field weld joists to supporting steel bearing plates and framework, in accordance with the contract documents, or if not shown, with SJI "Specifications" for type of joists used. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

D. Where joists penetrate fire walls, see Division 7 Section "Insulation" for related work.

E. Bolt joists to supporting steel framework using carbon-steel bolts.

F. Bolt joists to steel columns and at other locations where shown on the Contract Documents using high-strength structural bolts. Comply with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for high-strength structural bolt installation and tightening requirements.

G. Provide temporary bridging, connections, and anchors to ensure lateral stability during construction.
1. Where "open web" joist lengths are 40 feet and longer, install a center row of bolted bridging to provide lateral stability before slackening of hoisting lines.

H. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

I. At flat roofs (up to 1/4 inch per foot maximum slope), with joists of the same depth, splices shall be a minimum of 4 inches long with at least 1 1/2 inches of fillet weld on each side, and shall develop a minimum capacity of 700 pounds, whichever is greater. Splices may occur between joists unless a depth change occurs, or other conditions occur which would affect the continuity of the bridging. For either of these cases the splice must occur at the joist. If joists are not flat, splicing and weld requirements for bridging shall be designed by the joist manufacturer and noted in the shop drawings.

J. Sweep: Sweep of joists after installation shall not exceed the greater of one half inch or L/300. Bottom and top chords shall be maintained in a vertical plane.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Visually inspect field welds according to AWS D1.1/D1.1M.
   1. In addition to visual inspection, provide non-destructive testing as indicated by AISC 360 and the Contract Documents, whichever is more stringent. Test field welds according to AWS D1.1/D1.1M and the following procedures, at testing agency's option:

      a. Liquid Penetrant Inspection: ASTM E 165/E 165M.
      b. Magnetic Particle Inspection: ASTM E 709.
      c. Ultrasonic Testing: ASTM E 164.
      d. Radiographic Testing: ASTM E 94.

C. Visually inspect bolted connections.

D. Prepare test and inspection reports.

3.4 PROTECTION

A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780/A 780M and manufacturer's written instructions.

B. Top Chord Repair: Repair all locations where the steel deck welding procedures have burned holes in the top chord members. Contact the Architect/Engineer for correction procedures.

C. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists, bearing plates, abutting structural steel, and accessories.

   1. Clean and prepare surfaces by hand-tool cleaning according to SSPC-SP 2 or power-tool cleaning according to SSPC-SP 3.
   2. Apply a compatible primer of same type as primer used on adjacent surfaces.

D. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure joists and accessories are without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 21 00

SECTION 05 31 00 - STEEL DECKING

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. Composite floor deck.
2. Noncomposite vented form deck.
3. Long-span acoustical roof deck.
    a. Perforated vertical webs.
    b. Acoustical Performance: NRC 0.70, with factory-installed sound-absorbing insulation.
4. Long-span exterior roof deck.
    a. Standard wide-rib non-perforated deck, matching the depth and profile of long-span acoustical roof deck for visual continuity.
    b. Acoustical Requirements: None; provide solid-web panels to ensure a moisture-tight exterior assembly.

B. Related Requirements:

1. Section 03 30 00 "Cast-in-Place Concrete" for normal-weight and lightweight structural concrete fill over steel deck.
2. Section 03 52 16 "Lightweight Insulating Concrete" for lightweight insulating concrete fill over steel deck.
3. Section 05 12 00 "Structural Steel Framing" for shop- and field-welded shear connectors.
4. Section 05 50 00 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.
5. Section 09 90 00 "Painting and Coatings" for repair painting of primed deck and finish painting of deck.

1.3 ACTION SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections. In addition to Division 1 requirements, provide one half-size hard copy (paper) of any drawings submitted in the electronic files.

B. Product Data: For each type of deck, accessory, and product indicated.

C. Wood Finish Samples: Submit two 6-inch by 6-inch samples of the specified wood-grain finish on the actual deck substrate for Architect's verification of color, grain pattern, and sheen.

D. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

2. Indicate clearly on Shop Drawings the extent of Interior-Type and Exterior-Type acoustical decking, including specific transitions and closure details at the building thermal envelope.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.

C. Product Test Reports: For tests performed by a qualified testing agency, indicating that each of the following complies with requirements:

1. Power-actuated mechanical fasteners.

2. Acoustical roof deck.

D. Evaluation Reports: For steel deck, from ICC-ES.

E. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
1. Welded decking in place is subject to inspection and testing. Expense of removing and replacing portions of decking for testing purposes will be borne by Owner if welds are found to be satisfactory. Remove work found to be defective and replace with new acceptable work.

C. FM Global Listing: Provide steel roof deck evaluated by FM Global and listed in its "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

PART 2 - PRODUCTS

2.1 DECKING MATERIALS

A. Source Limitations:
1. To the greatest extent possible steel shapes shall be manufactured with recycled material and shall be manufactured locally or within the State of Texas.

2.2 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.3 COMPOSITE FLOOR DECK

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Vulcraft Group, Division of Nucor Corporation; 936-687-4665; www.vulcraft.com
2. New Millennium Building Systems, LLC ; 870-722-4272; www.newmill.com
3. Epic Metals Corporation; 877-696-3742; www.epicmetals.com
4. Canam-buildings, a business unit of Canam Group; 866-466-8769; www.canam-construction.com
5. H.H. Robertson Floor Systems, a CENTRIA company; 800-932-0706; www.hhrobertson.com

B. Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:

1. Prime-Painted Steel Sheet: ASTM A 1008/A 1008M, Structural Steel (SS), Grade as Indicated on Contract Documents, with top surface phosphatized and unpainted and underside surface shop primed with manufacturers' standard gray baked-on, rust-inhibitive primer.
2. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade as Indicated on Contract Documents, G90 zinc coating.
3. Galvanized and Shop-Primed Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade as Indicated on Contract Documents, G90 zinc coating; with unpainted top surface and cleaned and pretreated bottom surface primed with manufacturer's standard gray baked-on, rust-inhibitive primer.
4. Profile Depth: As indicated on Contract Documents.
5. Design Uncoated-Steel Thickness: As Indicated.
6. Span Condition: Triple span or more.

2.4 NONCOMPOSITE VENTED FORM DECK

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Vulcraft Group, Division of Nucor Corporation; 936-687-4665; www.vulcraft.com
   2. New Millennium Building Systems, LLC ; 870-722-4272; www.newmill.com
   3. Epic Metals Corporation; 877-696-3742; www.epicmetals.com
   4. Canam-buildings, a business unit of Canam Group; 866-466-8769; www.canam-construction.com

B. Non-composite Vented Form Deck: Fabricate ribbed- and vented-steel sheet noncomposite form-deck panels to comply with "SDI Specifications and Commentary for Noncomposite Steel Form Deck," in SDI Publication No. 31, and with the following:

   1. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade as Indicated on Contract Documents G90 zinc coating.
   2. Galvanized and Shop-Primed Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade as Indicated on Contract Documents, G60 zinc coating; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.

      a. Color: Manufacturer's standard.

   3. Profile Depth: As Indicated.
   4. Design Uncoated-Steel Thickness: As Indicated.
   5. Span Condition: Triple span or more.
   6. Side Laps: Overlapped.
   7. Vent Slot Area: Manufacturer's standard vent slots providing 1-1/2 percent open area.

2.5 LONG-SPAN ACOUSTICAL AND EXTERIOR ROOF DECK

A. Basis-of-Design Product:

   1. Epic Metals Corporation; Envista FA series Roof Deck System with Timberlok wood grain finish system.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   1. Epic Metals Corporation; 877-696-3742; www.epicmetals.com
   2. Vulcraft Group, Division of Nucor Corporation; 936-687-4665; www.vulcraft.com
   3. New Millennium Building Systems, LLC ; 870-722-4272; www.newmill.com

C. Long-Span Acoustical Roof Deck (Interior): Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:

   1. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade as Indicated on Contract Documents, G90 zinc coating.
   2. Deck Profile: Perforated vertical webs for sound absorption; profiles and depths as indicated on Contract Documents, with bottom plate.
   3. Design Uncoated-Steel Thickness: As indicated on Contract Documents.
   4. Design Uncoated-Steel Thicknesses; Deck Unit/Bottom Plate: As indicated on Contract Documents.
   5. Span Condition: Triple span or more.

6. Side Laps: Overlapped or interlocking seam at Contractor's option.
7. Acoustical Perforations: Deck units with manufacturer's standard perforated vertical webs Single-pan units: Single-pan fluted units with vertical webs perforated with approximate 5/32 inch diameter holes staggered 3/8 inch o.c..
8. Sound-Absorbing Insulation: Manufacturer's standard premolded roll or strip of glass or mineral fiber to fit void space between vertical ribs.
9. Acoustical Performance: NRC 0.70, tested according to ASTM C 423.
10. Factory installed air dams shall be provided by deck manufacturer along perimeter of building envelope if shown on Architectural or Structural design drawings.
11. Shop-Applied Finish for Exposed Surfaces: Clean, pretreat, and factory-finish underside surfaces. Finish Type: Provide a factory-applied, two-coat, oven-cured architectural coating system replicating wood grain. Wood Species/Pattern: As selected by Architect from manufacturer's standard wood-look collection.
    a. Pre-treatment: Surface shall be chemically cleaned and pre-treated to ensure maximum adhesion of the coating system.
    b. Primer: Factory-applied, oven-cured corrosion-inhibitive primer; minimum 0.20 mil dry film thickness.
    c. Topcoat: Topcoat: Factory-applied, oven-cured high-performance architectural color coat (Silicone Modified Polyester or High-Performance Polyester); minimum 0.80 mil dry film thickness.
    d. Total Dry Film Thickness: 1.0 mil minimum.
    e. Application: Ensure the coating application is uniform and does not bridge or clog acoustical perforations.
12. Finish Performance Requirements:
    a. Gloss: As selected by Architect. Provide (2) samples of each type of gloss option available.
    b. Adhesion: No loss of adhesion when tested in accordance with ASTM D3359.
    c. Humidity Resistance: No blistering or loss of adhesion after 1,000 hours of testing in accordance with ASTM D2247.

D. Long-Span Exterior Roof Deck: Fabricate panels to match the profile and depth of the acoustical roof deck for visual continuity, but without acoustical perforations, complying with the following:
1. Galvanized and Shop-Primed Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade as Indicated on Contract Documents, G90 zinc coating; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.
2. Profile: Solid vertical webs (non-perforated) to prevent moisture infiltration into the deck flutes.
3. Design Uncoated-Steel Thickness: As indicated on Contract Documents; 22-gauge minimum.
4. Factory installed air dams shall be provided by deck manufacturer along perimeter of building envelope if shown on Architectural or Structural design drawings.
5. Exterior Finish: Match Interior Acoustical Roof Deck.
    a. Color: To match Interior Acoustical Roof Deck.
6. Finish Performance Requirements:
    a. Gloss: As selected by Architect. Provide (2) samples of each type of gloss option available.
    b. Adhesion: No loss of adhesion when tested per ASTM D3359.
    c. Salt Spray Resistance: No blistering or loss of adhesion after 2,000 hours of testing in accordance with ASTM B117.

2.6 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile recommended by SDI Publication No. 31 for overhang and slab depth.

G. Metal Cover Plates: Fabricate metal cover plates for end abutting floor deck units of not less than same thickness as decking. Form to match contour of deck units and approximately 6" wide.

H. Metal Closure Strips: Fabricate metal closure strips, for openings between decking and other construction, of not less than 0.045 inch min. (18 gage) sheet steel. Form to provide tight fitting closures at open ends of cells or flutes and sides of decking.

I. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 16 gage thickness, with factory-punched hole of 3/8-inch minimum diameter.

J. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.

K. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck, with 3-inch- wide flanges and level recessed pans of 1-1/2-inch minimum depth. For drains, cut holes in the field. Galvanizing Repair Paint: ASTM A 780/A 780M.

L. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.

B. Locate deck bundles to prevent overloading of supporting members.

C. Decorative Finish Protection: Use non-marring tools and equipment during installation to prevent scratching of the factory wood finish. Panels with visible surface damage to the wood grain shall be rejected and replaced.

D. Coordination with Lighting:
   1. Reveal and Joint Alignment: Align deck joints and reveals accurately to maintain the continuity of the wood grain pattern as indicated on the Reflected Ceiling Plans.

E. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

   1. Maximum vertical dimension between deck units at a support shall be 1/16 inch.

   2. Align cellular deck panels over full length of cell runs and align cells at ends of abutting panels.

F. Place deck panels flat and square, secured to adjacent framing with top flange having no warping in excess of 1/16 inch across any three adjacent flanges.

G. Do not place deck units on concrete supporting structure until concrete has cured and is dry.

H. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

I. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work. Coordinate reinforcing requirements of openings in first paragraph below with applicable Sections. Reinforce openings as indicated on the contract documents, and not less than:
   1. Reinforce steel deck openings from 6 to 18 inches in size with 2x2x1/4 inch steel angles. Place angles perpendicular to flutes; extend a minimum of two flutes beyond each side of opening and fusion weld to deck at each flute.

J. Deck Transitions: At the building line where Long-Span Acoustical Roof decking meets Long-Span Exterior Roof decking provide a continuous 20-gauge galvanized steel closure strip or "flute plug" to seal the ends of the interior acoustical flutes.

K. Air Seal: Apply a continuous bead of sealant (Section 07 90 00) between the deck closure strip and the building structure to maintain the integrity of the conditioned air plenum.

L. At transitions between Long-Span Acoustical Roof decking and Long-Span Exterior Roof decking, provide a continuous metal closure strip or 'thermal break' as indicated to prevent unconditioned air from infiltrating the interior plenum.

M. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

N. Fastening Deck Units: The top flanges of the beams and the steel deck shall be free of paint, water, ice, oil, rust, or any other material which might interfere with the welding process.

O. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 ROOF-DECK INSTALLATION

A. Install temporary shoring before placing deck panels if required to meet deflection limitations.

B. Uplift Loading: Install and anchor roof deck units to resist gross uplift loading as indicated on the Contract Documents.

C. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches long, and as follows:

1. Weld Diameter: As Indicated on the Contract Documents.
2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Space welds As indicated on Contract Documents.
3. Weld Washers: Install weld washers at each weld location where deck thickness is less than 0.028 inches.

D. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or 36 inches, and as follows:

1. Mechanically fasten with self-drilling, No. 10 diameter or larger, length as required, carbon-steel screws.
2. For decks with positive registering, interlocking male/female type side laps, join by button punching.

E. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:

1. End Joints: Lapped 2 inches minimum.

F. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and weld or mechanically fasten flanges to top of deck. Space welds or mechanical fasteners not more than 12 inches apart with at least one weld or fastener at each corner.

1. Install reinforcing channels or zees in ribs to span between supports and weld or mechanically fasten.

G. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. [Weld] to substrate to provide a complete deck installation.

1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.

H. Sound Absorption Batts: Install sound absorbing batts immediately prior to installation of roof insulation. Keep materials dry before, during, and after installation.

I. Provide minimum 1 inch thick soft composition rubber closures above walls and partitions contiguous to acoustical steel roof deck.

3.4 FLOOR-DECK INSTALLATION

A. Floor decking units shall be temporarily shored in accordance with the manufacturer's Allowable Shoring Tables. Shoring requirements shall be determined as follows:

1. Bending stress shall not exceed 0.60 times the yield strength, nor exceed 36,000 psi under the combined weights of wet concrete, deck and the following construction live loads: 20 psf uniform load, or 150 lb. concentrated load on a 1' 0" width section of deck.
2. Slab dead load shall not cause deflection in excess of 1/180 of the span or a maximum of 3/4 inch. Shoring shall be designed in accordance with local building code provisions. Shoring shall be left in place until the concrete attains 75 percent design compressive strength.

B. Do not use floor deck units for storage or working platforms until permanently secured.

C. Fasten composite floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:

1. Weld Diameter: As Indicated on the Contract Documents.
2. Weld Spacing: Weld edge ribs of panels at each support. Space additional welds at not more than 12 inches apart with a minimum of 2 welds per unit at each support.
3. Weld Washers: Install weld washers at each weld location where deck thickness is less than 0.028 inches**.**

D. Fasten non-composite floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
1. Weld Diameter: As Indicated on the Contract Documents.
2. Weld Spacing: As Indicated on the Contract Documents, at a minimum provide welds at the ends and at all end laps, provide welds at the side of each sheet (including sides where sheets lap), and at the midspan of each sheet. Provide welds at each support, and alternate the two following weld patterns: 1) at each side, and/or at each side lap, 2) at the midspan of each sheet, and at each side.
3. Weld Washers: Install weld washers at each weld location where deck thickness is less than 0.028 inches**.**

E. SDI requires side-lap and perimeter edge fastening if deck spans exceed 60 inches (1524 mm).

F. Side-Lap and Perimeter Edge Fastening: As Indicated on the Contract Documents, at a minimum, fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or 36 inches, and as follows:

1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
2. Mechanically clinch or button punch.
3. Fasten with a minimum of 1-1/2-inch long welds.

G. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:

1. End Joints: 2” minimum lap for non-composite floor deck or Butted for composite floor decking.

H. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated.

I. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

J. Deformed bar anchors: Deformed bar anchors shall be automatically end welded on centers as shown on drawings in accordance with manufacturer's recommendations.

K. Shear Connectors: Shear connectors shall be solid fluxed and are to be automatically end welded through the metal deck at spacings shown on the drawings and in accordance with manufacturer's recommendations. Do not weld shear connectors through two layers (lapped ends) of decking units. Weld only on clean, dry deck surfaces.

1. A minimum of 2 shear connector studs shall be welded at the start of each production period in order to determine proper generator, control unit, and stud welder settings. These studs shall be capable of being bent 45 degrees from vertical without weld failure. If, after welding, visual inspection reveals that a sound weld or a full 360 degree fillet weld has not been obtained for a particular stud, such stud shall be struck with a hammer and bent approximately 15 degrees off perpendicular to the nearest end of the beam. Studs meeting this test shall be left in this position. Studs failing under this test shall be replaced. When the temperature is below 32 degrees F., one stud in each 100 shall be tested after cooling.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Field welds will be subject to inspection.

C. Prepare test and inspection reports.

3.6 PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780/A 780M and manufacturer's written instructions.

B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.

1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.

END OF SECTION 05 31 00

SECTION 05 40 00 - COLD-FORMED METAL FRAMING

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. Exterior non-load-bearing wall framing.
2. Interior non-load-bearing wall framing exceeding height limitations of standard, nonstructural metal framing.
3. Ceiling joist framing.
4. Soffit framing.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for miscellaneous steel shapes, masonry shelf angles, and connections used with cold-formed metal framing.
2. Section 061053 "Miscellaneous Rough Carpentry" for subflooring, wall sheathing, or roof sheathing using wood-based structural-use panels, particleboard, fibrous-felted board, and foam-plastic sheathing.
3. Section 092216 "Gypsum Board Assemblies" for standard, interior non-load-bearing, metal-stud framing, with height limitations and ceiling-suspension assemblies.

1.3 DEFINITIONS

A. Uncoated Steel Design Thickness: Minimum uncoated thickness of cold-formed framing delivered to the Project site shall be not less than 95 percent of the indicated thickness used in the cold-formed framing design. Lesser thicknesses shall be permitted at bends due to cold forming. Where decimal thicknesses of framing are not indicated, the thicknesses in “gages” and “mils” shall be provided in conformance with the thicknesses indicated in the Steel Stud Manufacturers Association.

B. Producer: Entity that produces steel sheet coil fabricated into cold-formed members.

C. Engineer of Record: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing cold formed metal framing engineering services and is specifically hired to do so.

D. Engineering Services: Services performed by the Engineer of record for installations of cold-formed metal framing for this Project.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site prior to commencing the Work.
   1. Require attendance of parties directly affecting the Work of the section. The cold-formed metal framing Engineer of Record shall be an attendee of the Preinstallation Conference. If the Engineer of Record is not able to attend the scheduled Preinstallation Conference, the conference shall be rescheduled as many times as necessary, until the Engineer of Record is able to attend the conference.
   2. Review conditions of installation, installation drawings, procedures and coordination with related work.
   3. Approved Cold-Formed Metal Framing shop drawings shall be reviewed at the Preinstallation Conference with the Engineer of Record present for the review.
   4. Review required inspecting, testing, and certifying procedures.
   5. The Owner's Materials Testing Lab shall attend the Preinstallation Conference if the Owner has engaged the service of an independent lab for site inspections of CFMF.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

   1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

B. Shop Drawings:
   1. Provide shop/installation drawings prepared by cold-formed metal framing engineer.
   2. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
   3. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

C. Delegated-Design Submittal: For cold-formed steel framing. For cold-formed metal framing, connection design including fasteners, clips, anchors and all other related aspects of the framing design: comply with all applicable model code required design loads. Include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL 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. Welding certificates.

C. Product Certificates: For each type of code-compliance certification for studs and tracks.

D. Product Test Reports: For each listed product, for tests performed by a qualified testing agency.

   1. Steel sheet.
   2. Expansion anchors.
   3. Power-actuated anchors.
   4. Mechanical fasteners.
   5. Vertical deflection clips.
   6. Horizontal drift deflection clips
   7. Miscellaneous structural clips and accessories.

E. Evaluation Reports: For nonstandard cold-formed steel framing post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

F. Submittals required as part of component manufacturer's and installer's Quality Control Program(s) that include material control procedures, inspection procedures, and nonconformance procedures.

G. Component manufacturer's and installer's Quality Control Inspector qualifications.

H. Certificates of Compliance: Certificate from Professional Structural Engineer responsible for system design that system was designed in accordance with Contract Documents requirements, applicable Building Code, and generally accepted engineering practices.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Installer Qualifications: An experienced installer who has completed cold-formed metal framing 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.
   1. The installer shall establish and maintain quality control procedures and perform inspections to ensure that the work is in accordance with AISI referenced documents and Contract Documents.

C. Engineer of Record:
   1. Engage a qualified professional Engineer to prepare design calculations, Shop Drawings, and other structural data as required.
   2. The Engineer of Record shall perform two (2) site inspections during installation and one (1) site inspection at completion of cold-formed metal framing.
   3. The Engineer of Record shall provide reports, including any nonconformance, issued to the Construction Manager, Owner, and Architect/Engineer within 48 hours of inspection.

D. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

E. Welding Qualifications: Qualify procedures and personnel according to the following:

   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
   2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

F. AISI Specifications and Standards:
   1. Comply with AISI documents as referenced standards in the applicable version of the International Building Code for this project.
   2. Comply with AISI S202-15 "Code of Standard Practice for Cold-formed Steel Structural Framing".
   3. Comply with AISI S240-15 "North American Standard for Cold-Formed Steel Structural Framing", including Section D Quality Control and Quality Assurance.

1.8 DELIVERY, STORAGE AND HANDLING

A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling in accordance with AISI's "Code of Standard Practice".

B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation in accordance with AISI's "Code of Standard Practice".

C. The contractor shall verify that the framing materials delivered meet the requirements of the contract, construction documents, and submittals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cold-formed steel framing.

B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated. The size of framing members indicated in the drawings, are minimum sizes – provide the indicated sizes, or larger sizes where structural engineering dictates larger sizes are required. Where larger sizes of studs, tighter spacing of studs or more studs are indicated by the Structural Engineer preparing the buildings framing design, provide these material increases to the job, at no additional cost of the Owner. In some instances, the stud sizes indicated may be larger than engineering analysis dictates are necessary - heavier indicated stud sizes may have been chosen, and subsequently indicated in order to support, or otherwise accommodate other building systems which require heavier stud gages than basic structural engineering (framing design to meet the Building Code) dictates – DO NOT DOWN-SIZE THE STUD SIZES INDICATED.

1. Design Loads: As indicated on Drawings
2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:

    a. Exterior Load-Bearing Wall Framing used behind masonry veneer: Horizontal deflection of 1/600 of the wall height.
    b. Exterior Load-Bearing Wall Framing not used behind masonry veneer: Horizontal deflection of 1/360 of the wall height.
    c. Exterior Non-Load-Bearing Framing used behind masonry veneer: Horizontal deflection of 1/600 of the wall height.
    d. Exterior Non-Load-Bearing Framing not used behind masonry veneer: Horizontal deflection of 1/360 of the wall height.
    e. Interior Non-Load-Bearing Framing: Horizontal deflection of 1/360 of the wall height under a horizontal load of 5 lbf/sq. ft.
    f. Roof Rafter Framing: Vertical deflection of 1/360 of the horizontally projected span for live loads.
    g. Ceiling Joist Framing: Vertical deflection of 1/360 of the span for live loads and 1/240 for total loads of the span.

3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:

    a. Upward and downward movement of 1-1/2 inches.

5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

C. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing shall comply with AISI S100, AISI S200, and the following:

1. Floor and Roof Systems: AISI S210.
2. Wall Studs: AISI S211.
3. Headers: AISI S212.
4. Lateral Design: AISI S213.

D. Design framing installed behind exterior ceramic tile walls to comply with ANSI A108.11-4.0-4.3 requirements for framing.

E. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency acceptable to authorities having jurisdiction.

2.2 COLD-FORMED STEEL FRAMING MATERIALS

A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:

1. Grade: As required by structural performance.
2. Coating: G60 (Z180) unless otherwise indicated, G90 (Z275) at masonry curtain-wall framing.

B. Steel Sheet for Vertical Deflection Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:

1. Grade: As required by structural performance.
2. Coating: G60 (Z180) unless otherwise indicated, G90 (Z275) at masonry curtain-wall framing.

2.3 EXTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch.
2. Flange Width: 1-5/8 inches, minimum.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: Matching steel studs.
2. Flange Width: 1-1/4 inches, minimum.

C. Vertical Deflection Clips: Manufacturer's standard bypass clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical

attachment to stud web to permit frictionless vertical movement, 68 mils (1.72 mm) minimum thickness, size as required by structural design calculations.

1. Basis-of-Design: VertiClip, The Steel Network, Inc. 888-474-4876 www.steelnetwork.com
2. Manufacturers: Subject to compliance with requirements, provide the named product, or a comparable product by other manufacturer.

D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:

1. Minimum Base-Metal Thickness: 0.0538 inch.
2. Flange Width: As required to accommodate upward or downward deflection of primary structure.

E. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.4 INTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch.
2. Flange Width: 1-5/8 inches, minimum.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: Matching steel studs.
2. Flange Width: 1-1/4 inches, minimum.

C. Vertical Deflection Clips: Manufacturer's standard head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web to permit frictionless vertical movement, 68 mils (1.72 mm) minimum thickness, size as required by structural design calculations.

1. Basis-of-Design: VertiClip, The Steel Network, Inc. 888-474-4876 www.steelnetwork.com
2. Manufacturers: Subject to compliance with requirements, provide the named product, or a comparable product by other manufacturer.

D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:

1. Minimum Base-Metal Thickness: 0.0538 inch.
2. Flange Width: As required to accommodate upward or downward deflection of primary structure .

E. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.5 CEILING JOIST FRAMING

A. Steel Ceiling Joists: Manufacturer's standard C-shaped steel sections, of web depths indicated, punched with standard holes, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch.
2. Flange Width: 1-5/8 inches, minimum.

B. Connector Devices: For transfer of loads from ceiling joist framing members to supporting structure, hanger type and size as required by structural design calculations. ASTM A 653/A 653M, structural steel, zinc coated.
1. Grade: As required by structural performance.
2. Coating: G90 (Z275).
3. Basis-of-Design: StiffClip, The Steel Network, Inc. 888-474-4876 www.steelnetwork.com
4. Manufacturers: Subject to compliance with requirements, provide the named product, or a comparable product by other manufacturer.]

2.6 SOFFIT FRAMING

A. Exterior Soffit Frame: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch.
2. Flange Width: 1-5/8 inches, minimum.

2.7 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members, with a minimum yield strength of 33,000 psi. Where any of the framing’s minimum yield strength is greater than 33,000 psi, i.e. 50,000 psi, accessory minimum yield strength shall be match the framings minimum yield strength.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

1. Supplementary framing.
2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. Anchor clips.
5. End clips.
6. Foundation clips.
7. Gusset plates.
8. Stud kickers and knee braces.
9. Joist hangers and end closures.
10. Hole-reinforcing plates.
11. Backer plates.

2.8 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.

B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel bolts, carbon-steel nuts, and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C.

C. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC58 at masonry walls or ICC-ES AC308 at concrete walls as appropriate for the substrate.

1. Uses: Securing cold-formed steel framing to structure.
2. Type: Adhesive anchor.
3. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
4. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

D. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.

1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.

F. Welding Electrodes: Comply with AWS standards.

2.9 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: ASTM A 780/A 780M, MIL-P-21035B, or SSPC-Paint 20.

B. Nonmetallic, Nonshrink Grout: Factory-packaged, nonmetallic, noncorrosive, nonstaining grout, complying with ASTM C 1107/C 1107M, and with a fluid consistency and 30-minute working time.

C. Shims: Load-bearing, high-density, multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.

D. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members as required.

2.10 FABRICATION

A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, Engineer’s shop/installation drawings, manufacturer's written instructions, and requirements in this Section.

1. Fabricate framing assemblies using jigs or templates.
2. Cut framing members by sawing or shearing; do not torch cut.
3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.

    a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    b. Locate mechanical fasteners and install according to Shop Drawings, with screws penetrating joined members by no fewer than three exposed screw threads.

4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies by means that prevent damage or permanent distortion.

C. Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable variation of 1/8 inch in 10 feet and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, conditions, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that required to obtain fire-resistance ratings indicated. Protect remaining fire-resistive materials from damage.

C. Grout bearing surfaces uniform and level to ensure full contact of bearing flanges or track webs on supporting concrete or masonry construction.

D. Install load-bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch to ensure a uniform bearing surface on supporting concrete or masonry construction.

E. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed steel framing according to AISI S200, AISI S202, Engineer’s shop/installation drawings, and manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.

D. Provide supplementary framing, blocking, and bracing where metal framing systems are indicated to support fixtures, equipment, services, casework, heavy trim and furnishings, metal roof, wall, and soffit panels, and similar work requiring attachment. Where type of supplementary support is not otherwise indicated, comply with cold- formed metal framing manufacturer's recommendations and industry standards in each case, considering weight or loading resulting from item supported.

E. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.

a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
b. Locate mechanical fasteners, install according to Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.

F. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

G. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

H. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.

I. Install insulation, specified in Section 072100 "Thermal Insulation," in framing-assembly members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

J. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

3.4 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.

B. Fasten both flanges of studs to bottom track unless otherwise indicated. Space studs as follows:

1. Stud Spacing: As indicated on Shop Drawings.

C. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Install single deep-leg deflection tracks and anchor to building structure.
2. Connect vertical deflection clips to bypassing studs and anchor to building structure.
3. Connect drift clips to cold-formed steel framing and anchor to building structure.

E. At exterior walls where walls are adjacent to the primary building structure, connect vertical deflection clips with slip capability, to the studs and anchor the clips to the primary building structure. The connection at the stud is to allow vertical movement only, not horizontal movement. Tighten connection nuts for vertical movement only. Deflection clips shall have vertical slot connection holes for vertical movement. Locate the slots adjacent to the stud, not at the primary building structure. The slip fasteners at the studs shall allow vertical movement without the fastener being able to disconnect from and fall from the framing studs. Slip connection shall be with bolts, nuts and washers unless the framing manufacturer has other recommendations that are acceptable to the Architect – submit designs in shop drawings. If framing manufacturer does not have other permanent fastening options that are acceptable to the Architect, deform the bolt threads after the nuts are in place to create a permanent fastener installation.

F. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.

1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
3. Subject to compliance with authorities having jurisdiction and other requirements, provide either bridging method indicated immediately above.
4. Where Portland Cement Plaster (PCP) is to be installed over walls, and the lath used in the PCP is welded wire lath, the wall bracing shall be provided in accordance with the International Building Code section 2308.9.3 or section 2308.12 regardless of type of studs used in the PCP wall.

G. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
1. Install solid blocking at every other stud and at additional locations as indicated on shop drawings.

H. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 INTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.

B. Fasten both flanges of studs tobottom track unless otherwise indicated. Space studs as follows:

1. Stud Spacing: As indicated on Drawings.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Install single deep-leg deflection tracks and anchor to building structure.
2. Connect vertical deflection clips to studs and anchor to building structure.
3. Connect drift clips to cold-formed steel metal framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.

1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
3. Subject to compliance with authorities having jurisdiction and other requirements, provide either bridging method indicated immediately above.
4. Where Portland Cement Plaster (PCP) is to be installed over walls, and the lath used in the PCP is welded wire lath, the wall bracing shall be provided in accordance with the International Building Code section 2308.9.3 or section 2308.12 regardless of type of studs used in the PCP wall.

F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
1. Install solid blocking at every other stud and at additional locations as indicated on shop drawings.

G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.6 JOIST INSTALLATION

A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.

B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.

1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches.
2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections.

C. Space joists not more than 2 inches from abutting walls, and as follows:

1. Joist Spacing: As indicated on Drawings.

D. Frame openings with built-up joist headers, consisting of joist and joist track or another combination of connected joists if indicated.

E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement.

1. Install web stiffeners to transfer axial loads of walls above.

F. Install bridging at intervals indicated on Shop Drawings. Fasten bridging at each joist intersection as follows:

1. Bridging: Cold-rolled steel channel, welded or mechanically fastened to bottom flange of joists.

2. Joist-Track Solid Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.
3. Combination Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and joist-track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.
4. Subject to compliance with authorities having jurisdiction and other requirements, provide any bridging method indicated above.

G. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.

H. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

3.7 ERECTION TOLERANCES

A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.8 FIELD QUALITY CONTROL

A. Inspection: Component manufacturer and installer shall inspect the work as required by their Quality Control Program(s) per AISI S240-15.

B. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

C. Field and shop welds will be subject to testing and inspecting.

D. Testing agency will report test results promptly and in writing to Contractor and Architect.

E. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.

F. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.9 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780/A 780M and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 40 00

SECTION 05 50 00

METAL FABRICATIONS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes shop fabricated metal items.

B. Performance and design criteria for the delegated design for but not limited to the following:
   1. Supports for overhead doors and grilles.
   2. Elevator hoist beam.

C. Loose lintels.

D. Bollards.

E. Steel ladders.

F. Steel ships ladders.

G. Structural supports for miscellaneous attachments.

H. Steel framing and supports for mechanical and electrical equipment.

I. Other miscellaneous steel items indicated or as required for complete installation of indicated work.

J. Performance and design criteria for the delegated design for but not limited to the following:
   1. Supports for overhead doors and grilles.
   2. Elevator and machine hoist beam.

1.02 RELATED SECTIONS:

A. Section 03 30 00 - Cast-In-Place Concrete: Execution requirements for embedded anchors and attachments for metal fabrications specified by this section in concrete.

B. Section 05 12 00 - Structural Steel.

C. Section 05 21 00 - Steel Joists.

D. Section 05 31 13 - Steel Floor Decking.

E. Section 05 31 23 - Steel Roof Decking.

F. Section 09 90 00 - Painting and Coating: Field applied paint finishes.

1.03 REFERENCES

A. ASTM International:

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.

C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

E. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

F. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.

G. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

H. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.

I. ASTM F436 - Standard Specification for Hardened Steel Washers.
   1. American Welding Society:

J. AWS D1.1 - Structural Welding Code - Steel.
   1. SSPC: The Society for Protective Coatings:

K. SSPC-Paint 15 - Steel Joist Shop Paint.

L. SSPC-Paint 20 - Zinc-Rich Primers (Type I - Inorganic and Type II - Organic).

1.04 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal requirements.

B. Submit a Delegated-Design Submittal that includes the following, all of which shall be signed and sealed by the retained professional engineer:
   1. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
      a. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
      b. Design data: Submit drawings and supporting calculations, signed and sealed by a qualified professional structural engineer.
         1) Include the following, as applicable:
            (a) Design criteria.
            (b) Engineering analysis depicting stresses and deflections.
            (c) Member sizes and gauges.
            (d) Details of connections.
            (e) Support reactions.
            (f) Bracing requirements.

C. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

1.05 QUALIFICATIONS

A. Fabricator Qualifications: A firm experienced in producing metal fabrications 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.

B. Compliance Responsibility: The Contractor is responsible for ensuring compliance among suppliers, fabricators, and subcontractors.

C. Delegated Design Engineer: The Professional Engineer performing the delegated design shall be licensed in the State of Texas and shall have a minimum of five (5) years of experience in the design of structural metal fabrications and railing systems.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Accept metal fabrications on site in labeled shipments. Inspect for damage.

C. Protect metal fabrications from damage by exposure to weather.

1.07 FIELD MEASUREMENTS

A. Where metal fabrications 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.

B. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions. Allow for trimming and fitting.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

A. Steel Sections: ASTM A36/A36M.

B. Steel Plate: ASTM A36/A36M.

C. Hollow Structural Sections: ASTM A500, Grade B.

D. Steel Pipe: ASTM A53/A53M, Grade B Schedule 40. .

E. Sheet Steel: ASTM A653/A653M, Grade 33 Structural Quality with galvanized coating.

F. Bolts: ASTM A307; Grade A or B.

G. Nuts: ASTM A563 heavy hex type.

H. Washers: ASTM F436; Type 1.

I. Welding Materials: AWS D1.1; type required for materials being welded.

J. Shop Primer: SSPC-Paint 15, or manufacturer's standard primer complying with performance requirements of SSPC-Paint 15.

K. Touch-Up Primer: Match shop primer.

L. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20.

2.02 LOOSE LINTELS

A. Lintels: Steel sections, size and configuration as indicated on Drawings, length to allow 8 inches (203.2 mm) minimum bearing on both sides of opening.

B. Galvanize loose lintels installed in exterior walls.

2.03 BOLLARDS

A. Fabricate bollards from Schedule 80 steel pipe, size as indicated.

B. Standard Bollards: Fill with 3,000 psi (20684.28 kPa) concrete as specified in Section 03 30 00, with crowned cap.

C. Removable Bollards: Fabricate sleeves from Schedule 40 steel pipe or 1/4 inch (6.35 mm) wall thickness steel tubing with an ID 1/4 inch less than OD of bollards. Match drill sleeve and bollard for 1/2 inch (12.7 mm) steel machine bolt.

D. Cap removable bollards with 1/4 inch (6.35 mm) minimum steel plate. Do not fill with concrete.

2.04 STEEL LADDERS

A. General: Fabricate ladders for locations shown, with dimensions, spacings, details, and anchorages as indicated.

B. Comply with ANSI A14.3, unless otherwise indicated.

C. Provide hot-dip galvanizing after fabrication for exterior ladders.

D. For elevator pit ladders, comply with ASME A17.1.
   1. Unless detailed otherwise in the drawings, provide following fabrication:

E. Side Rails: Continuous 1/2 x 2-1/2 inch (64 mm) flat bars with eased edges, spaced 18 inches (457.2 mm) apart.
   1. Manufactured Bar Rungs: 1-inch round steel bars, spaced 12 inches (304.8 mm) o.c.
      a. Fit bar rungs in centerline of side rails; plug-weld and grind smooth on outer rail faces.
      b. Provide nonslip surfaces on top of each bar rung by light coating of abrasive material:
         1) Mebac Anti-Slip Coatings; IKG Borden www.ikgindustries.com
         2) SLIP-NOT; W. S. Molnar Company www.wsmolnar.com .
   2. Support each ladder at top and bottom and not more than 60 inches (1524 mm) o.c. with welded or bolted steel brackets. Size brackets to support design loads specified in ANSI A14.3.

2.05 STEEL SHIP'S LADDERS

A. Ship’s Ladders: Fabricate with structural steel channel stringers, steel pipe handrails, and steel bar grating treads with open risers, unless otherwise indicated. Provide brackets and fittings for installation.

B. Dimensions:
   1. Width: 36 inches (914.4 mm) or wider as indicated.
   2. Stringer depth: Minimum 10 inches (254 mm).
   3. Inclination: As indicated.

C. Treads: Minimum 7-in. wide galvanized steel bolt-on bar grate stair treads as manufactured by Borden or approved equivalent.
   1. Riser Height: Maximum 12 inches (304.8 mm) and minimum 9 inches (228.6 mm).

D. Railings: As specified in Section 05 52 00 - Metal Railings.

E. Galvanize ship's ladders, including brackets and fasteners, in exterior locations, and elsewhere where indicated.

2.06 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports that are not a part of structural steel framework as necessary to complete the Work.

B. Fabricate units from structural steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.

C. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors 1-1/4 inches (32 mm) wide by 1/4 inch (6.35 mm) thick by 8 inches (203.2 mm) long at 24 inches (609.6 mm) o.c., unless otherwise indicated.

D. Furnish inserts if units must be installed after concrete is placed.
   1. Operable Partitions: Fabricate supports for operable partitions of continuous steel shapes of sizes indicated, with attached bearing plates, anchors, and braces. Drill bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition shop drawings.

2.07 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Continuously seal joined members by continuous welds.

D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

F. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.08 FACTORY APPLIED FINISHES - STEEL

A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

B. Galvanizing: Hot-dip galvanize all items exposed to the exterior, ASTM A123/A123M, minimum 2.0 oz/sq ft coating thickness.

C. Galvanize after fabrication.

D. After galvanizing, fill vent holes and grind smooth

E. Do not apply galvanizing using double- dip or progressive processes without Architect's or Engineer's written approval.

F. Galvanizing for Fasteners, Connectors, and Anchors:
1. Hot-Dipped Galvanizing: ASTM A153/A153M.
2. Mechanical Galvanizing: ASTM B695; Class 50 minimum.
3. Prime paint items with one coat except where galvanizing or stainless steel to remain unpainted is indicated.

G. Do not prime surfaces in direct contact with concrete or where field welding is required.

H. Do not prime surfaces in direct contact with concrete or where field welding is required.

I. Typical: For items indicated to receive typical interior or exterior acrylic or alkyd finish paint, use Red Oxide or High-performance, lead-and-chromate-free, rust-inhibitive primer compatible with specified finish coatings. Verify compatibility with specified finish paint.

J. Epoxy: For items to receive urethane alkyd enamel, use two-package epoxy primer after power wire-brushing or sandblasting all surfaces to bright steel.

2.09 FABRICATION TOLERANCES

A. Squareness: 1/8 inch (3.18 mm) maximum difference in diagonal measurements.

B. Maximum Offset Between Faces: 1/16 inch (1.59 mm).

C. Maximum Misalignment of Adjacent Members: 1/16 inch (1.59 mm).

D. Maximum Bow: 1/8 inch (3.18 mm) in 48 inches (1219.2 mm).

E. Maximum Deviation From Plane: 1/16 inch (1.59 mm) in 48 inches (1219.2 mm).

PART 3 EXECUTION

3.01 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify field conditions are acceptable and are ready to receive Work.

3.02 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Supply steel items required to be cast into concrete or embedded in masonry with setting templates to appropriate sections.

3.03 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Make provisions for erection stresses. Install temporary bracing to maintain alignment, until permanent bracing and attachments are installed.

C. Field weld components indicated on shop drawings.

D. Perform field welding in accordance with AWS D1.1.

E. Obtain approval of Architect/Engineer prior to site cutting or making adjustments not scheduled.

F. After erection, touch up welds, abrasions, and damaged finishes with prime paint or galvanizing repair paint to match shop finishes.

G. Grind field welds smooth and flush; apply zinc-rich galvanizing repair paint to match shop-applied finish in accordance with ASTM A780

3.04 ERECTION TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Maximum Variation From Plumb: 1/4 inch (6.35 mm) per story or for every 12 ft in height whichever is greater, non-cumulative.

C. Maximum Offset From Alignment: 1/4 inch (6.35 mm).

D. Maximum Out-of-Position: 1/4 inch (6.35 mm).

END OF SECTION

SECTION 05 51 00

METAL STAIRS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Steel stair frame of structural sections, with closed risers and pan to receive concrete fill.
      a. Metal nosings at stairs with clear tread coating finish.
      b. Perforated steel sheet at risers where indicated.
   2. Delegated design of the complete metal stair system, including anchorage to the primary building structure.

B. Related Sections:
   1. Section 03 30 00 - Cast-In-Place Concrete: Concrete fill in stair pans and landings.
   2. Section 05 52 00 - Metal Railings: Railing systems related to metal stairs.
   3. Section 05 73 00 - Glazed Decorative Metal Railings.
   4. Section 09 61 50 - Concrete Floor Clear Finish: Stair tread finish.
   5. Section 09 65 00 - Resilient Flooring and Base: Stair tread finish.
   6. Section 09 90 00 - Painting and Coating: Paint finish.

1.02 REFERENCES

A. ASTM International:
   1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
   2. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
   3. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
   4. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
   5. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.
   6. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy
   7. ASTM A1008 - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
   8. ASTM F436 - Standard Specification for Hardened Steel Washers.

B. American Welding Society:
   1. AWS D1.1 - Structural Welding Code - Steel.

C. National Association of Architectural Metal Manufacturers:
   1. NAAMM AMP 510 - Metal Stairs Manual.

D. SSPC: The Society for Protective Coatings:

1. SSPC-Paint 15 - Steel Joist Shop Paint.
2. SSPC-Paint 20 - Zinc-Rich Primers (Type I - Inorganic and Type II - Organic).

1.03 DESIGN REQUIREMENTS

A. Fabricate stair assembly to support uniform live load of 100 lb/sq ft and concentrated load of 300 lb/sq ft with deflection of treads, stringers, or landings not to exceed L/360.

B. Where local building codes exceed the above design requirements, provide the most stringent.

1.04 PERFORMANCE REQUIREMENTS

A. Delegated Design: The design of the complete metal stair system, including but not limited to, stair stringers, treads, risers, platforms, landings, support framing, guardrails, handrails, and anchorage to the primary building structure, shall be the responsibility of the Contractor.

B. The Contractor shall retain a qualified professional engineer, licensed in the project's jurisdiction, to perform the delegated design and provide all necessary engineering calculations and sealed drawings.

C. Performance Criteria: Design and size components to comply with all applicable requirements of the governing building code.
   1. Design Loads: At a minimum, design the stair system to support:
      a. A uniform live load of 100 psf on all treads and platforms.
      b. A concentrated load of 300 pounds applied over a 4-square-inch area on any tread or platform, whichever condition produces greater stress.
   2. Guardrail and Handrail Loads: Design guardrails and handrails to resist a minimum uniform load of 50 plf or a 200 pound concentrated load applied in any direction, in accordance with the building code.

D. Deflection Limits:
   1. Stair Assembly: Limit deflection of stringers, treads, and platforms under the specified live load to L/360 of the span.
   2. Tread Deflection: Limit deflection of individual treads under a 300-pound concentrated load to 1/8 inch or L/240, whichever is less.
   3. Guardrail Assembly: Limit deflection of guardrail members and attachments under specified loads in accordance with building code requirements.

1.05 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal requirements.

B. Submit a Delegated-Design Submittal that includes the following, all of which shall be signed and sealed by the retained professional engineer:
   1. Engineering Calculations:
      a. Provide comprehensive engineering analysis and calculations verifying compliance with all specified performance criteria and the governing building code.
      b. Calculations must demonstrate the structural adequacy of all components and anchorage to support specified design loads, including uniform, concentrated, and guardrail/handrail loads.
   2. Shop Drawings

a. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
b. Connection design including fasteners, clips, anchors and all other related aspects of the stair design.
c. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
d. Comply with all applicable model code required design loads.
e. Shop drawings shall be signed and sealed by a professional engineer licensed to practice in the state of Texas. Submit design calculations.

C. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months

1.06 QUALIFICATIONS

A. Prepare Shop Drawings under direct supervision of Professional Engineer experienced in design of this Work and in the State of Texas.

1.07 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Alfab, Inc.; www.alfabinc.com

B. American Stair, Inc.; www.americanstair.com

C. The Sharon Companies, Ltd.; www.sharoncompanies.com

D. Substitutions: Section 01 60 00 - Product Requirements.

2.02 COMPONENTS

A. General: Steel components shall contain not less than 28% recycled steel.

B. Steel Sections: ASTM A36/A36M.

C. Steel Plate: ASTM A36/A36M.

D. Hollow Structural Sections: ASTM A500, Grade B.

E. Steel Pipe: ASTM A53/A53M, Grade B Schedule 40.

F. Sheet Steel:
1. Commercial Quality: ASTM A569/A569M, uncoated cold rolled steel sheet.
2. Structural Quality: ASTM A570/A570M, Grade 30 (unless higher grade is required by design loads) uncoated cold rolled steel sheet

G. Welded Wire Fabric: ASTM A185, 6 x 6 W1.4 x W1.4.

H. Bolts: ASTM A307; Grade A or B.

I. Nuts: ASTM A563 heavy hex type.

J. Washers: ASTM F436; Type 1.

K. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; consistent with design of stair structure.

L. Welding Materials: AWS D1.1; type required for materials being welded.

M. Concrete: Type specified in Section 03 30 00.

N. Shop Primer: SSPC-Paint 15, Type 1, red oxide.
   1. Touch-Up Primer: Match shop primer.

O. Abrasive Nosings: Single-stage surface-mount type meeting requirements of ASTM B221
   1. Provide at stairs with clear finish coating at stair treads.
   2. Black aluminum oxide abrasive strips set in 3-inches wide x 1/4-inches x continuous mill finish extruded aluminum plate with integral turn-down nosing. Provide (5) abrasive strips with a total combined width of not less than 1-inch.
   3. Basis-of-Design: No. A3D mechanically-fastened as manufactured by Babcock-Davis or approved equivalent by Balco.
   4. Predrill for flat-head flush expansion anchors set no more than 3” from each end and maximum 15” O.C.; designed for post-installation on concrete-filled metal pan stair treads. Coordinate installation with concrete polishing contractor.
   5. Each nosing shall be in one-piece section and shall run from stringer to stringer.

2.03 SPECIALTIES

A. Perforated Steel Sheet Riser Infill
   1. Type: Minimum 16 ga. steel sheet with round-hole perforations. Provide as infill at open risers where indicated.
   2. Perforation Pattern: Maximum 1/8-inch diameter holes with a maximum 20% open area.
   3. Finish: Powder coat finish, shop applied. Color as selected by the Architect.
   4. Mounting Accessories: As indicated in the drawings.
   5. Manufacturers:
      a. McNichols Co.; www.mcnichols.com.
      b. Substitutions: Section 01 60 00 - Product Requirements.

2.04 FABRICATION - GENERAL

A. Comply with NAAMM AMP 510, "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" for Commercial Class, unless more stringent requirements are indicated.

B. Preassemble stairs in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

C. Fabricate components with joints tightly fitted and secured.

D. Continuously seal joined pieces by continuous welds.

E. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

F. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

G. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

H. Accommodate for expansion and contraction of members and building movement without damage to connections or members.

I. Fabricate treads and platforms of exterior stairs so finished walking surfaces slope to drain at slope not to exceed 1/4 inch (6.35 mm) per foot.

2.05 FABRICATION - PAN STAIRS AND LANDINGS

A. Fabricate stairs and landings with closed risers and treads of metal pan construction, ready to receive concrete.

B. Form treads and risers with minimum 14 gage sheet steel stock.

C. Secure tread pans to stringers with clip angles welded in place.

D. Form stringers with rolled steel channels or rectangular hollow sections, minimum 12 inches (304.8 mm) deep. Close exposed ends of channels and tubes with minimum 14 gage steel sheet.

E. Form landings with minimum 14 gage sheet stock. Reinforce underside with angles to attain design load requirements.

2.06 SHOP FINISHING

A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

B. Shop prime metal stairs. Do not prime surfaces that will be embedded in concrete or masonry.

PART 3 EXECUTION

3.01 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify field conditions are acceptable and are ready to receive work. Verify concealed blocking and reinforcement is installed and correctly located to receive wall mounted handrails.

3.02 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Supply items required to be cast into concrete and or embedded in masonry with setting templates.

C. Confirm field-applied paint system is compatible with shop primer specified in this section.

3.03 INSTALLATION

A. Install components plumb and level, accurately fitted, free from distortion or defects.

B. Install anchors, plates, angles, hangers, and struts required for connecting stairs to structure.

C. Allow for erection loads. Install sufficient temporary bracing to maintain framing safe, plumb, and in alignment.

D. Clean and strip primed steel items to bare metal where site welding is required.

E. Field weld components indicated on shop drawings. Perform field welding in accordance with AWS D1.1.

F. Field bolt and weld to match shop bolting and welding. Conceal bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.

G. Mechanically fasten joints butted tight, flush, and hairline. Grind welds smooth and flush.

H. Obtain approval of Architect/Engineer prior to site cutting or creating adjustments not scheduled.

I. After erection, prime welds, and abrasions, except surfaces to be in contact with concrete.

3.04 ERECTION TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Maximum Variation From Plumb: 1/4 inch (6.35 mm) per story, non-cumulative. Maximum Variation From Plumb: 1/8 inch (3 mm) in 10 feet (3 m), non-cumulative at stairs with Glazed Decorative Metal Railings.

C. Maximum Offset From Alignment: 1/4 inch (6.35 mm).

3.05 PROTECTION AND COMPLETION

A. Protect steel tread pans during construction. Provide tight-fitting temporary plywood or solid lumber tread infill boards of sufficient thickness to protect against damage to tread pan edges if concrete infill is delayed.

B. Just prior to concrete infill of tread pans, remove any loose rust at pan bottoms and clean thoroughly.

C. Metal Nosings:

1. Install specified metal nosing on cured concrete infill using flat-head flush expansion bolts. Set nosing on cured concrete tread using 2-part epoxy and apply weight to nosing during curing of epoxy.
    a. Where underside of stairs is concealed, or if specifically approved by the Architect, drill through concrete infill and tread pan to install through-bolts with lock-washers and nuts in lieu of expansion bolts. Ping threads or spot weld nuts to bolts after installation.
    b. Keep traffic off of stairs until completed installation of nosing.
2. Prior to nosing installation coordinate with finish tile installer to ensure flush condition at tile interface of tile and nosing plate.
    a. Where installed tile thickness will exceed thickness of nosing plate, provide 2-1/2” wide X min. 14-ga. continuous galvanized sheet steel shimming plate(s) under nosing plate prior to installing expansion bolts to ensure flush condition at tile interface.
    b. Provide epoxy adhesive between shimming and concrete tread infill, between each shimming plate, and between shimming and bottom of nosing plate.

END OF SECTION

SECTION 05 52 00

METAL RAILINGS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Shop-primed steel railings, ready for finish field painting.
   2. Aluminum handrails.
   3. Stainless steel handrails and railings as defined by material and finish standards in Section 05 73 00.
   4. Delegated design of the complete railing system, including all components, connections, and anchorage.

B. Related Sections:
   1. Section 03 30 00 - Cast-In-Place Concrete: Execution requirements for placement of anchors specified in this section in concrete.
   2. Section 04 20 00 - Unit Masonry Assemblies: Execution requirements for placement of anchors specified in this section in masonry.
   3. Section 05 51 00 - Metal Stairs.
   4. Section 05 73 00 - Glazed Decorative Metal Railings: Technical requirements for stainless steel alloys, finishes, and fabrication.
   5. Section 09 21 16 - Gypsum Board Assemblies: Execution requirements for placement of anchors specified in this section in stud wall construction.
   6. Section 09 90 00 - Painting and Costing: Paint finish.

1.02 REFERENCES

A. AAMA - American Architectural Manufacturers Association (www.aamanet.org).
   1. AAMA 611 - Voluntary Standards for Anodized Architectural Aluminum; 1998.
   2. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels; 2011 (Testing based on 2005 Edition).

B. ASTM International:
   1. ASTM B241/B241m-22 – Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.
   2. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
   3. ASTM B221-12 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

C. SSPC: The Society for Protective Coatings:
   1. SSPC Paint 15 - Shop Painting.

1.03 DESIGN REQUIREMENTS

A. Design handrail, guardrail, and attachments to resist forces as required by applicable code. Apply loads non-simultaneously to produce maximum stresses.
   1. Guard Top Rail and Handrail Concentrated Load: 200 pounds applied at any point in any direction.
   2. Guard Top Rail Uniform Load: 50 plf applied in any direction.
   3. Intermediate Rails, Panels, and Baluster Concentrated Load: 50 pounds applied to 1 sf area.

B. Performance Requirements: The Professional Engineer shall design the complete metal railing system, including all members, connections, and anchorage to the building structure, to comply with the code requirements referenced on Drawings, and to resist the following loads:
   1. Guard Top Rail and Handrail Concentrated Load: 200 pounds applied at any point in any direction.
   2. Guard Top Rail Uniform Load: 50 plf applied in any direction.
   3. Intermediate Rails, Panels, and Baluster Concentrated Load: 50 pounds applied to a 1 sq. ft. area.

C. Deflection Limits: Design the system to not exceed the following deflection limits when subjected to design loads:
   1. Top Rail (Vertical and Horizontal): Deflection shall not exceed L/120 between posts, or 1/2 inch (13 mm), whichever is less.
   2. Pickets/Balusters (Horizontal): Deflection shall not exceed L/120 or 1/2 inch (25 mm).

D. Anchorage Design: The Professional Engineer shall design all anchorage (e.F., post base plates, anchor bolts, and connections to building structure) to resist the applied loads. Design shall account for the specific substrate (e.g., concrete, steel, or masonry) at each connection point.

1.04 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal requirements.

B. Delegated Design Submittals:
   1. Shop Drawings: In addition to fabrication details, shop drawings shall bear the seal and signature of the responsible Professional Engineer.
   2. Structural Calculations: Submit comprehensive structural calculations, signed and sealed by the Professional Engineer, demonstrating compliance with all specified performance requirements and governing codes. Calculations shall include analysis of:
      a. All railing members (top rails, posts, intermediate rails).
      b. All connections (welds and mechanical fasteners).
      c. Anchorage details, including base plate analysis, anchor bolt selection, and embedment depth.

C. Samples:
   1. Submit one 6” x 6” sample of perforated clear anodized aluminum infill panel.
   2. Provide on-site mock-up of decorative steel railing section with finish painted steel and clear anodized perforated infill panel. Mock-up shall be full size and include at least 2 vertical supports and one infill panel. Mock-up may be utilized in the permanent construction if approved.

D. Product Data: Submit manufacturer's data for wall brackets.

1.05 QUALIFICATIONS

A. Delegated Design Engineer: The Professional Engineer performing the delegated design shall be licensed in the State of Texas and shall have a minimum of five (5) years of experience in the design of structural metal fabrications and railing systems.

B. Fabricator: Firm with a minimum of five (5) years of experience in fabricating railing systems of the type and complexity required for this Project.

1.06 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.01 STEEL RAILING SYSTEM COMPONENTS

A. Tubing: ASTM A513, Type 5, minimum 50 ksi yield strength.

B. Shapes, Plates, and Bars: ASTM A36/A36M.

C. Hollow Structural Sections: ASTM A500, Grade B.

D. Pipe: ASTM A53/A53M, Grade B, Schedule 40.

E. Fittings: Elbows, T-shapes, wall brackets, escutcheons; cast steel.

F. Splice Connectors: Steel welding collars.

G. Shop Primer: SSPC Paint 15, Type 1, red oxide.

H. Touch-Up Primer: Match shop primer.

2.02 ALUMINUM RAILING SYSTEM COMPONENTS

A. Pipe: Extruded aluminum, Schedule 40 Extruded Aluminum: ASTM B221; 6063 alloy, T5 temper typical, 6061 alloy, T6 temper for extruded structural members.

B. Fittings: Elbows, T-shapes, wall brackets, escutcheons; cast aluminum.

C. Splice Connectors: Welding collars; cast aluminum.

D. Interior Aluminum Surfaces: AAMA A41 anodized, prepared with mechanical pre-treatment, clear anodized.

E. Extruded Aluminum: ASTM B221; 6063 alloy, T5 temper typical, 6061 alloy, T6 temper for extruded structural members.

F. Apply one coat of bituminous paint to concealed aluminum surfaces in contact with cementitious or dissimilar materials.

2.03 STAINLESS STEEL RAILING COMPONENTS

A. Material and Finish Standards:
   1. Provide stainless steel tubing, pipe, and fittings complying with the alloy and mechanical finish requirements specified in Section 05 73 00.
   2. Alloy: Type 304 stainless steel.
   3. Finish: NAAMM No. 4 directional satin finish.

B. Fabrication:
   1. Fabricate stainless steel components using shop-welded connections in accordance with Section 05 73 00.
   2. Field welding of stainless steel is prohibited.

2.04 MISCELLANEOUS COMPONENTS

A. Exposed Fasteners: Flush countersunk screws or bolts; consistent with design of railing.

B. Cast-in-Place and Post-installed Anchors: Anchors of type indicated below, fabricated from corrosion-resistant materials with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete.
   1. Cast-in-place anchors.
   2. Chemical anchors.
   3. Expansion anchors.

C. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, non-staining, noncorrosive, nongaseous grout complying with ASTM C1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

D. Brackets, Flanges, and Anchors: Cast or formed metal of same material and finish as supported rails, unless otherwise indicated.
   1. Manufacturers: Julius Blum and Co. www.juliusblum.com

2.05 FABRICATION

A. Preassemble handrails and railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

B. Form changes in direction of railing members as follows:
   1. By flush radius bends.
   2. By inserting prefabricated flush-elbow fittings.

C. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail and railing components.

D. Fabricate components with joints tightly fitted and secured. Furnish spigots and sleeves to accommodate site assembly and installation.

E. Fasteners for Interconnecting Handrail and Railing Components: Use fasteners fabricated from same basic metal as fastened metal, unless otherwise indicated. Do not use metals that are corrosive or incompatible with materials joined.
   1. Provide concealed fasteners for interconnecting handrail and railing components and for attaching them to other work, unless otherwise indicated.
   2. Provide Phillips flat-head machine screws for exposed fasteners, unless otherwise indicated.

F. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect handrail and railing members to other work, unless otherwise indicated.

G. For railing posts set in concrete, provide preset sleeves of steel not less than 6 inches (152.4 mm) long with inside dimensions not less than 1/2 inch (12.7 mm) greater than outside dimensions of post, and steel plate forming bottom closure.

H. For removable railing posts, fabricate slip-fit sockets from steel tube whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height. Provide socket covers designed and fabricated to resist being dislodged.

I. Close exposed ends of handrail and railing members with prefabricated end fittings.

J. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated. Close ends of returns, unless clearance between end of railing and wall is 1/4 inch (6.35 mm) or less.

K. Exterior Components: All exterior steel components shall be hot-dip galvanized. Provide shop painting where final finish is field painting. Continuously seal joined pieces by continuous welds. Drill condensate drainage holes at bottom of members at locations not encouraging water intrusion.

L. Interior Components: Continuously seal joined pieces by continuous welds.

M. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

N. Accurately form components to fit stairs and landings, each other, and building structure.

O. Accommodate for expansion and contraction of members and building movement without damage to connections or members.

2.06 FINISHES

A. Anodize all aluminum railings and hardware after fabrication. Provide matching anodized aluminum fittings, brackets, fasteners, sleeves, and other components unless indicated otherwise in the drawings.
   1. Clear Anodic Finish: AA-M12C22A31 (Mech. Finish): nonspecular as fabricated; Chemical Finish: etched, medium matte; anodic coating: Architectural Class I, clear coating 0.7 mil (0.01778 mm) or thicker) complying with AAMA 607.1 and AAMA 611.

B. Shop prime all steel components where final finish is field painting.

PART 3 EXECUTION

3.01 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify field conditions are acceptable and are ready to receive work.

C. Verify concealed blocking and reinforcement is installed and correctly located to receive wall mounted handrails.

3.02 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Supply items required to be cast into concrete, embedded in masonry, or placed in partitions with setting templates.

3.03 INSTALLATION

A. Install components plumb and level, accurately fitted, free from distortion or defects.

B. Set embedded posts in pipe sleeves and fill space between post and sleeve with nonshrink grout.

C. Fit exposed connections together to form tight, hairline joints.

D. Anchor railings to structure.

E. Field weld anchors as indicated on shop drawings. Touch-up welds with primer. Grind welds smooth.

F. Conceal bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.

G. Assemble tube rails with sleeves to accommodate tight joints and secure installation.

H. Attach handrails to wall with wall brackets. Provide bracket with 1-1/2-inch clearance from inside face of handrail and finished wall surface.
   1. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
   2. Secure wall brackets to building construction as follows:
      a. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
      b. For hollow masonry anchorage, use toggle bolts.
      c. For steel-framed gypsum board assemblies, use hanger or lag bolts set into wood backing between studs. Coordinate with stud installation to locate backing members.

3.04 INSTALLATION - STAINLESS STEEL

A. Coordination: Coordinate with Section 09 21 16 and Section 06 10 53 to ensure internal wall blocking is correctly located for handrail brackets.

B. Mounting: Secure wall brackets to building construction using fasteners appropriate for the substrate as specified in Section 05 73 00.

C. General: Install stainless steel railings in accordance with the quality standards and tolerances defined in Section 05 73 00 and this Section.

D. Protection: Apply strippable temporary protective covering to all exposed stainless steel surfaces prior to shipment to the project site. Maintain factory-applied protective coverings until Substantial Completion to prevent "tea-staining" or construction damage.

3.05 ERECTION TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Maximum Variation From Plumb: 1/4 inch (6.35 mm) per story, non-cumulative.

C. Maximum Offset From Alignment: 1/4 inch (6.35 mm).

D. Maximum Out-of-Position: 1/4 inch (6.35 mm).

END OF SECTION

SECTION 05 73 00

GLAZED DECORATIVE METAL RAILINGS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Post-supported stainless steel railing system with custom specialty glass infill.
   2. Delegated design of structural glass railing system, including all components and anchorage.

B. Related Sections:
   1. Section 05 51 00 - Metal Stairs: Steel stair stringers, treads, and risers.

1.02 REFERENCES

A. American National Standards Institute (ANSI) (www.ansi.org)
   1. Z97.1 - Safety Performance Specifications and Methods of Test for Safety Glazing Material Used in Buildings.

B. ASTM International (ASTM) (www.astm.org):
   1. A240/A240M – Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
   2. A554 - Standard Specification for Welded Stainless Steel Mechanical Tubing.
   3. C1048 - Standard Specification for Heat-Treated Flat Glass-Kind HS, Kind FT, Coated and Uncoated Glass.
   4. E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings.

C. National Association of Architectural Metal Manufacturers (NAAMM) (www.naamm.org)
   1. AMP 503 - Finishes for Stainless Steel.

1.03 DEFINITIONS

A. Railings: Guards, handrails, and similar devices used for protection of occupants at open-sided floor areas, pedestrian guidance and support, visual separation, or wall protection.

1.04 PERFORMANCE REQUIREMENTS

A. Structural Performance: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
   1. Handrails:
      a. Uniform load of 50 lbf/ft. applied in any direction.
      b. Concentrated load of 200 lbf applied in any direction.
      c. Uniform and concentrated loads need not be assumed to act concurrently.
   2. Glazing Infill:

a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
b. Infill load and other loads need not be assumed to act concurrently.

1.05 SUBMITTALS

A. NAAMM AMP 503 manufacturer's product lines of railings assembled from standard components.

B. Grout, anchoring cement, and paint products.

C. Delegated-Design Submittal: For manufactured glazed infill metal railings, provide connection design including fasteners, clips, anchors and all other related aspects of the framing design: comply with all applicable code-required design loads. Include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

D. Samples for Initial Selection: For products involving selection of color, finish, or design, including mechanical finishes.

E. Samples for Verification: For each type of exposed finish required.
1. Sections of each distinctly different linear railing member, including handrails, top rails, and posts.
2. Nominal 2 feet (60.96 cm) x 2 ft. laminated glazing panel including approved design for interlayer film.
3. Fittings and brackets.
4. Welded connections.
5. Assembled Samples of railing systems, made from full-size components, including top rail, post, handrail, and infill. Show method of finishing members at intersections. Samples need not be full height.

F. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.
1. Welding certificates.
2. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E894 and ASTM E935.

1.06 QUALITY ASSURANCE

A. Delegated Design Engineer: The Professional Engineer performing the delegated design shall be licensed in the State of Texas and shall have a minimum of five (5) years of experience in the design of structural metal fabrications and railing systems.

B. Source Limitations: Obtain each type of railing from single source from single manufacturer.

C. Installer Qualifications: Minimum 5-years’ experience in installation of work of this section and similar scope.

D. Product Options: Drawings indicate size, profiles, and dimensional requirements of railings and are based on the specific system indicated. Refer to Section 01 60 00 "Product Requirements."

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

E. Retain "Welding Qualifications" Paragraph below if shop or field welding is required. If retaining, also retain "Welding certificates" Paragraph in "Informational Submittals" Article.

F. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.6, "Structural Welding Code - Stainless Steel."

G. Safety Glazing Labeling: Permanently mark glass 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.

H. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
1. Build mockups for each form and finish of railing consisting of panel base, infill panel, top channel, and anchorage system components that are full height and are not less than 48-inches in length.
2. Locate mockups as directed by Architect.

I. Preinstallation Conference: Conduct conference at Project site.

1.07 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication and indicate measurements on Shop Drawings.

1.08 COORDINATION AND SCHEDULING

A. Coordinate installation of anchorages for railings. 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.

B. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not suit structural performance requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. C.R Laurence Co., Inc.; www.crlaurence.com
2. Viva Railings; www.vivarailings.com
3. Livers Bronze Co.; www.liversbronze.com
4. P & P Artec.; www.artec-rail.com
5. Shickel Corporation., www.shickel.com

6. Tri Tech, Inc., www.tritechhandrails.com

B. Basis-of-Design: Modified *SOLO Fascia Overlay System* as manufactured by VIVA with custom decorative laminated glass or approved equivalent system by specified manufacturer.

C. Reference drawings for any custom features varying from manufacturer's standard design.

2.02 COMPONENTS

A. General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Stainless Steel:
1. Shapes: ASTM A240/A240M, Series 300.
2. Tube: ASTM A554, Series 300.
3. Finish: No. 4, 380 grit per NAAMM AMP 503.

C. Mounting Base
1. System manufacturer's cast aluminum 4-1/2" high X 2-7-8" wide X continuous Shoe Base anchored to steel stair channels as indicated.
a. Base designed to clamp glazing panel edges within continuous 1" open gap.
b. Provide cut-to-fit neoprene or clear nylon pressure pads between metal and glass.

D. Glazing Infill Panels – Tempered and laminated glazing as engineered by the system manufacturer:
1. Type: Tempered and laminated glazing as engineered by the system manufacturer:
a. 2 lites of minimum 1/4-inch thick clear tempered glass. Provide greater thickness where recommended by Engineer of Record.
b. Plastic Interlayer Film: Color matching Guardian's *LamiGlass Deep Red.* Thickness as recommended by system manufacturer.
c. Total Thickness: Minimum 9/16-inch.
d. Vertical Joints: 1/2" uniform gap open joints spaced as indicated, 5'-0" maximum.
2. Top Cap: System manufacturer's 1" high stainless steel inverted "U" cap, set over top edge of glass with manufacturer's recommended elastomeric adhesive. Run cap continuously over top glass edge and joint gaps. Provide tight hairline joints where a single length cannot be provided.
3. Handrailing:
a. 1.5-inch outside-diameter stainless steel round tubing.
b. Provide In longest practicable lengths between in-line joints.

2.03 WALL MOUNTED STAINLESS STEEL COMPONENTS

A. Wall-Mounted Handrails: 1.5-inch outside-diameter stainless steel round tubing, Type 304, with No. 4 finish.

B. Mounting Brackets: Series 300 stainless steel wall brackets with concealed anchorage, providing 1-1/2 inch clearance from finished wall.

2.04 ACCESSORIES

A. Connector Bolts and Anchors: Series 300 stainless steel bolts, washers, and nuts as part of manufacturer's system.

B. Handrail Brackets: Series 300 stainless steel.

2.05 STAINLESS STEEL

A. Tubing: ASTM A554, Grade MT 304.

B. Pipe: ASTM A312/A312M, Grade TP 304.

C. Castings: ASTM A743/A743M, Grade CF 8 or CF 20.

D. Sheet, Strip, Plate, and Flat Bar: ASTM A 666, Type 304.

E. Bars and Shapes: ASTM A 276, Type 304.

2.06 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Form work true to line and level with accurate angles and surfaces.

D. Connections: Fabricate railings with shop welded connections unless otherwise indicated.

E. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove flux immediately.
   4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 welds: no evidence of a welded joint.

F. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
   1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.

G. Form changes in direction as follows:
   1. By bending to smallest radius that will not result in distortion of railing member.

H. Bend railing members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

I. Close exposed ends of hollow railing members with prefabricated end fittings.

J. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns, unless clearance between end of rail and wall is 1/4 inch (6.35 mm) or less.

K. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
   1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers, or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

L. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

2.07 GLAZING PANEL FABRICATION

A. Fabricate laminated panels to sizes and shapes required; provide for proper edge clearance on glazing panels.

B. Grind and polish smooth exposed edges, including those at open joints, to produce square edges with slight chamfers at junctions of edges and faces.

2.08 GENERAL FINISH REQUIREMENTS

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 shipment.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. 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. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

E. Stainless Steel and Aluminum Finishes:
   1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
   2. Directional Finish: Grind and polish surfaces to produce uniform finish, free of cross scratches. Run grain of directional finishes with long dimension of each piece to provide No. 6. satin finish.
   3. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
   1. Do not field weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
   2. Set vertical railings and panels plumb within a tolerance of 1/16-inch in 3-feet.
   3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch (6.35 mm) in 12 feet (365.76 cm).

C. Adjust railings before anchoring to ensure matching alignment at abuttin

D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.02 RAILING CONNECTIONS

A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.

B. Welded Connections: Field welding not allowed.

C. Expansion Joints: Install expansion joints at locations required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches (50.8 mm) beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches (152.4 mm) of post.

3.03 ANCHORING TURN-DOWN POSTS

A. Anchor any turned-down posts to concrete floor slab with floor flanges with welded stub pipe to extend into railing turn-down. Fasten with flush stainless steel machine screw threaded through post and into stub pipe.

3.04 ATTACHING WALL RAILINGS

A. Attach handrails to walls with wall brackets. Provide brackets with 1-1/2-inch clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

B. Use type of bracket with flange tapped for concealed anchorage.

C. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

D. Secure wall brackets to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.
3. For steel-framed partitions, use hanger or lag bolts set into wood backing between studs. Coordinate with stud installation to locate backing members.

3.05 INSTALLING GLASS PANELS

A. Install railing system in accordance with railing manufacturer's written instructions and approved Shop Drawings.

B. Install all panels plumb, and panels at landings plumb and level. Panels shall be accurately fitted, free from distortion and defects. Keep open joints uniform in dimension.

C. Do not cut, drill, or alter glass panels in field. Protect edges from damage.

3.06 CLEANING

A. Clean stainless steel by washing thoroughly with clean water and soap, rinsing with clean water, and wiping dry.

B. Clean and polish glass as recommended in writing by manufacturer. Wash both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion.

3.07 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units. Glazing panels with edge damaged shall be replaced with new matching panels.

END OF SECTION

SECTION 06 10 53

MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:
   1. Blocking in wall and roof openings.
   2. Plywood sheathing.
   3. Wood furring and grounds.
   4. Concealed wood blocking for support of toilet accessories, wall cabinets, handrails, and other wall-mounted items.
   5. Telephone and electrical panel back boards.
   6. Fire retardant and preservative treatment of wood.

1.02 REFERENCES

A. American Forest and Paper Association:
   1. AF&PA - National Design Specifications for Wood Construction.

B. American Wood-Preservers' Association:
   1. AWPA U1 - User Specification for Treated Wood.
   2. ASTM International:
   3. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

C. Southern Pine Inspection Bureau:
   1. SPIB - Standard Grading Rules for Southern Pine Lumber.

D. U.S. Department of Commerce National Institute of Standards and Technology:
   1. DOC PS 1 - Construction and Industrial Plywood.
   2. DOC PS 2 - Performance Standard for Wood-Based Structural-Use Panels.
   3. DOC PS 20 - American Softwood Lumber Standard.

E. West Coast Lumber Inspection Bureau:
   1. WCLIB - Standard Grading Rules for West Coast Lumber.

F. Western Wood Products Association:
   1. WWPA G-5 - Western Lumber Grading Rules.

1.03 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit technical data on wood preservative and fire retardant treatment materials and application instructions.

1.04 QUALITY ASSURANCE

A. Perform Work in accordance with the following:
   1. Lumber Grading Agency: Certified by DOC PS 20.
   2. Plywood Grading Agency: Certified by EWA - The Engineered Wood Association.
   3. Lumber: DOC PS 20.
   4. Plywood: DOC PS 1 or DOC PS 2.

B. Surface Burning Characteristics:
   1. Fire Retardant Treated Materials: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

C. Apply label from agency approved by authority having jurisdiction to identify each preservative treated and fire-retardant treated material.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Lumber Grading Rules: AF&PA, SPIB, WCLIB, WWPA G-5.

B. Miscellaneous Framing: Southern pine, mixed southern pine or spruce-pine-fir species; 19 percent maximum moisture content.

C. Plywood: APA/EWA; southern pine or Douglas fir species; 1/2 inch thick, minimum.

2.02 ACCESSORIES

A. Fasteners and Anchors:
   1. Fasteners: Hot dipped galvanized steel for high humidity and treated wood locations, unfinished or cadmium plated steel elsewhere.
   2. Nails and Staples: ASTM F1667.
   3. Anchors:
      a. Toggle bolt type for anchorage to hollow masonry.
      b. Expansion shield and lag bolt type for anchorage to solid masonry or concrete.
      c. Bolt or ballistic fastener for anchorages to steel.

2.03 FACTORY WOOD TREATMENT

A. Preservative Treatment: AWPA U1, Use Category UC2; using inorganic boron (SBX) preservative with 0.25 percent retainage.

B. Fire Retardant Treatment: AWPA U1, Use Category UCFA for interior use, and UCFB for exterior use; chemically treated and pressure impregnated.

C. Moisture Content after Treatment:
   1. Lumber: Maximum 19 percent.
   2. Plywood: Maximum 15 percent.

2.04 FIELD WOOD TREATMENT

A. Preservative Treatment: Brush applied inorganic boron solution, with minimum concentration of 1.5 percent.

B. Touch-up cut wood ends.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify substrate conditions are ready to receive blocking, curbing and framing.

3.02 PREPARATION

A. Coordinate placement of blocking, curbing and framing items.

3.03 INSTALLATION

A. Set members level and plumb, in correct position.

B. Place horizontal members, crown side up.

C. Construct curb members of solid wood sections.

D. Curb roof openings except where prefabricated curbs are provided. Form corners by alternating lapping side members.

E. Coordinate curb installation with installation of decking and support of deck openings.

F. Secure sheathing to framing members with ends over firm bearing and staggered.

G. Install plywood parapet sheathing using 1/- inch thick plywood. Space panels 1/8 inch apart at edges and ends.

H. Install telephone and electrical panel back boards using 3/4 inch thick plywood. Size back boards 12 inches beyond size of electrical and telephone panel, or as indicated on Drawings.

3.04 SCHEDULE OF WOOD TREATMENT

A. Note: The term “Treated” as may be used on the drawings for wood products does not distinguish between Fire-Retardant Treated or Preservative Treated. Conditions as specified below shall take precedence over drawing notations. Where governing code authorities require Fire-Retardant Treatment in addition to conditions stated below or noted in the drawings, those authorities shall govern.

B. Fire-Retardant Treatment: In buildings of Types I-B, II-A, and II-B construction, all rough carpentry items shall be fire retardant treated in the following conditions:

1. All wood including but not necessarily limited to cants, nailers, shims, curbs, equipment support bases, blocking, and sheathing built into the roof or above the roof line. Use only preservative treatment formulated for exterior use.
2. Blocking, nailers, supports, shims or other wood construction within the building whether or not concealed within walls or above-celling shall be fire-retardant treated. For wood in contact with concrete slab-on-grade use only preservative treatment formulated for exterior use
3. Any wood Items indicated on the drawings as “Fire-Retardant Treated”.

C. Preservative Treatment: Install preservative treated wood in the following conditions:
1. All wood including but not necessarily limited to sills, sleepers, blocking, furring, stripping, and wood flooring nailers that are in contact with concrete slab-on-grade or built into exterior walls.
2. All wood framing, blocking, and furring members used in exterior construction except for Fire-Retardant Treated wood conditions as specified above.
3. All wood framing, blocking, furring, and roofing wood including cants, nailers, shims, curbs, equipment support bases, and sheathing used in concession buildings, toilet buildings, press box buildings, and similar free-standing separate ancillary buildings shall be Preservative Treated.

END OF SECTION

SECTION 06 20 24

INTERIOR FINISH CARPENTRY AND MILLWORK

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes the following:
   1. Miscellaneous wood or plastic laminate clad millwork items that are not included in Section 12 32 16 Plastic Laminate Clad Casework.

B. Related Sections:
   1. Section 06 10 53 - Miscellaneous Rough Carpentry: Wood furring, blocking, shims, and hanging strips required for installing finish carpentry and millwork items.
   2. Section 06 61 19 - Quartz Surfacing Fabrications.

1.02 REFERENCES

A. American Forest and Paper Association:

B. AF&PA - National Design Specifications for Wood Construction.

C. ASTM International:
   1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

1.03 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: For each type of product indicated.

C. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

D. Show locations and sizes of required furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
   1. Indicate wood type and finish of each piece of construction.
   2. Samples:
   3. Submit three representative samples of each finish carpentry and millwork item, illustrating wood grain, edge and corner condition(s), and finish.

1.04 QUALITY ASSURANCE

A. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for interior finish carpentry including wood grades, construction, finishes, and other requirements.

B. Surface Burning Characteristics for Fire Retardant Treated Items: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

C. Where required by authority having jurisdiction, apply label from approved agency identifying each item.

1.05 QUALIFICATIONS

A. Installer Qualifications: An experienced installer who has completed finish interior carpentry 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. Fabricator Qualifications: A firm experienced in producing finish interior carpentry millwork similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Protect work from moisture damage.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

B. Comply with AWI requirements.

C. Maintain temperature and humidity conditions within ranges recommended by AWI. Do not deliver or install millwork 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.

D. Allow materials to acclimate to temperature and humidity conditions recommended by AWI for minimum of 48 hours prior to installation. Maintain same conditions during and after installation.

1.08 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.09 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Coordinate work with electrical rough-in and installation of associated and adjacent finishes.

C. Coordinate locations and requirements for blocking and backing for support and attachment of work of this section.

PART 2 PRODUCTS

2.01 MATERIALS

A. Plastic Laminate Surfacing: Comply with NEMA Standard GP50 high pressure laminated plastic as provided by Wilsonart, Formica, or Pionite. Provide 0.053-inch thick material at horizontal surfaces, and 0.033-inch thick laminate on exposed vertical surfaces. Provide backing sheet on bottom or concealed surfaces. Color(s) to be selected by the Architect from manufacturer's full range.

B. Hardwood Plywood and Face Veneers: HPVA HP-1, Grade A, min 7-ply wood veneer core, face species to match hardwood lumber.

C. Interior Composite Wood Products: Contain no added urea-formaldehyde resins.

D. Concealed Plywood: U.S. Product Standard PSI-66, 7-ply wood veneer core Douglas Fir plywood, grade trademarked DFPA, sanded. A-D grade. Use only in concealed areas or as core for plastic laminate. Use exterior grade at sink cabinets.

2.02 ACCESSORIES

A. Fasteners and Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors in masonry walls.

B. Adhesive for High Pressure Decorative Laminates: FS A-A-1936 contact adhesive.

C. PVC Edge Trim (mandatory): Extruded rigid PVC; smooth finish, of width to match component thickness; standard or custom color as required to match plastic laminate; 0.04 inch (1 mm) and 0.12 inch (3 mm) thickness.

D. Glass: Clear tempered double strength, as specified in Section 08 80 00.

E. Fasteners and Anchors:
   1. Fasteners: Hot dipped or Electro galvanized steel for high humidity and treated wood locations, unfinished steel elsewhere.

F. Nails and Staples: ASTM F1667.

G. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application.

H. Concealed Joint Fasteners: Threaded steel.

I. Door and Drawer Pulls: Edge Pull by Tudix,www.tydrix.com

J. Length: 3 inch (76.2 mm)

K. Style:SR

L. Roller Diameter: 1/4 inch (6.35 mm)

M. Finish: Satin Nickel US 15

N. Hinges: European style concealed self-closing type, steel with nickel-plated finish.

O. Grommets:
   1. Type: Plastic or nylon 2-1/2” diameter with flip-top tab in cap, in color(s) as selected by the Architect.
   2. Locations: Where indicated on the drawings and where needed for data wiring to pass through counter tops, whether or not indicated.
   3. Basis of Design: Model #EDP3 as manufactured by Doug Mocket & Co., 800-523-1269.
      a. Workstation Countertop Brackets (Hidden):
         1) Material: Steel.
         2) Finish: Manufacturer's standard, factory-applied powder coat, in black color.
   4. Basis of Design: Iron Supports, Hidden Center Mount Countertop Bracket, www.ironsupports.com

2.03 FABRICATION, GENERAL

A. Provide Custom grade interior millwork complying with the referenced quality standard. All work shall be of the highest quality workmanship thoroughly sanded and cleaned, free from tool marks, with all nails properly set, filled and sanded smooth. Moldings and trim shall be furnished in as long lengths as practicable. All pencil and chalk marks shall be removed.

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. Fabricate millwork to dimensions, profiles, and details indicated.

D. 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.

PART 3 EXECUTION

3.01 PREPARATION

A. Condition millwork to average prevailing humidity conditions in installation areas before installation.

B. Before installing architectural millwork, examine shop-fabricated work for completion and complete work as required, including removal of packaging and.

3.02 MISCELLANEOUS MILLWORK INSTALLATION

A. Install miscellaneous millwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch (3.18 mm) in 96 inches (2438.4 mm).

B. Scribe and cut millwork to fit adjoining work and refinish cut surfaces and repair damaged finish at cuts.

C. Anchor millwork to anchors or blocking built in or directly attached to substrates. Secure with concealed fasteners and blind nailing as required for complete installation.

D. Field Finishing:

E. Mask off adjacent surfaces before beginning sanding.
   1. Sand to smooth even finish with no evidence of sander marks. Take precautions to contain dust. Remove dust by vacuum.
   2. Apply filler and stain and three finish coats.
   3. Apply first coat, allow to dry, then buff lightly with steel wool to remove irregularities. Vacuum clean and wipe with damp cloth before applying succeeding coat.
   4. Apply second and successive coats. Allow to dry. Lightly buff between coats with steel wool and vacuum clean before applying succeeding coat.

3.03 ADJUSTING AND CLEANING

A. Repair damaged and defective millwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace millwork. Adjust joinery for uniform appearance.

B. Clean millwork on exposed and semi-exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION

SECTION 06 42 17

MANUFACTURED DECORATIVE WOOD WALL PANEL SYSTEM - ALTERNATE

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Custom plywood decorative wall panels, shop fabricated and finished.
   2. Shop finishing.

B. Related Sections:
   1. Section 06 20 24 - Interior Finish Carpentry and Millwork.

1.02 REFERENCES

A. ASTM International:
   1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
   2. Underwriter’s Laboratories: Class A rating.per UL 723.

B. Architectural Woodwork Institute:
   1. AWI - Quality Standards Illustrated.

1.03 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate panel materials, shapes and sizes, surface graining, fastening methods, joining methods, and connections to other work, to minimum scale of 1-1/2 inch to 1 ft.

C. Product Data: Submit data on fire retardant classification and treatment.

D. Samples: Submit three representative samples of finished panels, 12 x 12 inch in size illustrating panel construction, decorative pattern, and final finish.

E. Product Data:
   1. Panel manufacturer’s printed data describing panel construction, materials, installation hardware, and decorative pattern.
   2. Finish manufacturer’s printed data describing proposed applied finish material and fire protection characteristics.

1.04 QUALITY ASSURANCE

A. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork, construction, finishes, and other requirements.

B. Receive manufactured panels at shop and finish panels in accordance with AWI Quality Standard Section 1500.

1.05 QUALIFICATIONS

A. Installer Qualifications: An experienced installer who has completed architectural woodwork 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. Fabricator Qualifications: A firm experienced in producing architectural woodwork similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

C. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for finishing, cutting, fitting and installation of manufactured wall panels.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Protect work from moisture damage.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

B. Comply with AWI requirements.

C. Maintain temperature and humidity conditions within ranges recommended by AWI. 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.

D. Allow materials to acclimate to temperature and humidity conditions recommended by AWI for minimum of 48 hours prior to installation. Maintain same conditions during and after installation.

1.08 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.09 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Coordinate work with electrical rough-in and installation of associated and adjacent finishes.

C. Coordinate locations and requirements for blocking and backing within finished walls for support and attachment of work of this section.

PART 2 - PRODUCTS

2.01 DECORATIVE WOOD WALL PANELS

A. Basis of Design: Raggio Natura Collection as manufactured by Soelberg, www.soelbergi.com.

B. System Description: 3/4” thick factory-sanded Baltic Birch plywood panels with routed decorative pattern nominal 7/16” deep.

C. Manufacture’s Components
   1. Baltic Birch Panels
      a. Size(s): 3/4” thick x 48” x 96” face size(s) as received from the panel manufacturer. Panels shop cut and fit to size(s) required for measured construction and indicated design.
      b. Material: 7-ply wood-veneer core with sanded Birch faces; Cabinet-grade Baltic Birch plywood, with no voids in panel edges or design cuts.
   2. Mounting System and Trim:
      a. Panel manufacturer’s concealed low-profile aluminum zee clips mounted on panel back and wall. Provide quantity as recommended by panel manufacturer for the particular panel size and substrate material.
      b. Fasteners:
         1) Back of Panels: Flat head counter sunk screws to fasten each half of zee clips to back of plywood panels.
         2) Wall: Flat head counter sunk screws to fasten mated half of each zee clip through finish wall into solid furring. Provide screw type appropriate for furring material.

D. Finish System: Thermoformed rigid decorative surface contoured to the panel surface design. UL Class-A fire rating:
   1. Color/Pattern: As scheduled.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify adequacy of substrate, support framing and concealed furring.

C. Verify any mechanical, electrical, or other building items affecting work of this section are installed and ready to receive this work.

3.02 INSTALLATION

A. Install each half of concealed mounting clips onto furring using wood screws for wood furring, or self-drilling sheet metal screws for cold formed metal furring.

B. Match locations on back of panels with mated halves of mounting clips using wood screws.

C. Install panels plumb, square, and uniformly spaced on mounting clips, and set with minimal amount of construction adhesive behind top panel edges to avoid accidental lift from clips.

D. Joints between panels shall be butted uniformly tight.

END OF SECTION

SECTION 06 42 19

PLASTIC LAMINATE WALL PANELS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Plastic laminate-clad individual panels with all edges finished.

B. Related Sections:
   1. Section 06 10 53 - Miscellaneous Rough Carpentry: Concealed sheet metal mounting bands required for installing paneling. Wood blocking as may be required by the panel manufacturer or installer.
   2. Section 09 21 16 - Gypsum Board Assemblies: Installation and finishing of drywall after installation of sheet metal mounting bands.
   3. Section 09 90 00 - Painting and Coating: Finish painting of drywall prior to installation of panels.

1.02 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: For each product indicated.
   1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.

C. Shop Drawings: Show location of paneling, large-scale details, attachment devices, and other components. Include dimensioned plans and elevations based on job measurements.
   1. Show typical and all non-typical details full size.
   2. Show locations and sizes of concealed mounting clips.
   3. Show typical location for exposed false mounting bolts and washers.

D. Samples for Verification: For the following:
   1. Plastic laminate chain of samples for initial approval of color/finish selection.
   2. Plastic-laminate-clad panel sections nominal 8 by 10 inches (254 mm) face size, with matching vinyl edges. Provide one sample panel for each selected color/pattern/finish once initial selections are determined.

E. Provide fire-test-response characteristics as determined by testing identical products per test method indicated by UL, ITS, or other testing and inspecting agency acceptable to authorities having jurisdiction

F. Product Certificates: Signed by manufacturers of paneling certifying that products furnished comply with requirements.

1.03 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed paneling 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. Fabricator Qualifications: A firm experienced in producing paneling similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

C. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of paneling, construction, finishes, and other requirements.

1.04 MOCK-UP

A. Section 01-40 00 - Quality Requirements: Mock-up requirements.

B. Before fabricating panels build onsite mockup using a minimum of (3) stacked panels mounted on finished stud wall. Approved mockup will become the standard of fit, finish, materials and workmanship for the completed Work. Build mockup 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, as directed by Architect.
   2. Notify Architect seven days in advance of dates and times when mockups will be installed.
   3. Use only materials that meet the requirements of the specifications, and finish materials in the selected color(s) and finish(es).
   4. Obtain Architect's approval of mockup before starting paneling fabrication.
   5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
   6. Approved mockups may become part of the completed Work.

1.05 PRE-INSTALLATION MEETINGS

A. Section 01 31 19 – Project Meetings: Schedule and coordinate pre-installation meeting that includes the trade(s) for the work of this Section and other trades that whose work is related to the work of this Section.

B. Convene minimum one week prior to commencing work of this Section.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Do not deliver paneling until painting and similar operations that could damage paneling have been completed in installation areas. If paneling must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.07 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install paneling until building is enclosed, wet work is complete, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Field Measurements: Where paneling is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
   1. Locate concealed framing, blocking, and reinforcements that support paneling by field measurements before being enclosed and indicate measurements on Shop Drawings.
   2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating paneling without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.08 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that paneling can be installed as indicated.

PART 2 PRODUCTS

2.01 PANELING FABRICATORS

A. Available Fabricators: Subject to compliance with requirements, fabricators offering paneling that may be incorporated into the Work include, but are not limited to, the following:
   1. Panel Specialists, Inc. (PSI), www.panelspec.com.
   2. Custom Plastics, www.customplastics.com.
   3. Substitutions: Section 01 60 00 - Product Requirements.

2.02 MATERIALS

A. General: Provide materials that comply with requirements of the AWI quality standard for quality grade specified, unless otherwise indicated.

B. Wood Products: Comply with the following:
   1. Particle board: 4-pound density particle board core faced with fire-rated vertical surface type (.030") high-pressure laminate and backed with .028" high pressure laminate backer sheet.
   2. Manufacturer: Provide "Duraflake FR" by Willamette Industries or equivalent.

C. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated, or if not indicated, as required by woodwork quality standard.
   1. Available Manufacturers:
      a. Formica Corporation.
      b. International Paper; Decorative Products Div, www.internationalpaper.com.
      c. Pionite Decorative Surfaces, www.pionite.com.
      d. Laminart, www.laminart.com.

e. Wilsonart International, www.wilsonart.com.

D. Panel Fire-Test-Response Characteristics: Fabricated panels rated Class A in accordance with ASTM E84;
1. Flame spread 25 or less.
2. Smoke developed 460 or less.
3. Cataloged by Underwriters Laboratories as UL 723.
a. Provide fire-test-response characteristics as determined by testing identical products per test method indicated by UL, ITS, or other testing and inspecting agency acceptable to authorities having jurisdiction.
4. Rated Class “A”.
5. Flame Spread Rating: Less than 25.
6. Smoke Developed Rating: Less than 100.

E. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln-dried to less than 15 percent moisture content.

F. 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.

2.03 FABRICATION, GENERAL

A. Paneling Grade: Provide Custom grade paneling complying with the referenced quality standard.

B. Wood Moisture Content: Comply with requirements of the referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.

C. Complete fabrication to maximum extent feasible, before shipment to Project site. Disassemble components only as necessary for shipment and installation.

D. Neatly cut openings to receive 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 and seal with clear waterproofing agent.

2.04 PLASTIC-LAMINATE-CLAD PANELS

A. Quality Standard: Comply with AWI Section 500.

B. Plastic-Laminate Cladding: High-pressure decorative laminate, color(s) and finish as scheduled:
1. Faces: Type VGF.
2. Backs: Type BKV.
3. Panel Edges: 3mm PVC edging in color to match panel face.

C. Panel Core Construction: Fire-retardant high-density particleboard.

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 E84.

E. Finish Sizes:
   1. Overall finish panel thickness shall be 7/16 inch (11.11 mm) minimum.
   2. Panel face size(s) shall be as indicated in the drawings.

F. Accessories:
   1. Panel anchors: Panel manufacturer's recommended formed steel or extruded aluminum zee clips specially designed for panel mounting. Zee clips shall provide for 1/4-inch gap from face of mounting substrate to back of panel.
   2. Divider moulding: No. 302.
   3. Outside corner moulding, 90 degrees: No. 103-90, with end caps.
   4. Trim moulding: No. 304.

PART 3 EXECUTION

3.01 PREPARATION

A. Condition paneling to average prevailing humidity conditions in installation areas before installation.

B. Before installing paneling, examine shop-fabricated work for completion and complete work as required, including removal of packing and back-priming.

3.02 INSTALLATION

A. Quality Standard: Install panels to comply with AWI Section 1700 for the appropriate grade of materials.

B. Install continuous horizontal bands of 16-ga. x 4" wide sheet metal to metal wall studs prior to installation of gypsum board.
   1. Fasten sheet steel band using minimum of (2) bugle-head drywall screws at each stud. Dimple sheet metal at screw locations for flush heads to avoid interference with gypsum board installation.
   2. Provide continuous metal bands horizontally as required for mounting of panel zee-clip receivers using flat-head sheet metal screws or drywall screws.
      a. Fasten corresponding half of each zee clip to back of panel using flat-head wood screws.
      b. Each panel shall have a minimum total of (6) zee clips mounted to the horizontal mounting bands.

C. Install each panel with long length horizontal; level, plumb, true, and straight with no distortions and with all top and bottom edges in alignment.
   1. Shim as required with concealed shims to ensure full length of each panel is flush with adjacent panel. Install level and plumb to a tolerance of 1/8 inch (3.18 mm) in 96 inches (2438.4 mm).
   2. Install each panel flush with adjacent panels.

3. Install self-adhesive foam backer spacers where required to keep panel mounts tight without rattle.

3.03 ADJUSTING AND CLEANING

A. Adjust installed panels where necessary to provide uniform gaps between panels, all top edges level and in alignment, and with all panel edges flush with each adjacent panel edge.

B. Replace any panels that are damaged during installation or prior to Owner acceptance.

C. Clean exposed surfaces of panels and deliver to the Owner recommended cleaner in quantity suitable for a minimum of 50 cleanings.

END OF SECTION

SECTION 06 61 19

QUARTZ SURFACE FABRICATIONS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes quartz-based fabricated stone fabrications and countertops.

B. Related Sections:
1. Section 06 20 24 - Interior Finish Carpentry and Millwork: Base cabinet countertop support.
2. Section 12 32 16 - Manufactured Plastic Laminate-Clad Casework

1.02 REFERENCES

A. ASTM International:
1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
2. ASTM C97 - Standard Test Methods for Absorption and Bulk Specific Gravity of Dimension Stone.
3. ASTM D1709 - Standard Test Methods for Impact Resistance of Plastic Film by the Free Falling Dart Method.
4. ASTM C501 - Standard Test Method for Relative Resistance to Wear of Unglazed Ceramic Tile by the Taber Abraser.
5. ANSI Z124.6 - Stain resistance of plastic fixtures.
6. NEMA LD3 - High Temperature Resistance.

1.03 SUBMITTALS

A. Section 013300 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate dimensions, thicknesses, required clearances, tolerances, materials, colors, finishes, fabrication details, field jointing, adjacent construction, methods of support, integration of plumbing and electrical components, and anchorages.

C. Product Data: Submit data on specified component products.

D. Samples: Submit two samples, 12 x 12 inch in size illustrating each color, texture, and finish.

E. Manufacturer's Installation Instructions: Submit preparation of opening required, rough-in sizes, and tolerances for item placement.

1.04 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

B. Operation and Maintenance Data: Submit list of approved cleaning materials and procedures required, and list of substances harmful to component materials. Include instructions for stain removal and surface and gloss restoration.

1.05 WARRANTY:

A. Provide manufacturer's limited commercial 10-year warranty against product defects.

1.06 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years' documented experience.

B. Installer: Fabricated and installed by manufacturer's certified fabricator/installer with a minimum of 5-years' experience in similar installations. Provide manufacturer's written certification with assurance of manufacturer's warranty.

PART 2 - PRODUCTS

2.01 QUARTZ SURFACING FABRICATIONS

A. Manufacturers:
   1. Basis-of-Design: Corian Quartz, as manufactured by DuPont; www.corian.com
   2. Acceptable Manufacturers:
      a. LX Hausys (Viatera); www.lxhausys.com/us/
      b. Wilsonart Quartz; www.wilsonart.com
   3. Substitutions: Section 01 60 00 - Product Requirements.

B. Performance Characteristics:
   1. Surface Burning Characteristics: Class A (Class 1) per ASTM E84.
      a. Flame Spread: 25 or less.
      b. Smoke Developed: 450 or less.
   2. Water Absorption: Less than 0.05% per ASTM C97.
   3. Performance Standards: Provide products certified as meeting or exceeding performance standards for quartz surfacing as established by the International Surface Fabricators Association (ISFA).

C. Basis of Design: Reference the Drawings: Finish Schedule.

2.02 COMPOSITION

A. Nominal 93% crushed quartz aggregate combined with resins and pigments fabricated into slabs using a vacuum vibro-compaction process.

B. Color: As selected by the Architect from manufacturer's full range of standard and custom colors for polished finish.

2.03 SHOP FABRICATION

A. Finished Slab Thickness: 3/4-inch or 1-1/4-inch as indicated in the drawings.

B. Slab Sizes: As indicated.

C. Identification: Each slab shall be labeled with fabricator’s batch number and imprinted with manufacturer’s identifying mark on the back side.

D. Polish exposed surfaces to manufacturer’s “Polished” finish with gloss rating of 35%.

E. Beveled or slightly radiused corners and edges.

F. Provide all necessary cut-outs. Obtain templates from plumbing subcontractor for fittings, sinks, and lavatories. Provide cut-outs with minimum 3/8” inside corner radius. Reinforce any remaining material less than 3-inches wide with concealed strip(s) of quartz panels, or as recommended by the manufacturer's approved fabrication guidelines.

G. Laminate layers of quartz surfacing as required to create built-up edges or other areas requiring additional thickness as indicated in the drawings.

2.04 ACCESSORIES

A. Adhesives and Sealants:
   1. Provide manufacturer's recommended seaming adhesive for all joints.
   2. Provide a high-grade, 100-percent silicone sealant, in a color matching the countertop, for all joints to dissimilar materials (e.g., backsplashes, walls).
   3. Use mildew-resistant type in wet areas.
   4. Joint Sealants: Clear silicone sealant by Dow Corning or General Electric as recommended by the manufacturer for the specific application and conditions of use. Provide anti-bacterial type at restrooms and food preparation areas.

PART 3 - EXECUTION

3.01 STORAGE AND HANDLING

A. Store in racks in near-vertical position, indoors and away from direct exposure to sun or other heat source.

B. Protect against warpage and breakage.

C. Store with finished face turned toward finished face and separated by heavy paper or cardboard.

3.02 EXAMINATION

A. Reference Section 01 30 00 - Administrative Requirements: Coordination and project conditions

B. Field-verify all relevant dimensions prior to beginning fabrication.

C. Verify that substrates supporting quartz surfacing are plumb, level, and within plane to within 1/16-inch per ten-ft., and that necessary supports and blocking are in place.

D. Ensure that base cabinets are securely fixed to adjoining units and back wall.

E. Verify joint preparation and affected dimensions are acceptable.

3.03 INSTALLATION

A. Align work plumb and level.

B. Rigidly adhere or physically anchor finished panels in concealed manner to prevent movement or misalignment.

3.04 ERECTION TOLERANCES

A. Maximum Variation from Indicated Dimension: 1/8 inch.

B. Maximum Offset from Indicated Position: 1/8 inch.

3.05 FINAL CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Clean and polish all exposed surfaces of quartz surfacing.

C. Furnish to the Owner (2) 16 oz. or larger containers of manufacturer’s recommended non-abrasive, low pH cleaning and polishing agent.

END OF SECTION

SECTION 07 13 00

SHEET WATERPROOFING

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:
   1. Modified bituminous sheet waterproofing.
      a. Vertical Application
   2. Auxillary Products (accessories).
      a. Protection Board
         1) Rigid asphaltic-compositition protection board for vertical application at locations indicated and as specified herein.

B. Related Sections:
   1. Section 07 27 26 - Fluid-Applied Air Barrier.
   2. Section 07 90 00 - Joint Protection.
   3. Section 09 21 16 - Gypsum Board Assemblies for interior walls at showers.
   4. Section 09 30 00 - Tiling: Membrane liner at shower pan.
   5. Section 14 24 00 - MRL Hydraulic Passenger Elevators.

1.02 REFERENCE STANDARDS

A. ASTM International:
   1. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension.
   2. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

B. National Roofing Contractors Association:
   1. NRCA - The NRCA Waterproofing and Dampproofing Manual.

1.03 SYSTEM DESCRIPTION

A. Waterproofing System: Capable of resisting water under positive pressure and preventing moisture migration to interior.

B. General:
   1. Waterproofing sheet material and protection board shall be provided at:
      a. All locations where water resistant membranes and waterproofing membranes are indicated below grade,
      b. All interior or exterior walls that are retaining soil.
      c. At walls separating the inside of the building from soil on the outside of the wall (exterior side of the wall).
      d. Locations where sheet waterproofing will be required include, but are not limited to:
         1) Portions of walls below finish floor level such as auditorium walls, orchestra pit walls, pit walls of any kind, elevator pit walls.

2) Walls retaining soil at open air structures including but not limited to stadiums and parking structures, walls adjacent to ramps, exterior retaining walls and planter walls.

e. Where the Construction Documents for the preceding locations do not indicate sheet waterproofing, Contractor shall provide sheet waterproofing and protection boards as specified in this Section.

f. Sheet waterproofing and protection board shall be considered as a single system – where one is required, both are required.

g. Bituminous dampproofing in liquid or mastic form is not considered a substitute for sheet waterproofing for any portion of the building.

1.04 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings:
1. Indicate special joint or termination conditions and conditions of interface with other materials.

C. Product Data: Submit data for surface conditioner, flexible flashings, joint cover sheet, and joint and crack sealants, with temperature range for application of waterproofing membrane.

D. Samples: Submit 12 x 12 inch samples of waterproofing sheet and protection board.

E. Manufacturer's Installation Instructions:
1. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.
2. Submit special procedures and perimeter conditions requiring special attention.

F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Perform Work in accordance with NRCA Waterproofing Manual NRCA (WM) and manufacturer’s instructions.

1.06 QUALIFICATIONS

A. Applicator: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.

1.07 PRE-INSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.08 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

B. 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. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application and until liquid or mastic accessories have cured.
   2. Do not apply waterproofing in snow, rain, fog, or mist.

1.09 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Furnish five year manufacturer warranty for waterproofing failing to resist penetration of water.

C. For warranty repair work, remove and replace materials concealing waterproofing.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Source Limitations for Waterproofing System: Obtain waterproofing materials, and associated materials, not limited to protection course, and molded-sheet drainage panels from single source from single manufacturer.

2.02 MODIFIED BITUMINOUS SHEET WATERPROOFING

A. Modified Bituminous Sheet: 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; formulated for application with primer or surface conditioner that complies with VOC limits of authorities having jurisdiction.

B. Subject to compliance with requirements, products which may be incorporated in the Work include the following:
   1. Bituthene System 4000, GCP Applied Technologies, www.gcpat.com
   2. Mel-Rol, W. R. Meadows, Inc., www.wrmeadows.com
   3. CCW Miradri 860/861, Carlisle Coatings & Waterproofing Incorporated, Division of Carlisle Companies Incorporated www.carlisle-ccw.com
   4. Duramem 700-SM, Pecora Corporation, www.pecora.com
   5. Polyguard 650, Polyguard Products, Inc., www.polyguardproducts.com
   6. TW-60, Tamko Building Products, Inc., www.tamko.com
   7. Substitutions: Section 01 60 00 - Product Requirements.

C. Physical Properties:

Properties	Test	Results
Tensile Strength	ASTM D412	250 psi
Elongation	ASTM D412	300 percent
Low-Temperature Flexibility	ASTM D1970/D1970M	Pass at minus 20 deg F
Crack Cycling	ASTM C836/C836M	100 Cycles of 1/8" movement
Puncture Resistance	ASTM E154/E154M	40 lbf

Water Absorption	ASTM D570	0.15 percent weight gain
Moisture Vapor(perms)	ASTM E96/E96M	0.05 perms
Hydrostatic-Head Resistance	ASTM D5385/D5385M	150 feet

D. Sheet Strips: Self-adhering, rubberized-asphalt strips of same paterial and thickness as sheet waterproofing.

2.03 AUXILIARY MATERIALS

A. Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.

B. Surface Conditioner: Surface Conditioner: Liquid, waterborne surface conditioner recommended for substrate by sheet-waterproofing material manufacturer.
   1. Compatible with membrane.

C. Primer: Liquid waterborne or solvent-borne primer recommended for substrate by sheet-waterproofing material manufacturer.

D. Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, of trowel grade or low viscosity.

E. Substrate Patching Membrane: Low-viscosity, two-component, modified asphalt coating.

F. Sealant: As specified in Section 07 90 00.

G. Protection Board: Rigid asphaltic-composition board, nominal 1/4-inch thick, or structural insulating board conforming to ASTM C208.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of waterproofing.
   1. Verify substrate surfaces are durable; free of matter detrimental to adhesion or application of waterproofing system.
   2. Verify items penetrating surfaces to receive waterproofing are securely installed.
   3. Verify substrate surface slopes to drain for horizontal waterproofing applications.
   4. 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.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Protect adjacent surfaces not designated to receive waterproofing.

B. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.

C. Seal cracks and joints with sealant materials using depth to width ratio as recommended by sealant manufacturer.

D. Apply surface conditioner at rate recommended by manufacturer. Protect conditioner from rain or frost until dry.

E. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.

F. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

G. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.

H. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D4258.

I. 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.

J. Corners: Prepare, prime, and treat inside and outside corners according to manufacturer's written recommendations.

K. 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:
   1. At footing-to-wall intersections, extend liquid membrane in each direction from corner or install membrane strip centered over corner.
   2. At plaza-deck-to-wall intersections, extend liquid membrane or sheet strips onto deck waterproofing and to finished height of sheet flashing.

L. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions according to manufacturer's written instructions.

3.03 MODIFIED BITUMINOUS SHEET-WATERPROOFING APPLICATION

A. Install modified bituminous sheets according to waterproofing manufacturer's written instructions and per recommendations.

B. 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 2-1/2-inch- (64-mm-) minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure watertight installation.
   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).

D. Apply continuous sheets over already-installed sheet strips, bridging substrate cracks, construction, and contraction joints.

E. Seal edges of sheet-waterproofing terminations with mastic.

F. Install sheet-waterproofing and auxiliary materials to tie into any adjacent waterproofing.

G. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending 6 inches (150 mm) beyond repaired areas in all directions.

H. Immediately install protection course with butted joints over waterproofing membrane.
   1. Molded sheet drainage panels, Insulation drainage panels, or Board insulation may be used in place of a separate protection course to vertical applications when approved by waterproofing manufacturer and installed immediately.

3.04 INSTALLATION - SELF ADHERED MEMBRANE WATERPROOFING

A. Roll out membrane. Minimize wrinkles and bubbles.

B. Remove release paper layer. Roll out on substrate with mechanical roller to encourage full contact bond.

C. Lap sides and ends.

D. Overlap edges and ends minimum 3 inches and seal with contact adhesive. Seal permanently waterproof.

E. Reinforce membrane with multiple thickness of membrane material over joints, whether joints are static or dynamic.

F. Weather lap joints on sloped substrate in direction of drainage. Seal joints and seams. Coordinate with drain installation.

G. Seal membrane to adjoining surfaces.

H. Extend membrane over cants and up intersecting surfaces at membrane perimeter minimum 6 inches above horizontal surface laid in shingle fashion.

I. Seal items protruding to or penetrating through membrane.

3.05 INSULATION DRAINAGE-PANEL INSTALLATION

A. Install insulation drainage panels over waterproofed surfaces. Cut and fit to within 3/4 inch (19 mm) of projections and penetrations.

B. Ensure that drainage channels are aligned and free of obstructions.

C. On vertical surfaces, set insulation drainage panels in adhesive or tape applied according to manufacturer's written instructions.

D. On horizontal surfaces, loosely lay insulation drainage panels according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.]

3.06 FIELD QUALITY CONTROL

A. Testing Agency: Owner may engage a qualified testing agency to perform tests.

B. Manufacturer's Field Service: If required as a condition of warranty, engage a site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components; and to furnish daily reports to Architect.

C. Waterproofing will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.07 PROTECTION, REPAIR, AND CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Protecting installed construction.

B. Do not permit foot or vehicular traffic on unprotected horizontal membranes.

C. Protect waterproofing from damage and wear during remainder of construction period.

D. Protect membrane from damage by adhering protection board immediately after membrane placement.

E. Protect installed insulation drainage 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.

F. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

G. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

H. Carefully backfill and compact so as not to damage or dislodge protection board.

END OF SECTION

SECTION 07 21 13

THERMAL WALL INSULATION

PART 1 GENERAL

1.01 SUMMARY

A. Section includes
1. Rigid plastic insulation at exterior masonry wall construction.
2. Rigid mineral fiberboard insulation at exterior masonry wall construction with air spaces exceeding 2-1/2" in clear opening.
3. Rigid mineral fiberboard insulation at exterior ACM metal panel walls.
4. Blanket insulation where specifically indicated at detail areas.

1.02 REFERENCE STANDARDS

A. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013 (Reapproved 2019).

B. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).

C. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2017.

D. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2022a.

E. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics; 2019.

F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2022.

G. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.

H. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 °C; 2022.

I. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2023.

1.03 RELATED SECTIONS:

A. Section 04 20 00 - Unit Masonry Assemblies: Cavity wall construction.

B. Section 04 73 00 – Manufactured Stone Masonry

C. Section 06 10 53 – Miscellaneous Rough Carpentry: Wood stud wall construction.

D. Section 07 27 26 – Fluid-Applied Membrane Air Barrier: Substrate.

E. Section 07 42 13 – Prefinished Metal Wall and Soffit Panels.

F. Section 09 21 16 – Gypsum Board Assemblies: Gypsum sheathing substrate.

1.04 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit for product characteristics, performance criteria, and limitations.
   1. Provide product data indicating fire-test-response characteristics in accordance with the following, or similar testing and inspecting agency acceptable to authorities having jurisdiction:
      a. Identify materials with appropriate markings of applicable testing and inspecting agency.
         1) Surface-Burning Characteristics tested per ASTM E84.
         2) Fire-Resistance Ratings tested per ASTM E119.
         3) Combustion Characteristics tested per ASTM E136.
      b. Provide product data indicating thermal characteristics.
   2. Provide documentation that the proposed total R-value meets the requirements of ASHRAE 90.1 for project building zone per International Building Code.
   3. Provide coordinated submittal with Air Barrier system and/or other products required to be tested as part of an assembly for meeting requirements of NFPA 285.

C. Manufacturer's Installation Instructions: Submit special environmental conditions required for installation and installation techniques.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.05 QUALITY ASSURANCE

A. Insulation Installed in Concealed Locations Surface Burning Characteristics:
   1. Maximum 75/450 flame spread/smoke developed index when tested in accordance with ASTM E84.
      a. Apply label from agency approved by authority having jurisdiction to identify each foam plastic insulation board.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements.
   1. Do not install adhesives when temperature or weather conditions are detrimental to successful installation.

1.07 SEQUENCING

A. Section 01 10 00 - Summary: Work sequence.
   1. Sequence Work to ensure air barrier materials are successfully completed before beginning Work of this section.

1.08 PRE-INSTALLATION MEETINGS

A. Section 01 31 19 – Project Meetings: Schedule and coordinate pre-installation meeting that includes the trade(s) for the work of this Section and other trades that whose work is related to the work of this Section.

B. Convene minimum one week prior to commencing work of this Section.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources.

B. Store inside and in a dry location.
   1. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

C. Protect plastic insulation as follows:
   1. Do not expose plastic insulation to sunlight, except to extent necessary for period of installation and concealment.
   2. Protect against ignition at all times.
   3. Do not deliver plastic insulating materials to Project site before installation time.
   4. Once started, complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 PRODUCTS

2.01 APPLICATIONS

A. Use only insulation board products that have been tested as an assembly with other specific products, including Air Barrier system, per NFPA 285. Coordinate with General Contractor to ensure products are submitted as part of a tested assembly.

B. Protection: All plastic insulation boards must be utilized, detailed, and protected in accordance with requirements of NFPA 285- and applicable governing authorities.

2.02 CAVITY WALL PLASTIC RIGID INSULATION BOARD

A. Manufacturers
   1. Thermax; Dow Chemical USA, www.dow.com
   2. EnergyGuard; GAF Corp., www.gaf.com
   3. XCI Class A; Hunter Panels, www.hunterpanels.com
   4. EnergyShield PRO2: Atlas Wall Board, www.atlaswall.com
   5. ThermaSheath; Rmax, www.rmax.com
   6. Substitutions: Section 01 60 00 - Product Requirements.

B. Materials
   1. Polyisocyanurate Insulation Board meeting requirements of ASTM C1289 and NFPA 285:
   2. Board size: 16 x 96 inches (2438.4 mm).
   3. Board Thickness: 2-inches or as indicated in the drawings.

4. Thermal Resistance: 5-year aged R-value of 5.7 per inch thickness or greater.
5. Face Material: Type I foil face or Type II glass mat face as required to meet the specific requirements of ASTM C1289 and NFPA 285 for the tested insulation/air barrier assembly.

C. Accessories
1. Adhesive: Type recommended by insulation manufacturer for application. Ensure compatibility with applied air barrier material.

2.03 FIBERBOARD INSULATION MATERIALS

A. Mineral Fiberboard Insulation: Rigid or semi-rigid mineral fiber, ASTM C612 or ASTM C553; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
1. Facing: Unfaced, dark.
2. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
3. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
4. Board Thickness: 3-inches, or as indicated in the drawings.
5. Thermal Resistance: R-value of 4.3 per inch of thickness.
6. Maximum Density: 8 pcf, nominal.
7. Location: Exterior cavity wall, continuous insulation within air space.
8. Products:
a. Rockwool (Roxul, Inc); Cavityrock: www.rockwool.com
b. Thermafiber, Inc; Rainbarrier 45: www.thermafiber.com

2.04 BLANKET INSULATION

A. Manufacturers:
1. CertainTeed Corporation www.certainteed.com
2. Johns Manville Corporation. www.jm.com
3. Owens Corning. www.owens-corning.com
4. Substitutions: Section 01 60 00 - Product Requirements.

B. Type: ASTM C665; preformed glass fiber blankets; friction fit, conforming to the following:
1. Thermal Resistance: Minimum R-value of 19.
2. Thickness: 6 inches (152.4 mm).
3. Width: 12 and 16 inches (406.4 mm) wide, as needed for the particular stud spacing.
4. Facing: Unfaced.

C. Applications:
1. Special applications only where specifically indicated in the drawings at exterior stud wall cavities and parapets.

PART 3 EXECUTION

3.01 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

1. Verify substrate, adjacent materials, and insulation boards are dry and ready to receive insulation.
2. Verify all debris has been cleared from wall cavity.

B. Verify wall ties are properly spaced and ready to receive insulation.

3.02 BOARD INSUALTION

A. Apply adhesive to substrate.

B. Install boards horizontally between wall ties.

C. Stagger end joints. Butt edges and ends tight to adjacent boards.

D. Cut and fit insulation tight to protrusions or interruptions to insulation plane.

3.03 BLANKET INSULATION

A. Install only at areas where board insulation or loose fill insulation is not indicated.

B. Use blanket widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.

C. Place blankets in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.

D. For metal-framed wall cavities where cavity heights exceed 96 inches (2438.4 mm), support unfaced blankets mechanically.

E. Do not compress insulation.
1. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
2. Fit insulation tight in spaces and tight to exterior side of mechanical and electrical services within plane of insulation.

3.04 PROTECTION OF INSTALLED CONSTRUCTION

A. Section 01 70 00 - Execution and Closeout Requirements: Protecting installed construction.

B. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

SECTION 07 27 26

FLUID-APPLIED MEMBRANE AIR BARRIER

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:
   1. Vapor-permeable, fluid-applied air barriers.

B. Related Sections include the following:
   1. Section 07 21 13 - Thermal Wall Insulation: Board insulation and compatibility.
   2. Section 09 21 16 - Gypsum Board Assemblies: Exterior sheathing board.

1.02 REFERENCE STANDARDS

A. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016 (Reapproved 2021).

B. ASTM D570 - Standard Test Method for Water Absorption of Plastics; 2022.

C. ASTM D1004 - Standard Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting; 2021.

D. ASTM D1876 - Standard Test Method for Peel Resistance of Adhesives (T-Peel Test); 2008 (Reapproved 2023).

E. ASTM D1938 - Standard Test Method for Tear-Propagation Resistance (Trouser Tear) of Plastic Film and Thin Sheeting by a Single-Tear Method; 19.

F. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2021.

G. ASTM D2178/D2178M - Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing; 2015a (Reapproved 2021).

H. ASTM D2369 - Standard Test Method for Volatile Content of Coatings; 2020.

I. ASTM D4263 - Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method; 1983 (Reapproved 2018).

J. ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers; 2022.

K. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2023.

L. ASTM E154/E154M - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover; 2008a (Reapproved 2019).

M. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials; 2021a.

N. ASTM E2357 - Standard Test Method for Determining Air Leakage Rate of Air Barrier Assemblies; 2018.

O. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2023.

1.03 REFERENCES

1.04 DEFINITIONS

A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.

B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.

C. Edge Protection: Provide at the following locations: 1) at sheathing perimeter edges, and 2) at edges where holes are cut in sheathing. Protect all instances of the exposed gypsum core of sheathing with a continuous self-adhering sheet flashing compatible with the air barrier system.

D. Air-Barrier Assembly: The collection of air-barrier materials and accessories applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include manufacturer's written instructions for evaluating, preparing, and treating each substrate; technical data; dry film thickness; and tested physical and performance properties of products.
   2. Include manufacturer’s data from ICC-ES substantiating recent compliance with building code in effect for Project. The ICC-ES report for the submitted Vapor Permeable Weather-resistive Barrier shall indicate that the ”Barrier” is approved for use in the Type of Construction corresponding to the Project’s Type of Construction (i.e. Type I, II, III, IV and Type V). Where this is not the case, the report shall not exclude the Air Barrier from being used for the Type of Construction corresponding to the Project.
   3. Provide documentation showing compliance with NFPA 285 as required by applicable building code for combustible weather-resistive barriers.
   4. Installation Accessories (Tapes, precut closure pieces and other items required or recommended by the manufacturer, if any): Manufacturer’s data sheets and complete installation requirements and recommendations.
   5. Submit proof of proposed product being listed on the ABAA web site as an acceptable Air Barrier.

B. Shop Drawings: For air-barrier assemblies.
   1. Show locations and extent of air-barrier materials, accessories, and assemblies specific to Project conditions.
   2. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
   3. Include details of interfaces with other materials that form part of air barrier.

1.06 INFORMATIONAL SUBMITTALS

A. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with the barrier.

B. Compatibility: Submit a letter from the primary material manufacturer stating that the materials proposed for use are permanently chemically compatible as well as adhesively compatible with the adjacent materials proposed for use. Submit the letter from manufacturer stating that cleaning materials used during installation are also chemically compatible with adjacent materials proposed for use.

1. Confirm that air / water barrier included in the Masonry “Compatibility Report” is compatible with all Masonry related products to be used on the job, and that the barrier has been checked for compatibility with all other products (not Masonry) which it will touch or be placed in-close-proximity to. Compatibility with the following items, but not limited to the following, shall be confirmed: air / water barrier materials, vapor retarders if any, insulation, and sheathing surfaces. Incompatible products shall not be provided nor combined. Products that are incompatible with the air / water barrier shall not be provided nor combined and used with the air barrier. [If proposed product is asphalt-based, and incompatible with the masonry accessories, state this in the submittal.]

C. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.

D. Field quality-control reports.

E. NFPA 285 coordination and compliance data shall include, but not be limited to, showing that the air barrier product(s) and other products / materials also being supplied on the job for the wall systems, have been tested together in a wall system matching the job requirements.

F. Quality Assurance:

1. Submit evidence of current accreditation and certification under the Air Barrier Association of America’s (ABAA) Quality Assurance Program. Submit accreditation number of manufacturer and certification numbers of proposed installers.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

B. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended in writing by air-barrier manufacturer.

C. Do not install liquid-applied membrane in snow, rain, fog, or mist or when such conditions are expected within 24 hours of completed application. Do not install liquid-applied membrane when the temperature of substrate surfaces and surrounding air temperatures are below those recommended by the vapor permeable air barrier manufacturer.

1.08 PERFORMANCE REQUIREMENTS

A. Material performance: Provide materials that have an air permeance not to exceed 0.004 cu. ft. per minute per sq. ft. under a pressure differential of 0.3 in. water (1.57 psf) (0.02 L/m2@75 Pa.) when tested in in accordance with ASTM E2178.

B. Assembly Performance: Provide a continuous vapor permeable air barrier assembly that has an air leakage not to exceed 0.040 cu. ft. per minute per sq. ft. under a pressure differential of 0.3 in. water (1.57 psf) (0.20 L/m2@75 Pa.) when tested in in accordance with ASTM E2357.
   1. Assembly shall be capable of withstanding combined positive and negative design wind, fan, and stack pressures on the envelope without damage or displacement, and shall transfer the load to the structure.
   2. Assembly shall perform as a liquid drainage plane flashed to discharge condensation or water penetration to the exterior. Assembly shall accommodate movements of building materials by providing expansion and control joints as required, with accessory vapor permeable air barrier materials at such locations, changes in substrate, and perimeter conditions.
   3. Assembly shall not displace adjacent materials under full load.
   4. Assembly shall be joined in an airtight and flexible manner to the air barrier material of adjacent assemblies, allowing for the relative movement of assemblies due to thermal and moisture variations, and any anticipated seismic movement. Connection shall be made between:
      a. Foundation and walls.
      b. Walls and windows or doors.
      c. Different wall systems.
      d. Wall and roof.
      e. Wall and roof 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.
   5. All penetrations of the air barrier and paths of air infiltration/exfiltration shall be made airtight.

C. System is not suitable for waterproofing applications in hydrostatic condition.

D. System is not compatible with petroleum solvents, fuels and oils, materials containing creosote, pentachlorophenol, or linseed oil.

1.09 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
   1. Installer shall be licensed by ABAA according to ABAA's Quality Assurance Program and shall employ ABAA-certified installers and supervisors on Project.

B. Coordination Requirements: Even though the following conditions exist on the job 1) there may, or may not, be an indicated Basis-of-Design for the combustible wall “air barrier” and the combustible “rigid foam plastic wall insulation” indicated to be used together in the project walls to achieve NFPA 285 wall system testing compliance - and 2) the choice of air barrier (and insulation) to be used on the project is open to the bidding process and contingent on the air barrier product having been tested with other “to be bid” products including but not limited to the combustible rigid foam plastic wall insulation, submit evidence that the proposed air barrier and associated proposed wall system components have been tested together, as a “system” to pass NFPA 285 testing requirements. The lead Contractor shall coordinate as necessary, or cause to be coordinated as necessary, to provide a set of materials that have been fire tested together for the job.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to project site in original packages with seals unbroken, labeled with manufacturer's name, product, date of manufacturer, and any special directions for storage.

B. Store materials in their original undamaged packages in a clean, dry, protected location within temperature range recommended by the manufacturer. Protect stored materials from direct sunlight.

C. Handle materials in accordance with manufacturer's recommendations.

D. Remove and replace liquid materials that cannot be applied within their stated shelf life.

1.11 WARRANTY

A. Material Warranty: Provide Manufacturer's standard form in which manufacturer agrees to replace fluid-applied air barrier membrane materials that fail within specified warranty period when installed and used in accordance with manufacturer's written instructions.
   1. Failures include, but are not necessarily limited to the following:
      a. Failure to maintain air permeance rating not to exceed .004 cfm/sq. ft (0.02 L/s/sq. m.) when tested per ASTM E2178, within specified warranty period.
      b. Failure to maintain a vapor permeance rating greater than 10 perms when tested in accordance with ASTM E96/E96M, Method B.
   2. Warranty Period: Minimum of 20-years from date of Substantial Completion of the Project.

B. Installer's Warranty: Provide air barrier subcontractor's material and installation warranty for a minimum of 2-years from date of Substantial Completion of the Project. Warranty shall cover all components of the air barrier assembly against failure including loss of airtight seal, loss of watertight seal, loss of adhesion, loss of cohesion, failure to cure properly.

1.12 PRE-INSTALLATION CONFERENCE

A. A pre-installation conference shall be held prior to commencement of field operations to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work. Pre-installation conference shall include the Contractor, installer, Architect, and system manufacturer's field representative. Agenda for meeting shall include but not be limited to the following:
   1. Review of Submittals.
   2. Review of surface preparation, minimum curing period and installation procedures.
   3. Review of special details and flashings.
   4. Sequence of construction, responsibilities and schedule for subsequent operations.
   5. Review of mock-up requirements.
   6. Review of inspection, testing, protection and repair procedures.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. General: Manufacturer shall be a firm with a minimum of 10-years' experience in the production and sales of waterproofing and air barriers. Manufacturers proposed for use, but not

named in these specifications shall submit evidence of ability to meet all requirements specified, and include a list of projects of similar design and complexity completed within the past five years.

1. Grace Construction Products: Perm-A Barrier VP.
2. Henry Company, Inc.: Air Bloc 31MR
3. Sika Corporation: Sikagard 530
4. Tremco, Inc.: ExoAir 220.
5. W.R. Meadows, Inc.: Air Shield LMP.
6. Substitutions: Section 01 60 00 - Product Requirements.

B. Fluid-Applied Membrane: Single component acrylic vapor-permeable air barrier membrane, resulting in minimum 30-mil dry thickness.

1. Basis of Design: Perm-A Barrier VP as manufactured by Grace Construction Products.
2. Air permeance: Less than 0.004 cfm/ft2 per ASTM E2178.
3. Water vapor transmission: Not less than 11.2 perms (649.6 ng/Pa x s x sq. m); when tested in accordance with ASTM E96/E96M.
4. Pull adhesion to glass faced wall board: 25 psi or greater per ASTM D4541.
5. Tensile strength: 15 psi or greater per ASTM D412.
6. Solids content: Minimum 50% by volume or weight per ASTM D2369.
7. UV exposure limit: Not more than 180 calendar days; per ASTM D412 and ASTM E96/E96M-Method B.

C. Transition Membrane: Perm-A-Barrier Detail Membrane, fully adhered.

D. Through-Wall Flashing: Perm-A-Barrier Wall Flashing: 0.8 mm (32 mils) of self-adhesive rubberized asphalt integrally bonded to 0.2 mm (8 mil) of cross-laminated, high-density polyethylene film to provide a min. 1.0 mm (40 mil) thick membrane. Membrane shall be interleaved with disposable silicone-coated release paper until installed, conforming with the following:

1. Water Vapor Transmission: ASTM E96/E96M, Method B: 2.9 ng/m2sPa (0.05 perms) max.
2. Water Absorption: ASTM D570: max. 0.1% by weight
3. Puncture Resistance: ASTM E154/E154M : 356 N (80 lbs.) min.
4. Tear Resistance:
5. Initiation ASTM D1004: min. 58 N (13.0 lbs.) M.D.
6. Propagation ASTM D1938 : min. 40 N (9.0 lbs.) M.D.
7. Lap Adhesion at -4ºC (25ºF): ASTM D1876: 880 N/m (5.0 lbs./in.) of width
8. Low Temperature Flexibility ASTM D1970/D1970M: Unaffected to -43ºC (-45ºF)
9. Tensile Strength: ASTM D412, Die C Modified: min. 5.5 MPa (800 psi)
10. Elongation, Ultimate Failure of Rubberized Asphalt: ASTM D412, Die C: min. 200%.

E. Primer: Water based Perm-A-Barrier Primer Plus or WB Primer.

F. Penetrations, terminations, and detailing sealant: Bituthene Liquid Membrane.

G. Joint Sealant: As recommended by the primary system manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify substrate surfaces are durable, free of matter detrimental to adhesion or application of air barrier system. Verify items penetrating substrate are securely anchored and prepared to receive air barrier system.

C. Ensure the following conditions:
   1. Surfaces are sound, dry, even, and free of oil, grease, dirt, excess mortar or other contaminants.
   2. Concrete surfaces are cured and dry, smooth without large voids, loose aggregate, spalled areas, or sharp protrusions.
   3. Masonry joints are full, flush, and completely filled with mortar, and all excess mortar on masonry ties has been removed.
   4. Corners and edges of drywall sheathing panels are properly screw-fastened to avoid any deflection in the final membrane, and all fastener heads are driven flush with the panel surface.
   5. Substrate dryness meets air barrier system manufacturer’s requirements. Test for capillary moisture in substrate by plastic sheet method according to ASTM D4263.
   6. Verify that substrates have cured and aged for minimum time recommended in writing by air-barrier manufacturer.

D. Verify sealants used in sheathing installation are compatible with proposed air barrier membrane. Perform field peel-adhesion test on materials to which sealants are adhered.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. During wall construction install embedded flashings including all membrane through-wall flashings where indicated and as necessary for successful air barrier installation. Install membrane flashing over vertical and horizontal legs of steel shelf angles and over transition between vertical leg and sheathing or CMU substrate.

B. Protect adjacent construction and surfaces not designated to receive air barrier system.

C. Clean loose dust and dirt from surfaces to receive air barrier system by brushing or use of a clean dry cloth.

D. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

E. Do not apply membrane or sealants to surfaces unacceptable to air barrier system manufacturer without corrective action.

F. Fill surface irregularities, voids, and joints in substrate as recommended by system manufacturer, with particular attention to expansion and construction joints. Remove any high spots to ensure uniform surface.

G. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

H. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching material.

I. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

J. On highly dusty or porous substrates apply a scratch coat of liquid membrane prior to spraying to full thickness.

K. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through air barrier and protrusions.

L. Protection of Other Work: Do not allow liquid and mastic compounds to enter and clog drains and conductors. Prevent spillage and migration onto other surfaces of work by masking or otherwise protecting adjoining work.

M. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

3.03 INSTALLATION

A. General: Install transition strip materials and fluid-applied vapor-permeable air and liquid water barrier to prevent air infiltration and exfiltration through the exterior wall construction without prohibiting the movement of water vapor through the wall.
   1. Install materials in accordance with manufacturer’s printed instructions, the approved submittals, and as specified herein.
   2. Do not allow materials to come in contact with other chemically incompatible materials.

B. Reinforcement and Joint Treatments
   1. Reinforce joints, corners, and changes in plane of substrate using air barrier system manufacturer’s approved transition membrane and sealant.
   2. Tape all vertical and horizontal joints in gypsum sheathing using 2-inch wide x continuous mesh wallboard tape or approved transition membrane as recommended by the system manufacturer. Joint gaps greater than 1/4” wide shall be filled with approved mastic or caulk and allowed to fully cure before application of tape. Ensure that open-mesh tape and any remaining joint gap is fully filled with specified-applied membrane material.

C. Priming:
   1. Apply primer for transition strips at rate recommended by manufacturer. Allow primer to dry completely before transition strip application. Prime all wood, metal, painted and shop coated substrates.
   2. Apply as many coats as necessary for proper adhesion.
   3. Prime masonry or concrete substrates with conditioning primer for fluid-applied vapor permeable air barrier as recommended by system manufacturer. Apply as many coats as necessary for proper adhesion. Provide adequate drying time between coats.
   4. Prime glass-fiber faced gypsum sheathing with number of coats as required to achieve proper bonding. Provide adequate drying time between coats.

D. Detailing:

1. Connect vapor permeable air barrier in exterior wall assembly continuously to the air barrier of the roof, to concrete below-grade structures, to windows, curtain wall, storefront, louvers, exterior doors, and other intersection conditions, and perform sealing of penetrations using accessory materials in accordance with system manufacturer's recommendations and approved submittals.
2. Transitions to beams, columns, and similar appurtenances shall be made with system manufacturer's transition membrane.
3. Apply transition strips and flashing to shed water naturally. Seal all sheet edges with permanently flexible termination mastic.
4. Install transition strips in shingle fashion so that any subsequent sheet overlaps sheet below by a minimum of 2-inches. Overlap horizontally adjacent transition strips a minimum of 2-inches. Roll overlaps into place using hand roller.
5. Seal all penetrations with termination mastic, extruded silicone sealant, membrane counter flashing or other material approved by the system manufacturer and the approved submittals.
6. At changes in substrate plane install approved transition material of sealant, mastic, membrane counter flashing or other material approved by the system manufacturer and the approved submittals. Eliminate all sharp 90-degree inside corners and provide a smooth transition from one plane to another.
7. At through-wall flashings provide an additional 6-inch wide strip of manufacturer's recommended membrane counter flashing to seal top of through-wall flashing to fluid-applied membrane. Seal top edge of strip with bead of approved sealant or mastic.
8. At expansion and control joints provide backup for the membrane to accommodate anticipated movement. Provide transition at all joint assemblies.
9. Apply a continuous bead or trowel coat of mastic along membrane seams at reverse-lapped seams, rough cuts, and as recommended by the manufacturer and the approved submittals.
10. Membrane shall be continuously supported by substrate. Provide mechanically fastened non-corrosive sheet metal to span gaps in substrate plane and to make smooth transition from one plane to another.
11. At the end of each working day, seal top edge of self-adhered membrane to substrate with termination mastic.

E. Fluid-Applied Membrane:
1. Ensure that all detailing of wall and sheathing is completed prior to applying the full coverage of fluid-applied membrane.
2. Apply fluid-applied vapor permeable air barrier using spray equipment and methods as required to achieve at a minimum the specified dry film thickness. Dry mil thicknesses thinner than specified shall not be acceptable even if tested and allowed by the system manufacturer.
3. Spray number of coats as required to achieve the specified dry film thickness. Allow for required drying time between each coat.

F. Inspection
1. Installer shall arrange for system manufacturer's field representative shall make a minimum of three inspection trips to the jobsite to review processes and work completed. Representative shall provide written report of relevant observations to the Contractor:
   a. At work commencement.
   b. At nominal 50% completion.
   c. Just prior to system cover-up.

2. All penetrations of the air barrier and paths of air infiltration/exfiltration shall be made airtight. Installer shall inspect completed system with manufacturer's field representative just prior to cover-up and make corrections to any tears, scuffs, cracks, penetrations, or other damage as directed by the manufacturer.

3.04 FIELD QUALITY CONTROL

A. ABAA Quality Assurance Program: Perform examinations, preparation, installation, testing, and inspections under ABAA's Quality Assurance Program.

B. Inspections/Photographs: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Subcontractor responsible for the work, or his agent, shall photograph items to be inspected, unless otherwise indicated, and submit to one copy each to the Architect and Owner in an electronic report printable on 8.5 inch x 11 inch format. Inspections shall include the following:
   1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes. This will require continuous structural support of air-barrier system over the entire area over which it is installed.
   2. Air-barrier dry film thickness.
   3. Maximum exposure time of materials to UV deterioration has not been exceeded.
   4. Surfaces have been primed, if applicable.
   5. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
   6. Termination mastic has been applied on cut edges.
   7. Strips and transition strips have been firmly adhered to substrate.
   8. Compatible materials have been used. Provide letters from manufacturers.
   9. Transitions at changes in direction and structural support at gaps have been provided.
   10. Connections between assemblies (air-barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
   11. All penetrations have been sealed.

C. Air barriers will be considered defective if they do not pass tests and inspections.
   1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
   2. Remove and replace deficient air-barrier components for retesting as specified above.

D. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

E. Prepare test and inspection reports.

3.05 CLEANING AND PROTECTING

A. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

B. Inspect installation just prior to final covering of system, and repair punctures, tears, damaged areas, and inadequately lapped seams with patches of membrane lapped and sealed per manufacturer's recommendations.

C. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
   1. Coordinate scheduling with installation of cover materials to ensure that membrane is not exposed to sunlight longer than recommended by the system manufacturer. Board insulation shall not be installed until fluid-applied membrane is fully cured.
   2. Protect air barrier from exposure to UV light and harmful weather exposure as recommended in writing by manufacturer. If exposed to these conditions for longer than recommended, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed materials according to air-barrier manufacturer's written instructions.
   3. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.

D. Remove masking materials after installation.

END OF SECTION

SECTION 07 42 13

METAL WALL PANELS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Prefinished steel metal panel systems with concealed fasteners.
   2. Related flashings and accessory components.

B. Related Sections:
   1. Section 05 40 00 - Cold-Formed Metal Framing: Stud wall framing system.
   2. Section 05 50 00 – Metal Fabrications: Secondary support framing for perforated screen.
   3. Section 07 21 13 – Thermal Wall Insulation.
   4. Section 07 27 26 – Fluid-Applied Membrane Air Barrier.
   5. Section 07 62 00 – Sheet Metal Flashing and Trim.

1.02 REFERENCES

A. ASTM International:
   1. ASTM A755/A755M - Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products.
   2. ASTM A924/A924M - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
   3. ASTM D226 - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.

1.03 PERFORMANCE REQUIREMENTS

A. Components: Design and size components to withstand dead and live loads caused by positive and negative wind pressure acting normal to plane of wall as calculated in accordance with applicable code.

B. Maximum Allowable Deflection of Panel: 1/180 of span.

C. Movement: Accommodate movement within system without damage to components or deterioration of seals, movement within system; movement between system and perimeter components when subject to seasonal temperature cycling; dynamic loading and release of loads; deflection of structural support framing.

D. Drainage: Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.

1.04 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate dimensions, layout, joints, expansion joints, construction details, methods of anchorage, and interface with adjacent materials.

C. Product Data: Submit data on panels.

D. Samples:
   1. Submit two samples of each type panel and panel finish, 12 x 12 inch (304.8 mm) in size, illustrating panel profile and finish color, sheen, and texture.
   2. Submit two samples of fasteners, closures, and other accessories.

E. Manufacturer's Installation Instructions: Submit special procedures.

1.05 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience.

B. Installer: Company specializing in performing Work of this section with minimum three years' experience and approved by manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Protect panels from accelerated weathering by removing or venting sheet plastic shipping wrap.

C. Store prefinished material off ground protected from weather, to prevent twisting, bending, or abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

D. Prevent contact with materials capable of causing discoloration or staining.

1.07 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Coordinate Work with installation of wall sheathing and dampproofing.

C. Coordinate Work with installation of windows, doors, and adjacent components or materials.

1.08 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Special Fluoropolymer Finish Warranty: Submit a written warranty, signed by manufacturer, covering failure of the factory-applied exterior finish on metal wall panels within the specified warranty period and agreeing to repair finish or replace wall panels that show evidence of finish deterioration. Deterioration of finish includes, but is not limited to, color fade, chalking, cracking, peeling, and loss of film integrity.
   1. Fluoropolymer Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 METAL WALL AND SOFFIT PANELS

A. Manufacturers - Prefinished Galvanized Steel Panels:
   1. Berridge Manufacturing Co. www.berridge.com
   2. Centria www.centria.com
   3. Petersen Aluminum Corp. www.pac-clad.com
   4. Substitutions: Section 01 60 00 - Product Requirements.

2.02 STEEL WALL PANELS

A. Base Material: Prefinished galvanized steel sheet. ASTM A755/A755M coil coated
   1. Base Metal: ASTM A653/A653M; Structural Quality; G90 zinc coating.
   2. Exposed Finish: Faux wood grain fluoropolymer coil coating with minimum 70 percent polyvinylidene fluoride resin.
      a. Color to be selected by the Architect.
         1) Color and wood grain pattern shall be the same matched color for all metal panel types, trim, and flashing provided under this Section.
   3. Unexposed Finish: Manufacturer's standard coating.
   4. Trim, Closure Pieces, and Flashings: Same material, thickness and finish as panel sheets; brake formed to required profiles
   5. 20-year finish warranty.
      a. MWP: Exterior Wall Panels:
         1) Vee-Panel as manufactured by Berridge Manufacturing, Houston, Texas or approved equivalent by specified manufacturer.
         2) Minimum 24 gage prefinished steel stock.
         3) 12-3/4-inch coverage with 3/8-inch deep vee grooves at 4-1/4” centers.
         4) Smooth-faced.
         5) Install horizontally with overlapping and interlocking long edges in shingle style. Panel ends lapped.
         6) Install with stainless steel concealed fasteners.

2.03 ACCESSORIES

A. Sealants: Specified in Section 07 90 00; color to match siding.

B. Fasteners: Manufacturer's standard type to suit application; with soft neoprene washers, stainless steel; fastener cap same color as exterior panel.

C. Field Touch-up Paint: As recommended by panel manufacturer.

D. Slip Sheet: Manufacturer's recommended non-asphaltic, high-perm synthetic slip sheet or drainage mat to prevent adhesion between metal panels and air barrier membrane.

2.04 FABRICATION

A. Form sections to shape indicated on Drawings, accurate in size, square, and free from distortion or defects.

B. Form pieces in longest practicable lengths.

PART 3 EXECUTION

3.01 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify plywood sheathing and bituminous dampproofing are in place and ready to receive metal wall panels.
   1. BUILDING PAPER – Only where specifically required by the panel manufacturer:

C. Install 1 layer building paper over air barrier membrane on walls to receive metal siding.

D. Weather lap edges 6 inches (152.4 mm) and ends minimum 6 inches, minimum.

E. Securely fasten in place.

F. Building paper when required by the panel manufacturer is in addition to specified Air Barrier.

3.02 METAL PANEL INSTALLATION

A. Install panels in accordance with manufacturer’s instructions using manufacturer’s standard flashing and trim details unless modified by Drawings.

B. Protect surfaces in contact with cementitious materials and dissimilar metals with bituminous paint. Allow to dry prior to installation.

C. Fasten wall panels through gypsum sheathing into cold formed metal framing members; space fasteners maximum 16 inches (406.4 mm) on center horizontally and vertically to suit application.

D. Use proper tools to obtain controlled, uniform compression for positive seal without rupture of neoprene washer.

E. Form laps and joints to shed water.

F. Field cutting panels by torch is not permitted.

G. Accessories: Install components necessary for complete wall panel assembly, including trim, flashings, sealants, gaskets, and similar items.

H. Seal and place gaskets to prevent weather penetration. Maintain neat appearance.

I. Installation Tolerances: Shim and align panel units within installed tolerance of 1/4 inch (6.35 mm) in 20 feet (609.6 cm) on level, plumb, and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.03 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Remove site cuttings from finish surfaces.

C. Remove protective films from panel surfaces within 60 days of installation.

D. Clean and wash prefinished surfaces with mild soap and water; rinse with clean water.

END OF SECTION

SECTION 07 54 23

THERMOPLASTIC MEMBRANE ROOFING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Fully adhered TPO roof membrane over insulating concrete roof fill.
   2. Walkway pads.

B. Related Sections:
   1. Section 03 52 16 - Insulating Concrete Roof Fill: Roof deck.
   2. Section 06 10 53 - Miscellaneous Rough Carpentry: Wood nailers.
   3. Section 07 62 00 - Sheet Metal Flashing and Trim: Sheet metal flashing and counterflashing.

1.02 REFERENCES

A. American Society of Civil Engineers:
   1. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.

B. National Roofing Contractors Association:
   1. NRCA - The NRCA Roofing and Waterproofing Manual.

C. Single Ply Roofing Institute:
   1. SPRI ES-1 - Wind Design Standard for Edge Systems used for Low Slope Roofing Systems.

D. Underwriters Laboratories Inc.:
   1. UL - Fire Resistance Directory.
   2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
   3. UL 790 - Tests for Fire Resistance of Roof Covering Materials.

1.03 SYSTEM DESCRIPTION

A. Thermoplastic Sheet Membrane Roofing System: One ply fully adhered with base flashing. System meeting “Cool Roof” aged requirements for Solar Reflectance:

B. Low Sloped Roofs: Roofs with slopes of 2:12 or less shall have Solar reflectance of not less than 0.64 when tested in accordance with ASTM E903, at 3-years after installation under normal conditions.

C. Steep Sloped Roofs: Roofs with slopes steeper than 2:12: Solar reflectance of not less than 0.16 when tested according to ASTM E903, at 3-years after installation under normal conditions

D. Roof Deck:

1. Insulating Concrete Roof Fill: NRCA Specification Plate: Lightweight insulating concrete deck - TP-N-A-S

1.04 PERFORMANCE REQUIREMENTS

A. Wind Uplift: In accordance with ASCE 7 requirements. Refer to Structural Drawings for wind design criteria.

B. Flashings and Fastening: Comply with requirements of Section 07 62 00 - Sheet Metal Flashing and Trim. Provide base flashings, perimeter flashings, detail flashings and component materials and installation techniques that comply with requirements and recommendations of the following:
   1. ANSI/SPRI ES-1 for Perimeter detail, metal edges and copings.
   2. NRCA Roofing and Waterproofing Manual for construction details and recommendations.
   3. SMACNA Architectural Sheet Metal Manual for construction details.

1.05 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate joint and termination detail conditions for membrane and base flashing. Indicate membrane layout and seam locations.

C. Product Data: Submit characteristics on membrane materials, adhesives, seaming materials, flashing materials, walkway pads, and any other roofing products specified.

D. Samples:
   1. Submit two samples of roof membrane, 12 x 12 inch (304.8 mm) in size, including lap seam.
   2. Submit 6 screw fasteners of each type, length, and finish.

E. Manufacturer's Installation Instructions: Submit special precautions required for seaming membrane.

F. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

G. Installer Certificates: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install specified roofing system.

H. Research/Evaluation Reports: Evidence of roofing system's compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.

I. Inspection Report: Copy of roofing system manufacturer's inspection report of completed roofing installation.

1.06 QUALITY ASSURANCE

A. Perform Work in accordance with NRCA Roofing and Waterproofing Manual and manufacturer’s instructions.

B. Fire Rated Roof Construction: Rating as indicated on Drawings.
   1. Tested Rating: Determined in accordance with ASTM E119.

C. Roof Assembly Fire Classification: Class A when tested in accordance with ASTM E108 or UL 790.

D. Apply label from agency approved by authority having jurisdiction to identify each roof assembly component.

1.07 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience.

B. Installer: Experienced and specialized in installing roofing similar to that required for this Project and who is approved, authorized, or licensed by the roofing system manufacturer to install manufacturer's product.

1.08 PRE-INSTALLATION MEETINGS

A. Section 01 31 19 - Project Meetings: Schedule and coordinate pre-installation meeting that includes the trade(s) for the work of this Section and other trades that whose work is related to the work of this Section.

B. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at Project site. Meet with the same participants and review the same items listed for the preinstallation conference. In addition, review status of submittals and coordination of work related to roof construction. Notify participants at least 5 working days before conference.

C. Preinstallation Conference: Before installing roofing system, conduct meeting at Project site. Notify participants at least 5 working days before meeting.
   1. Meet with Owner; Architect; Owner's insurer, if applicable; testing and inspecting agency representative; roofing Installer; roofing system manufacturer's representative; deck Installer; and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
   2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
   3. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
   4. Review loading limitations of deck during and after roofing.
   5. Review flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing.
   6. Review governing regulations and requirements for insurance, certificates, and inspection and testing, if applicable.
   7. Review temporary protection requirements for roofing system during and after installation.
   8. Review roof observation and repair procedures after roofing installation.
   9. Document proceedings, including corrective measures or actions required, and furnish copy of record to each participant.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Deliver products in manufacturer’s original containers, dry, undamaged, with seals and labels intact.

C. Store products in weather protected environment, clear of ground and moisture.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.

B. Do not apply roofing membrane during inclement weather without proper weather protection.

C. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.

D. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed during same day.

1.11 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Coordinate Work with installation of associated roof penetrations and metal flashings, as Work of this section proceeds.

1.12 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.

B. Manufacturer’s Warranty: Furnish 15-year manufacturer's no dollar limit, full system warranty including coverage of materials and installation resulting from failure to resist penetration of moisture.

C. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering Work of this Section, including membrane roofing, sheet flashing, fasteners, and vapor retarders, if any, for the following warranty period:
   1. Warranty Period: 2-years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 SINGLE PLY ROOFING - FULLY ADHERED

A. Manufacturers:
   1. EverGuard TPO, GAF, www.gaf.com.
   2. JM TPO, Johns Manville, www.specjm.com
   3. SureWeld TPO, Carlisle, www.carlisle-syntec.com.
   4. Ultra-Ply TPO, Firestone.
   5. Substitutions: Section 01 60 00 - Product Requirements.

B. Fleece-Back Membrane: TPO, polyester-reinforced, 60 mils (1.524 mm) thick; white color; conforming to the following criteria:

Breaking Strength	AST M D751	330 lbf

Elongation	ASTM D412	30 percent
Seam Strength	ASTM D638	120 lbf
Tear Strength	ASTM D624 ASTM D1004	70 lbf
Permeance	ASTM D96	0.01 Perms
Water Absorption	ASTM D570	0.7 percent
Fleece Backing	Polyester fabric	9 oz per sy.

2.02 COMPONENTS

A. General:

1. Base Flashing: Shall be same material as the white TPO fleece-backed adhered 50 mil (1.27 mm) minimum and be installed using the design principles set forth in the National Roofing Association manual.
    a. Termination Bars: Aluminum bars, 1 inch (25.4 mm) wide, pre-punched for fasteners 6 inches (152.4 mm) oc.
    b. Parapet Caps: Prefinished metal, as specified in Section 07 62 00.
    c. Counterflashings: Stainless steel, as specified in Section 07 62 00.
    d. Prefabricated Roof Specialties: As specified in Section 07 71 00.
    e. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, thickness, and color as sheet membrane.
    f. Bonding Adhesives: Manufacturer's standard bonding adhesives for membrane and flashings.
    g. Fasteners: Factory-coated steel fasteners and metal plates meeting corrosion-resistance provisions of FM 4470, designed for fastening sheet to substrate, and acceptable to roofing system manufacturer.
    h. Fascia, and Edge Flashings: Manufacturer’s 2-piece compression edge, 24 gage thick, galvanized G90; prefinished with two coat fluoropolymer coating with minimum 70 percent polyvinylidene fluoride resin.
        1) Color as indicated or selected by Architect from manufacturer's full custom range.
2. Counterflashings: As specified in Section 07 62 00.
    a. Walkway Pads: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads, approximately 3/32 inch (2.38 mm) thick, of materials acceptable to roofing system manufacturer. Provide at the top and bottom of all roof ladders, around the front and sides all roof hatches, around all serviceable rooftop equipment, and along the full width of all doors leading onto roof areas.
    b. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, seam calk, termination reglets, and other accessories recommended by roofing system manufacturer for intended use.
        1) Over insulating concrete deck.
3. Fleece-backed membrane as specified.
4. Roof Insulation: Integral with roof deck and provided under Section 03 52 16 - Insulating Concrete Roof Fill.
5. Roofing Protection Board: Not applicable for insulating concrete unless required by the membrane manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify surfaces and site conditions are ready to receive Work.

C. Verify deck is supported and secure.

D. Verify deck is clean and smooth, free of depressions, waves, or projections, properly sloped to drains or eaves, and suitable for installation of roof system.

E. Verify deck surfaces are dry and free of snow or ice.

F. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, and wood nailers are in place.

G. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
   1. Conduct fastener pull-out tests to verify that lightweight insulating concrete meets membrane manufacturer’s requirements.
   2. Roofing contractor shall provide to the owners testing laboratory the roofing system manufacturers requirements for dryness, walkability, and compressive strength of installed lightweight insulating concrete prior to roofing installation.

H. Verify that wood nailers have been anchored in accordance with SPRI ES-1 requirements and can resist a minimum force of 300 plf in any direction.

I. Moisture Testing: Take moisture readings for the lightweight insulating concrete deck using moisture meter approved by the roofing manufacturer. Do not install roofing system over deck not meeting dryness requirements as determined by the roofing manufacturer.

3.02 PREPARATION

A. Clean substrate of dust, debris, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.

B. 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.

C. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of the roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roof areas.

3.03 MEMBRANE INSTALLATION

A. Install roofing membrane over insulating concrete roof fil in accordance with roof manufacturer’s written instructions. Unroll roofing membrane and allow to relax before installing.
   1. Install sheet according to ASTM D5082.

2. Start installation of roofing membrane in presence of roofing system manufacturer’s technical personnel.
3. Apply adhesive at rate recommended by membrane manufacturer.
4. Roll out membrane, free from air pockets, wrinkles, or tears. Roll fleece back membrane sheet into place without stretching per manufacturers guidelines.
5. Accurately align roofing membrane sheets and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
6. Apply roofing membrane with side laps shingled with slope of roof deck where possible.
7. Seams: Clean seam areas, overlap roofing membrane, and hot-air weld side and end laps of roofing membrane according to manufacturer’s written instructions to ensure a watertight seam installation. Seams shall be welded daily, no exceptions.
    a. Test lap edges with probe to verify seam weld continuity.
    b. Verify field strength of seams a minimum of twice daily and repair seam sample areas.
    c. Repair tears, voids, and lapped seams in roofing membrane that does not meet requirements.
8. Mechanically fasten membrane around all perimeters, at the base of walls, drains, curbs, vents, and other roof penetrations. Install continuous aluminum termination bar where fully-adhered membrane extends up vertical walls or parapets. Locate as recommended by the membrane manufacturer.
9. Apply water block sealant under deck drain flange at deck drains and securely seal roofing membrane in place with clamping ring.
10. Seal membrane around roof penetrations.
11. Install T-patches over all T-seams.
12. Perimeter Edge: For edge conditions, including parapets, install two-piece compression edge in accordance with manufacturer’s instructions to meet SPRI ES-1 requirements.
13. Install and weld pre-fabricated boots on all pipe penetrations.

B. Base Flashing Installation:
1. Install sheet flashings and preformed flashing accessories and adhere to substrate according to roofing system manufacturer's written instructions.
2. Apply bonding adhesive to substrate and underside of flashing sheet at required rate and allow to partially dry. Do not apply bonding adhesive to seam area of flashing.
3. Flash penetrations and field-formed inside and outside corners with sheet flashing as recommended by manufacturer.
4. Clean seam areas, overlap sheets, and firmly roll flashings into the adhesive. Weld side and end laps to ensure a watertight seam installation.
5. Test lap edges with probe to verify seam weld continuity.
6. Terminate and apply water block seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.04 WALKWAY PADS INSTALLATION:

A. Install walkway pads in locations indicated.

B. Adhere walkway pads to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.05 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Verify field strength of seams a minimum of twice daily, according to manufacturer's written instructions, and repair seam sample areas.

C. Site Visits: Manufacturer or manufacturer’s representative shall visit the project during process minimum of one time per week for the duration of the installation.

D. Final Roof Inspection: Arrange for membrane manufacturer's technical personnel to inspect roofing installation on completion and submit report to the General Contractor and the Architect.
   1. Inspection Report: Copy of roofing system manufacturer's inspection report of completed roofing installation.

3.06 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. In areas where finished surfaces are soiled by Work of this section, consult manufacturer of surfaces for cleaning advice and conform to their documented instructions.
   1. Repair or replace defaced or disfigured finishes caused by Work of this section.

C. Pressure wash clean the entire roof area when the project is complete. Utilize minimal pressure as per membrane manufacturer’s guidelines.

3.07 PROTECTION OF INSTALLED CONSTRUCTION

A. Section 01 70 00 - Execution and Closeout Requirements: Protecting installed construction.
   1. Protect building surfaces against damage from roofing work.

B. Where rolling traffic such as wheelbarrows, or more than occasional foot traffic must continue over finished roof membrane, protect surfaces using temporary plywood walkways.

C. During installation any roofing system subjected to encroachment of water underneath the membrane will require membrane,through-drying of deck system, and replacement of membrane.

END OF SECTION

SECTION 07 61 00

MANUFACTURED SHEET METAL ROOFING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Structural standing seam metal roofing for conventional structure.
   2. Board insulation under metal roofing.
   3. Roofing underlayment.
   4. Metal fascias with continuous fastening cleats, flashings, and trim.

B. Related Sections:
   1. Section 06 10 53 - Miscellaneous Rough Carpentry: Wood blocking.
   2. Section 07 62 00 - Sheet Metal Flashing and Trim.
   3. Section 07 90 00 - Joint Protection.
   4. Section 13 34 19 - Metal Building Systems: Matching non-insulated roofing system for metal building.

1.02 REFERENCES

A. American Society of Civil Engineers:
   1. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.

B. ASTM International:
   1. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   2. ASTM A792 Standard Specification for Steel Sheet, 55% Aluminum-Zinc Ally-Coated by the Hot-Dip Process (Galvalume)
   3. ASTM D226 - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
   4. ASTM E1680 Standard Test Method for Rate of Air Leakage Through Exterior Metal Roof Panel Systems
   5. ASTM E1646 Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference.

C. National Roofing Contractors Association:
   1. NRCA - The NRCA Roofing and Waterproofing Manual.

D. Sheet Metal and Air Conditioning Contractors:
   1. SMACNA - Architectural Sheet Metal Manual.

E. Underwriters Laboratories Inc.:
   1. UL 580 - Tests for Uplift Resistance of Roof Assemblies.

1.03 DESIGN REQUIREMENTS

A. Roof Loads: Design to resist live and dead loads with 1/240 maximum deflection.
   1. Live Loads: As indicated on Drawings.
   2. Dead Loads: Actual weight of materials incorporated into Work.

B. Wind Loads: Design and size components to withstand positive and negative wind loads, including increased loads at building corners.
   1. Design Wind Load: As calculated in accordance with applicable code and ASCE 7.

C. Air Infiltration: Limit air leakage through roof assembly to 1.1 cfm/gross leakage of wall area, measured at reference differential pressure across assembly of 6.24 psf as measured in accordance with ASTM E1680.

D. Water Leakage: None, when measured in accordance with ASTM E1646 with test pressure of 8 psf.

E. Exterior Components: Accommodate the following without damage to system, components or deterioration of seals.
   1. Movement within system.
   2. Movement between system and perimeter framing components.
   3. Dynamic loading and release of loads.
   4. Deflection of structural support framing.
   5. Expansion and contraction from temperature range of 170 degrees Fahrenheit (76.67 degrees Celsius) over 12 hour period.

1.04 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings:
   1. Indicate metal roofing panel profiles, jointing patterns, jointing details, fastening methods, flashings, terminations, and installation details.
   2. Submit additional information as required by manufacturer for special weather-tightness warranty.

C. Product Data:
   1. Submit data on metal types, finishes, and characteristics.
   2. Submit data on roofing panel manufacturer’s recommended corrosion-resistant screw fasteners, including recommended spacing(s) for the specific project.
   3. Submit data on roof insulation and underlayment.
   4. Submit color charts for finish selection.

D. Samples:
   1. Submit two samples illustrating metal roofing mounted on plywood backing illustrating typical seam profile and construction. Include clips, fasteners, seals, and other accessories.
   2. Submit two samples illustrating metal finish color.

E. Design Data:

1. Submit structural design calculations for metal roofing signed and sealed by professional engineer.

F. Manufacturer's Installation Instructions: Submit instructions including special procedures for roofing penetrations, flashings, and perimeter conditions requiring special attention.

G. Manufacturer's Certification: Certify Products meet or exceed specified requirements.

H. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for the following:
1. Metal Roof Panels: Include reports for air infiltration, water penetration, and structural performance.

1.05 QUALITY ASSURANCE

A. Perform Work in accordance with SMACNA Architectural Sheet Metal Manual and The NRCA Roofing and Waterproofing Manual.

1.06 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years' experience.

B. Installer: Company specializing in performing work of this section with minimum years' experience and approved by manufacturer.

C. Design sheet metal roofing system under direct supervision of Professional Engineer experienced in design of this Work and licensed in the State of Texas.

1.07 PRE-INSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

C. Prevent contact with materials causing discoloration or staining.

1.09 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.10 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.

B. Special Finish Warranty: Submit a written warranty, signed by manufacturer, covering failure of the factory-applied exterior finish on metal wall panels within the specified warranty period and agreeing to repair finish or replace wall panels that show evidence of finish deterioration. Deterioration of finish includes, but is not limited to, color fade, chalking, cracking, peeling, and loss of film integrity.
   1. Finish Warranty Period: 20 years from date of Substantial Completion.

C. Special Weather-tightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.
   1. Weathertight Warranty Period: 10 years from date of Substantial Completion.
   2. Include 2-year installer warranty as required by manufacturer for weathertight warranty.

PART 2 PRODUCTS

2.01 MANUFACTURED SHEET METAL ROOFING

A. Manufacturers:
   1. AEP-Span www.aep-span.com
   2. Architectural Building Components (ABC) www.archmetalroof.com
   3. Berridge Manufacturing Co. www.berridge.com
   4. Centria www.centria.com
   5. Metal Building Components, Inc. www.mbci.com
   6. Petersen Aluminum Corp. www.pac-clad.com
   7. Substitutions: Section 01 60 00 - Product Requirements.

B. Basis-of-Design: Berridge Zee-Lock Panel with zinc-coated (galvanized) Zee-Clips and vinyl weatherseal.

C. Structural Standing Seam Metal Roofing: Factory formed metal roofing panel system with concealed fasteners, designed for installation over conventional framing.
   1. Panel Materials: Pre-finished galvanized steel sheet, 24 gage base metal thickness.
   2. Panel Width: Nominal 16 inches (406.4 mm).
   3. Panel Profile: Flat panel with striated surface.
   4. Joint Type: Single folded.
   5. Seam Type: Sanding seam, field locked.
   6. Seam Height: 2 inches (50.8 mm).
   7. Color: As selected.

2.02 SHEET METAL MATERIALS

A. Pre-Finished Galvanized Steel Sheet: ASTM A792/A792M; Structural Quality; AZ50 or AZ55 aluminum-zinc alloy-coated steel.
   1. Base Metal: ASTM A792/A792M; Structural Quality; AZ50 or AZ55 aluminum-zinc alloy-coated steel.
   2. Exposed Finish: Minimum two coat fluoropolymer coating with minimum 70 percent polyvinylidene fluoride resin.
   3. Unexposed Finish: Manufacturer’s standard coating.

2.03 UNDERLAYMENT

A. Plastic Faced Waterproofing Membrane: Self-adhering, high-temperature sheet; 40-mils 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.
   1. Thermal Stability: Stable after testing at 240 degrees Fahrenheit (115.56 degrees Celsius); ASTM D 1970.
   2. Low Temperature Flexibility: Passes after testing at minus 20 degrees Fahrenheit (-6.67 degrees Celsius); ASTM D 1970.
   3. Available Products:
      a. Dri-Start "HR."; Carlisle Coatings & Waterproofing www.carlisle-ccw.com
      b. Grace Ultra; W. R. Grace, & Co. www.grace.com
      c. Perma-Seal PE.; Henry Company www.henry.com
      d. MetShield; Metal-Fab Manufacturing, LLC. www.met-fab.com
      e. WIP 300HT; TC MiraDRI. www.mirafi.com

2.04 INSULATION

A. Polyisocyanurate Board Insulation: Unfaced, preformed, rigid, cellular, polyisocyanurate thermal insulation complying with ASTM C591, Type 2, with aged thermal-resistance values for 1-inch thickness of 6.2 degrees Fahrenheit (-14.33 degrees Celsius) x h x sq. ft./Btu at 75 degrees Fahrenheit (23.89 degrees Celsius).
   1. Total insulation thickness: As required for R-values and thicknesses as indicated in the drawings.

B. Attachment Method: Two-component, low-rise polyurethane foam adhesive specifically formulated for bonding rigid insulation to galvanized steel roof decks.

2.05 ACCESSORIES

A. Individual Standing Seam Clips: galvanized steel clips, height as required to clear insulation thickness, designed for puddle-weld attachment to steel deck flutes.
   1. Clip Attachment: Clips shall be specifically designed for structural puddle-welding to the top flutes of the metal deck.

B. Vinyl Weatherseal: Manufacturer’s standard vinyl seal, profile as required to fit panel seams.

C. Fasteners: Puddle welds per AWS D1.3. Mechanical screw fasteners are permitted only for secondary trim-to-trim attachments not visible from the building interior.

D. Sealant: As specified in Section 07 90 00.

E. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.

F. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat, unless otherwise indicated. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.06 FABRICATION

A. Form sections shape as indicated on Drawings, accurate in size, square, and free from distortion or defects.

B. Fabricate fascia, trim, flashing, and other metal components from same material as metal roof panels. Provide exposed metal surfaces with same finish as exposed face of metal roof panels.

C. Fabricate fastening cleats of same material as sheet, to interlock with sheet. Cleats shall be continuous.

D. Fabricate starter strips of same material as sheet, continuous, to interlock with sheet.

E. Form roof panels in single length sheets, continuous from eave to ridge.

F. Hem exposed edges on underside 1/2 inch (12.7 mm); miter and seam corners.

G. At moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.

H. Fabricate corners from one piece with minimum 18-inch long legs; seam for rigidity, seal with sealant.

I. Fabricate vertical faces with bottom edge formed outward 1/4 inch (6.35 mm) and hemmed to form drip.

PART 3 EXECUTION

3.01 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Steel Deck Substrate:
   1. Inspect roof deck to verify deck is clean and smooth, free of depressions, waves, or projections, and properly sloped to eaves.
   2. Cleanliness: Verify that the top surface of the Epic Deck is free of processing oils, dust, or moisture. Any residue that could impair the bond of the polyurethane adhesive must be removed using a manufacturer-approved solvent or cleaning agent.
   3. Verify deck is dry and free of snow and ice. Verify substrate joints are solidly supported and fastened.
   4. Verify wood nailers are installed and correctly located.

C. Verify roof openings, curbs, pipes, sleeves, ducts, or vents through roof are solidly set, reglets are in place, and nailing strips located.

D. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 INSTALLATION – SECONDARY STRUCTURAL SUPPORTS

A. Where secondary structural supports for roofing panels are required or indicated, install secondary structural supports in accordance with manufacturer’s recommendations and approved shop drawings.

B. Align supports with top surface in plane, uniformly sloped to valleys and eaves.

C. Install supports spaced maximum feet on center. Provide support at roof panel end laps.

D. Secure supports to building structural frame using mechanical fasteners. Welding is not permitted.

3.03 INSTALLATION - ROOF INSULATION

A. Adhesive Application:
   1. Method: Apply insulation adhesive in continuous ribbons (beads) to the top flutes of the metal deck.
   2. Spacing: Bead spacing shall comply with the most stringent requirements of the manufacturer’s wind uplift testing for the project’s wind zone (typically 6 inches o.c. at corners/perimeters and 12 inches o.c. in the field).
   3. Ribbon Size: Ensure ribbons are sized to achieve a minimum 1-inch wide contact area when the insulation board is set.

B. Setting Boards:
   1. Timing: Place insulation boards into the adhesive while it is still "tacky" and before it begins to skin over.
   2. Compression: Immediately walk-in the boards or use weighted rollers to ensure full contact with the adhesive ribbons.

C. Coordination with Puddle-Welded Clips:
   1. Fitting: Neatly cut and notch insulation boards around the puddle-welded standoff clips.
   2. Gap Control: Ensure gaps around clips do not exceed 1/4 inch; fill any excessive voids with spray-applied polyurethane foam to maintain thermal continuity.

D. Install insulation with long joints in continuous straight lines, perpendicular to roof slope, with end joints staggered between rows.
   1. Cut and fit insulation within 1/4 inch (6.35 mm) of nailers, projections, and penetrations.

E. Where overall insulation thickness is 2-inches or greater, install insulation in two layers with joints of second layer staggered from joints of first layer a minimum of 6 inches (152.4 mm) in each direction.

3.04 INSTALLATION - UNDERLAYMENT

A. Apply one layer plastic-faced waterproof membrane underlayment over entire roof area as follows:
   1. Adhere underlayment to faced insulation.
   2. Install parallel to slope with joints lapped minimum 2 inches (50.8 mm).
   3. Stagger end joints minimum 8 inches (203.2 mm).
   4. Install perpendicular to slope with edges weather lapped minimum 2-inches.

3.05 INSTALLATION - STANDING SEAM METAL ROOFING

A. Conform to SMACNA, NRCA, and manufacturer’s instructions.

B. Install continuous Zee Ribs to secure roof panels without deforming roof panels.

C. Install roofing panels with long dimension perpendicular to eaves.

D. Install vinyl weather seal in seam to achieve manufacturer's weather-tightness warranty.

E. Machine lock standing seam between adjacent roofing panels. Hand lock joints where machine locking is not possible.

F. Accessories: Install components required for a complete roof assembly, including trim, copings, fasciae, continuous fastening cleats, ridge closures, flashings, sealants, gaskets, fillers, closure strips, and similar items.

G. Separate dissimilar metals by painting each metal surface in area of contact with a bituminous coating, by applying rubberized-asphalt underlayment to each metal surface, or by other permanent separation as recommended by manufacturers of dissimilar metals.

H. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not otherwise indicated, types recommended by panel manufacturer.

3.06 PROTECTION OF INSTALLED CONSTRUCTION

A. Section 01 70 00 - Execution and Closeout Requirements: Protecting installed construction.

B. Do not permit traffic over unprotected roof surface.

END OF SECTION

SECTION 07 62 00

SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 SUMMARY

A. Section includes fabricated sheet metal items, including:
   1. Flashings and counter flashings not a part of Unit Masonry systems.
   2. Roof fascias and gravel stops.
   3. Gutters and downspouts.
   4. Metal trim not part of manufactured roof or wall systems.

B. Related Sections:
   1. Section 04 20 00 - Unit Masonry Assemblies: Flashings embedded in masonry.
   2. Section 07 54 04 - Thermoplastic Membrane Roofing: Roof fascias, gravel stops, and expansion joints.
   3. Section 07 90 00 - Joint Protection.

1.02 REFERENCES

A. American Society of Civil Engineers:
   1. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.

B. ASTM International:
   1. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
   2. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   3. ASTM A755/A755M - Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Pre-painted by the Coil-Coating Process for Exterior Exposed Building Products.
   4. ASTM B32 - Standard Specification for Solder Metal.
   5. ASTM D226 - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
   6. ASTM D4586 - Standard Specification for Asphalt Roof Cement, Asbestos-Free.

C. Federal Specification Unit:
   1. FS TT-C-494 - Coating Compound, Bituminous, Solvent Type, Acid Resistant.

D. Sheet Metal and Air Conditioning Contractors:
   1. SMACNA - Architectural Sheet Metal Manual.

E. Single Ply Roofing Institute:
   1. SPRI ES-1 - Wind Design Guide for Edge Systems Used with Low-Slope Roofing Systems.

1.03 PERFORMANCE REQUIREMENTS

A. General: Manufacture and install items of this Section to resist thermally induced movement and exposure to weather without failing, rattling, leaking, and fastener disengagement.

B. Manufacture and install copings and roof edge flashings tested according to SPRI ES-1 and capable of resisting the area wind zone pressures in accordance with ASCE 7 requirements.

1.04 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

C. Product Data: Submit data on manufactured components metal types, finishes, and characteristics.

D. Samples: Submit two samples of each exposed metal finish.

E. Product Test Reports: Submit report based on evaluation of comprehensive tests performed by a qualified testing agency, verifying compliance of copings and roof edge flashings with performance requirements.

1.05 QUALIFICATIONS

A. Installer: Engage an experience Installer who has completed sheet metal flashing and trim work similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

1.06 PRE-INSTALLATION MEETINGS

A. Section 01 31 19 – Project Meetings: Schedule and coordinate pre-installation meeting that includes the trade(s) for the work of this Section and other trades that whose work is related to the work of this Section.

B. Convene minimum one week prior to commencing work of this Section.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

C. Prevent contact with materials causing discoloration or staining.

1.08 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Special Finish Warranty for Prefinished Steel Sheet: Submit a written warranty, signed by manufacturer, covering failure of the factory-applied exterior finish on metal wall panels within the specified warranty period and agreeing to repair finish or replace wall panels that show evidence of finish deterioration. Deterioration of finish includes, but is not limited to, color fade, chalking, cracking, peeling, and loss of film integrity.
   1. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 SHEET METAL FLASHING AND TRIM

A. Pre-Finished Galvanized Steel Sheet: ASTM A755/A755M coil coated.
   1. Base Metal: ASTM A653/A653M; Structural Quality; G90 zinc coating, minimum 24 gage thick.
   2. Exposed Finish: Minimum two coat fluoropolymer coating with minimum 70 percent polyvinylidene fluoride resin.
   3. Unexposed Finish: Manufacturer's standard coating.

B. Stainless Steel: ASTM A240/240M; Type 304, dead soft fully annealed; smooth surface, Number 2D finish; minimum 24 gage thick.

2.02 ACCESSORIES

A. Fasteners: Stainless steel, with soft neoprene washers. Match finish of exposed heads with material being fastened.

B. Underlayment: Self-adhering, high-temperature, non-asphaltic slip sheet compatible with fluid-applied air barrier and prefinished metal finishes

C. Protective Backing Paint: FS TT-C-494, Bituminous.

D. Sealant: As specified in Section 07 90 00.

E. Plastic Cement: ASTM D4586, Type I.

F. Solder: ASTM B32; type suitable for application and material being soldered.

2.03 FABRICATION

A. Form sections shape indicated on Drawings, accurate in size, square, and free from distortion or defects.

B. Fabricate cleats of same material as sheet metal, interlocking with sheet.

C. Form pieces in longest possible lengths.

D. Hem exposed edges on underside 1/2 inch (12.7 mm); miter and seam corners.

E. Form nonmoving seams with flat lock seams, except where otherwise indicated. At moving joints, use sealed lapped, bayonet-type or interlocking hooked seams. Form seams and joints in accordance with SMACNA standards.

F. Fabricate corners from one piece with minimum 18 inch (457.2 mm) long legs; seam and seal prefinished steel, solder stainless steel.

G. Fabricate vertical faces with bottom edge formed outward 1/4 inch (6.35 mm) and hemmed to form drip.

H. Separate metal from non-compatible metal or corrosive substrates by coating concealed surfaces at locations of contact with asphalt mastic or other permanent separation as recommended by manufacturer.

I. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of sheet metal exposed to public view.

J. Fabricate gutters to rectangular profile as indicated on Drawings.

K. Fabricate downspouts to square profile, 4-1/2 x 4-1/2 inch (114 mm) size unless indicated otherwise.

L. Fabricate accessories in profile and size to suit gutters and downspouts:
   1. Anchorage Devices: In accordance with SMACNA requirements.
   2. Gutter Supports: Brackets and straps.
   3. Downspout Supports: Straps.

M. Seal metal joints.

PART 3 EXECUTION

3.01 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, and nailing strips located.
   1. Verify that wood nailers have been anchored in accordance with SPRI ES-1 requirements.

C. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 PREPARATION

A. Install starter and edge strips, and cleats before starting installation.

B. Paint concealed metal surfaces with protective paint to minimum dry film thickness of 15-mil.

3.03 INSTALLATION

A. Install sheet metal flashing and trim in accordance with SMACNA requirements.

B. Secure flashings in place using concealed fasteners wherever possible. Use exposed fasteners only where not exposed to public view.

C. Install flashings embedded in roofing system in accordance with roofing manufacturer's details and instructions to meet SPRI ES-1 requirements.

D. Install edge flashings in accordance with Section 07 54 05 to meet SPRI ES-1 requirements.

E. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.

F. Expansion Provisions: Provide for thermal expansion of exposed sheet metal Work. Space movement joints at maximum of 10 feet (304.8 cm) with no joints allowed within 18 inches (457.2 mm) of corner or intersection. Where lapped or bayonet-type expansion provisions in Work cannot be used or would not be sufficiently weatherproof and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25.4 mm) deep, filled with mastic sealant (concealed within joints).

G. Secure gutters and downspouts in place.

H. Slope gutters minimum 1/4 inch (6.35 mm) per foot.

I. Seal metal joints watertight.

3.04 SCHEDULE

A. Gutters with Girth up to 20-Inches: Prefinished steel, 24 gage.

B. Gutters with Girth 20 to 25-inches: Prefinished steel, 22 gage.

C. Downspouts: Prefinished steel, 24-gage.

D. Scuppers: Stainless steel, 24-gage.

E. Gravel Stops and Fasciae: Two-piece snap-on edge flashings by roof membrane manufacturer.

F. Exposed Trim: Prefinished steel, 24-gage.

G. Counterflashings and Receivers: Stainless steel, 24-gage.

H. Roof Expansion Joints: Stainless steel, 24-gage.

I. Equipment Support and Roof Penetration Flashing: Stainless steel, 24-gage.

END OF SECTION

SECTION 07 71 00

ROOF SPECIALTIES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Roof curbs and equipment supports.

B. Related Sections:
   1. Section 06 10 53 - Miscellaneous Rough Carpentry: Wood curbs.
   2. Section 07 54 04 - Thermoplastic Membrane Roofing.
   3. Section 07 72 33 - Roof Hatches.
   4. Section 07 62 00 - Sheet Metal Flashing and Trim: Metal flashings.

1.02 REFERENCES

A. ASTM International:
   1. ASTM D4586 - Standard Specification for Asphalt Roof Cement, Asbestos-Free.

B. National Roofing Contractors Association:
   1. NRCA - The NRCA Roofing and Waterproofing Manual.

C. Sheet Metal and Air Conditioning Contractors:
   1. SMACNA - Architectural Sheet Metal Manual.

1.03 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: For each type of roof accessory indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

C. Manufacturer's Installation Instructions: Submit instructions for special procedures and perimeter conditions requiring special attention.

1.04 QUALITY ASSURANCE

A. Perform Work in accordance with SMACNA and NRCA details.

1.05 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 or roof expansion joints.

PART 2 PRODUCTS

2.01 ROOF CURBS AND EQUIPMENT SUPPORTS

A. Roof Curbs: Provide metal roof curbs and equipment supports, internally reinforced and capable of supporting superimposed live and dead loads, including equipment loads and other construction to be supported. Fabricate with welded or sealed mechanical corner joints, with integral formed mounting flange at perimeter bottom. Coordinate dimensions with rough-in information or shop drawings of equipment to be supported.

B. Manufacturers:
   1. Custom Curb, Inc.
   2. Roof Products, Inc. www.rpicurbs.com
   3. ThyCurb www.thybar.com
   4. Uni-Curb, Inc.
   5. Vent Products Company, Inc. www.ventprod.com

C. Load Requirements: As indicated.

D. Material: Minimum 0.050” thick aluminum or minimum 24-gage series 300 stainless steel.

E. Factory install wood nailers at tops of curbs and supports.

F. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.

G. Factory insulate curbs with 1-1/2 inch (38 mm) thick glass fiber board insulation.

H. Fabricate units to minimum height of 10 inches (304.8 mm) above finished membrane of adjacent roof surface, unless otherwise indicated.

I. Sloping Roofs: Fabricate curbs and equipment supports with height tapered to match slope to level tops of units.
   1. Where slope of roof exceeds 1:48, fabricate units with water diverter or cricket.

J. Sealant: As specified in Section 07 90 00.

K. Roofing Cement: As recommended by roofing system manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify deck, curbs, roof membrane, base flashing, and other items affecting Work of this section are in place and positioned correctly.

3.02 INSTALLATION

A. Conform to SMACNA - Architectural Sheet Metal Manual and NRCA - Waterproofing Manual.

B. Coordinate installation of components of this section with installation of roofing system and base flashings.

C. Install roof curbs and equipment supports so that top surface of unit is level.

D. Coordinate installation of sealants and roofing cement with Work of this section to ensure water tightness.

END OF SECTION

SECTION 07 72 33

ROOF HATCHES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Roof hatches.
   2. Roof hatch safety railing.

B. Related Sections:
   1. Section 06 10 53 - Miscellaneous Rough Carpentry: Wood curbs.
   2. Section 07 54 23 - Thermoplastic Membrane Roofing.
   3. Section 07 62 00 - Sheet Metal Flashing and Trim: Metal flashings.
   4. Section 07 71 00 - Roof Specialties.

1.02 REFERENCES

A. Underwriters Laboratories Inc.:
   1. UL - Building Materials Directory.

1.03 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit data on unit construction, sizes, configuration, jointing methods and locations when applicable, and attachment method.

C. Manufacturer's Installation Instructions: Indicate special installation criteria and interface with adjacent components.

1.04 QUALITY ASSURANCE

A. Perform Work in accordance with SMACNA and NRCA details.

PART 2 PRODUCTS

2.01 ROOF HATCHES

A. Manufacturers:
   1. Babcock-Davis www.babcockdavis.com
   2. Bilco Company www.bilco.com
   3. Custom Curb, Inc. www.customcurb.com
   4. Milcor Inc. www.milcorinc.com
   5. Nystrom, Inc. www.nystrom.com
   6. O'Keeffe's Inc. www.okeeffes.com

7. Roof Products, Inc. www.rpicurbs.com
8. ThyCurb www.thybar.com
9. Uni-Curb, Inc.
10. Vent Products Company, Inc. www.ventprod.com
11. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description: Manufacturer’s standard aluminum, with nominal 12-inch high integral curb, double-wall insulated type.

C. Size: 2’-6” x 3’-0” single-leaf, for ladder access.

D. Loads: Minimum 40-lbf/sq.ft. external live load and 30-lbf/sq.ft. uplift.

E. Integral Aluminum Curb: Minimum 11 gage mill finished aluminum; nominal 1-inch rigid glass fiber insulation; integral cap flashing to receive roof flashings; extended flange for mounting.

F. Flush Aluminum Cover: Minimum 11-gage mill finish aluminum; nominal 1-inch glass fiber or insulation; minimum 18 gage aluminum interior liner; continuous neoprene or vinyl gasket to provide weatherproof seal.

G. Hardware: Manufacturer’s standard Cadmium plated finish:
1. Compression spring operator;
2. Steel manual pull handle for interior and exterior operation;
3. Steel hold open arm with vinyl covered grip handle for easy release,
4. Padlock hasp.
5. Hinges: Manufacturer's recommended type for specific type of roof hatch.

H. Safety Railings: Manufacturer's integral hatch railing and gate system curb-mounted on 3 sides of the hatch.
1. Swinging gate automatically latches in the closed position. Non-roof-penetrating attachment.
2. Fabricated from fiberglass-reinforced polymer pipe and finished in safety yellow factory-applied paint. Mounting brackets Hot dip galvanized steel.
3. 25-year manufacturer’s warranty.
4. Basis of Design: Bil-Guard as manufactured by Bilco.

2.02 ACCESSORIES

A. Anchorage Devices: Type recommended by manufacturer.

B. Counterflashings: Same metal type and finish as roof hatch frame.

C. Protective Coating: Bituminous, FS TT-C-494.

D. Sealant: As specified in Section 07 90 00.

2.03 FABRICATION

A. Fabricate components free of visual distortion and free of defects. Weld corners and joints.

B. Provide for condensation occurring within components and within assembly to drain to exterior above roofing.

C. Fit components for weather tight assembly.

D. Sloped Roofs: Fabricate roof hatch curbs tapered to maintain hatch top level.

PART 3 EXECUTION

3.01 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify openings and substrate conditions are ready to receive Work of this section.

3.02 PREPARATION

A. Apply protective coating on aluminum surfaces of roof hatches to be in contact with cementitious materials or dissimilar metals.

3.03 INSTALLATION

A. Install curb assembly, fastening securely to roof decking. Flash curb assembly into roof system.

B. Place roof hatch and secure to curb assembly. Install integral setting sealant and counterflashing as required.

C. Final installation to be watertight assembly.

D. Coordinate with installation of roofing system and related flashings for weather tight installation.

E. Apply bituminous paint on surfaces of units in contact with cementitious materials or dissimilar metals.

F. Adjust hinges for smooth operation.

G. Install safety railing in accordance with manufacturer’s printed instructions.

3.04 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Wash down exposed surfaces; wipe surfaces clean.

C. Remove excess sealant.

END OF SECTION

SECTION 07 81 00

APPLIED FIREPROOFING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
1. Spray-on cementitious fireproofing for interior exposed and concealed structural steel where indicated.
2. Intumescent paint fireproofing for interior and exterior exposed structural steel.

B. Related Sections:
1. Section 05 12 00 - Structural Steel.
2. Section 05 21 00 - Steel Joist.
3. Section 07 84 00 - Firestopping.

1.02 REFERENCES

A. ASTM International:
1. ASTM C847 - Standard Specification for Metal Lath.
2. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
3. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
4. ASTM E605 - Standard Test Methods for Thickness and Density of Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members.
5. ASTM E736 - Standard Test Method for Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members.
6. ASTM E760 - Standard Test Method for Effect of Impact on Bonding of Sprayed Fire-Resistive Material Applied to Structural Members.
7. ASTM E761 - Standard Test Method for Compressive Strength of Sprayed Fire-Resistive Material Applied to Structural Members.
8. ASTM E859 - Standard Test Method for Air Erosion of Sprayed Fire-Resistive Materials (SFRMs) Applied to Structural Members.
9. ASTM E937 - Standard Test Method for Corrosion of Steel by Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members.
10. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

B. National Fire Protection Association:
1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

C. Underwriters Laboratories Inc.:
1. UL - Fire Resistance Directory.
2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.

1.03 PERFORMANCE REQUIREMENTS

A. Applied (Sprayed-On) Fireproofing Systems: Provide fire rated assembly ratings as indicated on Drawings.

B. Air Erosion: Maximum 0.025 gram/sq. ft allowable weight loss of fireproofing when tested in accordance with ASTM E859.

C. Corrosion: No contribution to corrosion of steel test panels when tested in accordance with ASTM E937.

D. Mold Resistance: Material to show resistance to fungi growth when tested in accordance with ASTM C665 requirements for fungi resistance of insulation or ASTM G21.

1.04 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data:
   1. Submit data for each type of fireproofing specified, indicating product characteristics, performance criteria, and limitations of use.

C. Test Reports: Indicate the following:
   1. Compressive Strength: ASTM E761.
   2. Dry Density: ASTM E605.
   3. Bond Strength of Fireproofing: ASTM E736.
   4. Bond Impact: ASTM E760.
   5. Fire test reports of fireproofing application to substrate materials, including primers, similar to Project conditions, conducted in conformance to ASTM E84 and ASTM E119.
   6. Air Erosion: ASTM E859.
   7. Corrosion: ASTM E937.
   8. Mold Resistance: ASTM C665 or ASTM G21.

D. Intumescent Paint Fireproofing Systems Test Reports: Indicate the following:
   1. Fire test reports of fireproofing application to substrate materials, including primers, similar to Project conditions, conducted in conformance to ASTM E84 and ASTM E119.

E. Manufacturer's Installation Instructions: Submit information including special procedures, and conditions requiring special attention.

F. Manufacturer's Certificate: Certify applied fireproofing products meet or exceed specified requirements.
   1. Certify applied fireproofing products contain no asbestos or other finely-divided particulate matter that can be released as airborne health hazard during or after application.

G. Manufacturer's Field Reports: Indicate compliance with manufacturer’s installation instructions and Contract Documents.

1.05 QUALITY ASSURANCE

A. Fireproofing Assembly: Rating as indicated on Drawings.

1. Tested Rating: Determined in accordance with ASTM E119.

B. Surface Burning Characteristics: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

1.06 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section, with minimum three years' experience.

B. Applicator: Company specializing in performing Work of this section, with minimum three years' experience and approved by manufacturer.

1.07 PRE-INSTALLATION MEETINGS

A. Section 01 31 19 – Project Meetings: Schedule and coordinate pre-installation meeting that includes the trade(s) for the work of this Section and other trades that whose work is related to the work of this Section.

B. Convene minimum one week prior to commencing work of this Section.

1.08 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

B. Maintain minimum ambient and substrate temperature of 40 degrees Fahrenheit (4.44 degrees Celsius) during and for minimum 24 hours after application of fireproofing, unless otherwise recommended by manufacturer.

C. Provide ventilation in areas to receive fireproofing during application and 24 hours afterward, to dry applied material.

1.09 SEQUENCING

A. Section 01 10 00 - Summary: Work sequence.

B. Sequence Work in conjunction with placement of masonry anchors and ties, partition track, and mechanical component hangers.

C. Provide temporary enclosure as required to confine spraying operations and protect the environment.

D. Provide temporary enclosures for applications to prevent deterioration of fire-resistive material due to exposure to weather and to unfavorable ambient conditions for humidity, temperature, and ventilation.

E. Avoid unnecessary exposure of fire-resistive material to abrasion and other damage likely to occur during construction operations subsequent to its application.

F. Do not apply fire-resistive material to metal roof deck substrates until concrete topping, if any, has been completed. For metal roof decks without concrete topping, do not apply fire-resistive material to metal roof deck substrates until roofing has been completed; prohibit roof traffic during application and drying of fire-resistive material.

G. Do not apply fire-resistive material to metal floor deck substrates until concrete topping has been completed.

H. Do not begin applying fire-resistive material until clips, hangers, supports, sleeves, and other items penetrating fire protection are in place.

I. Defer installing ducts, piping, and other items that would interfere with applying fire-resistive material until application of fire protection is completed.

J. Do not install enclosing or concealing construction until after fire-resistive material has been applied, inspected, and tested and corrections have been made to defective applications.

1.10 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Special Warranty: Manufacturer's standard form, signed by Contractor and by Installer, in which manufacturer agrees to repair or replace sprayed fire-resistive materials that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:
   1. Cracking, flaking, spalling, or eroding in excess of specified requirements; peeling; or delaminating of sprayed fire-resistive materials from substrates.
   2. Not covered under the warranty are failures due to damage by occupants and Owner's maintenance personnel, exposure to environmental conditions other than those investigated and approved during fire-response testing, and other causes not reasonably foreseeable under conditions of normal use.

C. Warranty Period: Two years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 CONCEALED SPRAY-ON CEMENTITIOUS FIREPROOFING

A. Manufacturers:
   1. Carboline Co., Pyrocrete www.carboline.com
   2. W. R. Grace & Co., Monokote Type MK-6/HY www.grace.com
   3. Isolatek International Corp., Cafco 300 www.cafco.com
   4. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description:
   1. Low Density Cementitious Type: Factory mixed, cementitious material blended for uniform texture with vermiculite or lightweight synthetic aggregate, and conforming to the following requirements:
      a. Type: As recommended by manufacturer for concealed interior applications.
      b. Compressive Strength: ASTM E761, minimum 5.21 psi (34.47 kPa).
      c. Dry Density: ASTM E605, minimum average density of 15 lb/cu ft.
      d. Bond Strength: ASTM E736, 150 psf when set and dry.
      e. Bond Impact: ASTM E760, no cracking, flaking or delamination.

2.02 EXPOSED SPRAY-ON CEMENTITIOUS FIREPROOFING

A. Manufacturers:
   1. Carboline Co., Pyrocrete 241 www.carboline.com
   2. W. R. Grace & Co., Monokote Type Z106 www.grace.com
   3. Isolatek International Corp., Cafco 400 www.cafco.com
   4. Pyrok, Inc., Pyrok-MD www.pyrokinc.com
   5. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description:
   1. Medium Density Cementitious Type: Factory mixed, portland cement blended for uniform texture with mineral aggregates or mineral fibers and additives, without chlorides, approved for exterior use and conforming to the following requirements:
      a. Type: As recommended by manufacturer for exposed interior applications, and for concealed exterior use.
      b. Compressive Strength: ASTM E761, minimum 51 psi (351.63 kPa).
      c. Dry Density: ASTM E605, minimum density of 22 lb/cu ft.
      d. Bond Strength: ASTM E736, 434 psf when set and dry.
      e. Bond Impact: ASTM E760, no cracking, flaking or delamination.

2.03 INTUMESCENT PAINT FIREPROOFING

A. Manufacturers:
   1. AD Fire Protection Systems, www.adfire.com.
   2. Albi Manufacturing, www.albi.com.
   3. Isolatek International Corp., www.cafco.com.
   4. Substitutions: Section 01 60 00 - Product Requirements.

B. Interior Thin-Film Fire-Resistant Intumescent Mastic Coating: Water-based, factory-mixed formulation, for interior use, consisting of intumescent coating and finish coat applied over primed steel. Provide compatible finish coat in color indicated.
   1. Basis-of-Design: Isolatek International Corp., Cafco SprayFilm-WB 3.

C. Exterior Thin-Film Fire-Resistant Intumescent Mastic Coating: Water-based, factory-mixed formulation, for exterior use, consisting of intumescent coating, topseal, and finish coat applied over primed steel. Provide compatible finish coat in color indicated.
   1. Basis-of-Design: Isolatek International Corp., Cafco SprayFilm-WB 4 Topseal.

2.04 ACCESSORIES

A. Primer, Adhesive, Bonding Agent, and Topseal as recommended by fireproofing manufacturer.

B. Metal Lath: Expanded metal lath where required for cementitious fireproofing; 3.4 lb/sq ft, galvanized finish; conform to ASTM C847.

C. Water: Clean, potable.

PART 3 EXECUTION

3.01 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify surfaces are ready to receive fireproofing.

C. Verify clips, hangers, supports, sleeves, and other items required to penetrate fireproofing are in place.

D. Verify ducts, piping, equipment, or other items interfering with application of fireproofing have not been installed.

E. Verify voids and cracks in substrate have been filled. Verify projections have been removed where fireproofing will be exposed to view as finish material.

F. Verify roof traffic has ceased and roof mounted equipment is in place.

G. Ensure that all steel members and sections scheduled to receive fireproofing have been properly prepared by the fabricator to receive the specified fireproofing application.

3.02 PREPARATION

A. Perform tests as recommended by fireproofing manufacturer in situations where adhesion of fireproofing to substrate is in question.

B. Remove incompatible materials affecting bond by scraping, brushing, scrubbing, or sandblasting.

C. Prepare substrates to receive fireproofing.

D. Apply fireproofing manufacturer's recommended bonding agent on primed steel.

E. Protect surfaces not scheduled for fireproofing and equipment from damage by overspray, fall-out, and dusting.

F. Close off and seal duct work in areas where fireproofing is being applied.

3.03 APPLICATION - SPRAY-ON CEMENTITIOUS FIREPROOFING

A. Install metal lath over steel members as required by fire rated assembly Design Numbers.

B. Apply primer or adhesive as required by fireproofing manufacturer for conditions encountered.

C. Apply fireproofing in sufficient thickness to achieve required fire ratings, with as many passes as necessary to cover with monolithic blanket of uniform density and texture.

D. In exposed locations, trowel surface smooth and form square edges, using tools and procedures recommended by fireproofing manufacturer.

E. Patch damaged work.

3.04 APPLICATION - INTUMESCENT PAINT FIREPROOFING

A. Verify compatibility of primer with intumescent coating.

B. Apply intumescent coating to primed steel in accordance with manufacturer's instructions.

C. Apply intumescent coating in sufficient thickness to achieve indicated fire rating with as many passes necessary.

D. Follow manufacturer's instructions for drying time between successive coats and before application of finish coat.

E. Apply seal coat over intumescent coating at exterior locations, in accordance with manufacturer's instructions.

F. Apply finish coat, in color indicated, in accordance with manufacturer's instructions.

3.05 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and to prepare test reports.

C. Independent Testing Agency To:
   1. Inspect fireproofing substrates prior to application of fireproofing for surface temperature and surface preparation in accordance with manufacturer's instructions.
   2. Inspect installed fireproofing after application and curing for integrity, prior to its concealment.
   3. Test frequency and type in accordance with applicable code and authorities having jurisdiction.
   4. Inspect for the following:
      a. Installed Thicknesses and Density: ASTM E605.
      b. Bond Strengths: ASTM E736.
   5. Re-inspect installed fireproofing for integrity of fire protection, after installation of subsequent Work.

3.06 MANUFACTURER'S FIELD SERVICES

A. Section 01 40 00 - Quality Requirements: Manufacturers’ field services.

B. Observe site conditions, conditions of surfaces and installation, quality of workmanship, and initiate instructions when necessary.

C. Manufacturer's Field Reports: Document above observations; include environmental conditions under which fireproofing materials were installed.

3.07 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Remove excess material, overspray, droppings, and debris.

C. Remove fireproofing from materials and surfaces not required to be fireproofed.

D. At exposed fireproofing, clean surfaces that have become soiled or stained, using manufacturer's recommended procedures.

END OF SECTION

SECTION 07 84 00

FIRESTOPPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Firestopping of joints and penetrations in fire-resistance-rated and smoke-resistant assemblies, whether indicated on drawings or not, and other openings indicated.

B. Protection Provided Under Other Sections – Where no reference to protection of penetrations is provided under the following Sections or their related drawings, then such protection shall be provided under the requirements of this Section 07 84 00:

1. Division 4 Sections - Masonry and mortar used for fireproofing and firestopping.
2. Division 9 Sections - Drywall systems and accessories used for fireproofing and firestopping.
3. Division 21 Sections - Penetrations by fire suppression piping.
4. Division 22 Sections - Penetrations by plumbing piping.
5. Division 23 Sections - Penetrations of HVAC equipment including ducting, wiring, and piping.
6. Division 26 Sections - Penetrations of electrical equipment including raceways, conduit, boxes, outlets, panels, and cabinets.
7. Division 27 Sections - Penetrations of communication and technology equipment including wiring, conduit, outlets, panels, and boxes.
8. Division 28 Sections - Penetrations of electronic safety and security equipment including wiring, conduit, outlets, panels, and boxes.

1.02 REFERENCE STANDARDS

A. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).

B. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.

C. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2023a.

D. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems; 2015 (Reapproved 2019).

E. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestop Systems; 2020a.

F. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers; 2020a.

G. ASTM E2307 - Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus; 2023b.

H. ASTM E2837 - Standard Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed between Rated Wall Assemblies and Nonrated Horizontal Assemblies; 2023a.

I. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems; Current Edition, Including All Revisions.

1.03 DEFINITIONS

A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.
   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.

C. Product Data: Provide data on product characteristics, performance ratings, and limitations.

D. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.

E. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.

F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

G. Manufacturer's qualification statement.

H. Installer's qualification statement.

I. Substitutions: Refer to "Default Joint Schedule of Joint Firestop Systems" at the end of this section for special substitution requirements.

J. Closeout Submittals:
   1. Installer Certificates: From Installer indicating that joint firestopping systems have been instaled in compliance with requiremnets and manufacturer's written instructions.

1.05 QUALITY ASSURANCE

A. Fire Testing: Provide firestopping assemblies of designs that provide the specified fire ratings when tested in accordance with methods indicated.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Installer Qualifications: Company specializing in performing the work of this section and:
   1. 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 UL's "Qualified Firestop Contractor Program Requirements."

D. Through Penetration Firestopping of Non-Fire Rated Floor and Roof Assemblies: Materials to resist free passage of flame and products of combustion.
   1. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.

E. Fire Resistant Joints in Fire Rated Floor, Roof, and Wall Assemblies: ASTM E1966 or UL 2079 to achieve fire resistant rating as indicated on Drawings for assembly in which joint is installed.

F. Fire Resistant Joints Between Floor Slabs and Exterior Walls: ASTM E119 with 0.10 inch water gage minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.

G. A qualified inspection agency shall check installed firestopping systems for compliance with requirements.

1.06 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.07 MOCK-UPS

A. Install one firestopping assembly representative of each fire rating design required on project.
   1. Where one design may be used for different penetrating items or in different wall constructions, install one assembly for each different combination.
   2. Where firestopping is intended to fill a linear opening, install at least 1 linear foot (0.305 linear m) of firestopping.

B. If accepted, mock-up will represent minimum standard for this work.

C. If accepted, mock-up may remain as part of this work if undisturbed at time of Subsantial Completion, if allowed by and coordinated with the Architect in the field. Remove and replace mock-ups not accepted.

D. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.08 FIELD CONDITIONS

A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.
   1. Do not apply materials when temperature of substrate material and ambient air is below 60 degrees F.

B. Provide natural ventilation per manufacturer's written instructions in areas where solvent-cured materials are being installed. If natural ventilation is not adequate, provide forced-air circulation.

1.09 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

C. Coordinate sizing of joints to accommodate joint firestopping systems.

1.10 DELIVERY, STORAGE AND HANDLING

A. Deliver firestopping products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer; date of manufacture; lot number; shelf life, if applicable; qualified testing and inspecting agency's classification marking applicable to Project; curing time; and mixing instructions for multicomponent materials.

B. Store and handle firestopping materials to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Penetration and Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated or adjoined. Penetration and Joint Firestopping Systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any. Subject to compliance with requirements, provide products by one of the following manufacturers:
   1. 3M Fire Protection Products: www.3m.com/firestop
   2. A/D Fire Protection Systems Inc: www.adfire.com
   3. Grabber Construction Products, Inc; GrabberGard EFC: www.grabberman.com
   4. Hilti, Inc: www.hilti.com/
   5. HoldRite, a Brand of Reliance Worldwide Corporation; HydroFlame: www.holdrite.com/#sle.
   6. Passive Fire Protection Partners; Firestop 3600EX: www.firestop.com
   7. NUCO Inc.; http://sealantcentre.com
   8. RectorSeal; www.rectorseal.com
   9. STC Architectural Products; www.stcsoundseal.com/
   10. Specified Technologies Inc: www.stifirestop.com
   11. Tremco Commercial Sealants & Waterproofing; TREMstop Acrylic: www.tremcosealants.com
   12. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 MATERIALS

A. Firestopping Materials
   1. 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.

2. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
3. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
4. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.
5. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.
6. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
7. 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 non-shrinking, homogeneous mortar.
8. 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.
9. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.
10. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

B. Mixing 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.

C. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.

2.03 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:
1. Conform to applicable code for fire resistance ratings and surface burning characteristics.
2. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
3. Test per testing standards referenced in "Firestopping Assembly Requirements" Article. Provide rated systems complying with the following requirements:
    a. Penetration 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."

2.04 FIRESTOPPING ASSEMBLY REQUIREMENTS

A. General: A qualified inspection agency shall check installed firestopping systems for compliance with requirements.

B. Perimeter Fire Containment Firestopping: Use system that has been tested according to ASTM E2307 to have fire resistance F Rating equal to required fire rating of floor assembly.

C. Head-of-Wall (HW) Joint System Firestopping at Joints Between Fire-Rated Wall Assemblies and Non-Rated Horizontal Assemblies: Use system that has been tested according to ASTM E2837 to have fire resistance F Rating equal to required fire rating of wall assembly.

D. Floor-to-Floor (FF), Floor-to-Wall (FW), Head-of-Wall (HW), and Wall-to-Wall (WW) Joints, Except Perimeter, Where Both Are Fire-Rated: Use system that has been tested according to ASTM E1966 or UL 2079 to have fire resistance F Rating equal to required fire rating of the assembly in which the joint occurs.

E. Through Penetration Firestopping: Use system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.
   1. Through Penetration Firestopping of Fire Rated Assemblies: UL 1479 or ASTM E814 with 0.01 inch water gage minimum positive pressure differential to achieve fire F-Ratings and temperature T-Ratings as indicated, but not less than 1-hour.
      a. Wall Penetrations: Fire F-Ratings as indicated on Drawings, but not less than 1-hour.
      b. Floor and Roof Penetrations: Fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.

F. Floor Penetrations Within Wall Cavities: T-Rating is not required.

G. Through Penetration Firestopping of Non-Fire Rated Floor and Roof Assemblies: Materials to resist free passage of flame and products of combustion.
   1. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.
   2. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.
   3. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479 applicable to F-Rating and T-Rating, hourly-rated systems, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
      a. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
      b. Ratings in "T-Rating" Subparagraph below indicate resistance to excessive thermal transmission.
      c. 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.
      d. Unrated Assemblies: An approved fill, void or cavity material that is, 1) tested in the form and manner intended for use to demonstrate that it will stay in place, 2) classified for use in through-penetration firestop systems. Firestopping is required in the annular space between the face of the penetrating item and the face of the floor opening, to resist the passage of flame and the products of combustion.

H. Fire Resistant Joints Between Floor Slabs and Exterior Walls: ASTM E119 with 0.01 inch water gage minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.

I. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg (74.7 Pa).

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.

J. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E 84.

K. 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. Retain accessories in subparagraphs below required.

L. Permanent forming/damming/backing materials.
1. Substrate primers.
2. Collars.
3. Steel sleeves.

M. Joints at Exterior Curtain-Wall/Floor Intersections: Provide joint firestopping systems with rating determined per ASTM E 2307.

N. Acoustically Rated Firestopping: Provide system tested in accordance with ASTM E90 with STC rating 50 to match penetrated assembly, minimum.

2.05 FIRESTOPPING FOR PERIMETER CONTAINMENT
1. Subject to compliance with requirements, products which may be incorporated in the Work include, but are not limited to, the following:
2. F-Rating: Equal to or exceeding the fire-resistance rating of the floor assembly.
3. Basis of Design: HI/BPF 120-10 Perimeter Fire Barriers Firestop Joint Spray DFS-SP WB by Hilti, Inc. www.us.hilti.com/ Engineering Judgements are required for this system to be used differently than tested.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify openings are ready to receive the work of this section.

B. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:
1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.

2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. 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.

D. Remove incompatible materials that could adversely affect bond.

E. Install backing materials to prevent liquid material from leakage.

3.03 INSTALLATION

A. Install materials in manner described in fire test report and in accordance with manufacturer's written instructions, completely closing openings. For this job, firestopping is required at all penetrations in all floors, rated and unrated, and includes, but is not limited to pipes, cables and conduits. Due to the variable and complex nature of what is required by the Building Code for unrated floors, and the desire to simplify the job with a single requirement, all penetrations in both unrated floors and rated floors are required to be treated with firestopping material, including penetrations within rated “shafts”. Any firestopping **within** rated “shafts” is not required to be rated, as the rated “shaft” will provide the rated separation of atmospheres between floors. If a penetration exits a “shaft” terminus at a floor, the penetration firestopping at the floor penetration shall be rated equal to the higher rating of either the rated “shaft” or the floor.

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 by proven techniques to produce the following results:
1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
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 the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.
4. Tool nonsag sealants immediately after sealant application and prior to the time skinning or curing begins. Form smooth, uniform beads of configuration indicated or required to produce fire-resistance rating, as well as to eliminate air pockets, and to ensure contact and adhesion of sealants with sides of joint. Remove excess sealant from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

D. Install elastomeric 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.

3.04 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) on center where structural bays are more than 30 feet wide. Where structural bays are shorter than 30 feet wide, locate wall identification at each structural bay, or fraction of structural bay width.

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. Designation of applicable testing and inspecting agency.
   4. Date of installation.
   5. Manufacturer's name.
   6. Installer's name.

C. 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 - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
   2. Contractor's name, address, and phone number.
   3. Designation of applicable testing agency.
   4. Date of installation.
   5. Manufacturer's name.
   6. Installer's name.

3.05 FIELD QUALITY CONTROL

A. Independent Testing Agency: Inspection agency employed and paid by Owner, will examine penetration firestopping in accordance with ASTM E2174 and ASTM E2393.

B. Repair or replace penetration firestopping and joints at locations where inspection results indicate firestopping or joints do not meet specified requirements, where deficiencies are found or penetration firestopping system is damaged or removed because of testing

C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.06 CLEANING

A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.

3.07 PROTECTION

A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.

END OF SECTION

SECTION 07 90 00

JOINT PROTECTION

PART 1 GENERAL

1.01 SUMMARY

A. Section includes sealants and joint backing, pre-compressed foam sealers, and accessories for control joints and joints between dissimilar materials where not a part of work specified under other sections. Sealant for specified systems such as roofing, waterproofing, air barriers, firestopping, glazing, sidewalks, paving, plumbing is provided under those sections.

B. Sections Related to Work Under This Section:
   1. Section 03 30 00 – Cast-In-Place Concrete: Sealant at expansion and control joints in interior and exterior walls, and in exposed interior concrete floors.
   2. Section 04 20 00 – Unit Masonry Assemblies: Sealant at expansion and control joints.
   3. Section 08 11 13 – Standard steel Doors and Frames: Perimeter sealant at interior and exterior door frames.
   4. Section 08 41 13 – Aluminum Framed Entrances and Storefronts: Perimeter joints
   5. Section 08 91 00 - Louvers: Perimeter joints between louvers and adjacent materials.
   6. Section 09 21 16 - Gypsum Board Assemblies: Joints between drywall assemblies and adjacent materials.

C. Sealant Work Specified in Other Sections:
   1. Section 06 20 24 - Finish Carpentry and Millwork: Sealant between millwork assemblies and adjacent materials.
   2. Section 07 84 00 - Firestopping: Sealant as part of firestopping assemblies.
   3. Section 08 80 00 - Glazing: Glazing sealants.
   4. Section 09 21 16 - Gypsum Board Assemblies: Acoustic sealant at drywall partitions.
   5. Section 09 30 00 - Tiling: Sealant as part of tiling systems, including expansion and control joints.
   6. Section 12 32 16 - Plastic Laminate-Clad Casework: Sealant between casework assemblies and adjacent materials.
   7. Division 22 Sections: Sealants as part of plumbing systems and fixture installations.
   8. Division 32 Sections: Sealants at paving and sidewalk joints.

1.02 REFERENCES

A. ASTM International:
   1. ASTM C834 - Standard Specification for Latex Sealants.
   2. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.
   3. ASTM C1193 - Standard Guide for Use of Joint Sealants.
   4. ASTM D1056 - Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.
   5. ASTM D1667 - Standard Specification for Flexible Cellular Materials-Vinyl Chloride Polymers and Copolymers (Closed-Cell Foam).

6. ASTM D2628 - Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements.

1.03 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Products Data: Submit data indicating sealant chemical characteristics, performance criteria, substrate preparation, limitations, and color availability.

C. Samples: Submit two samples illustrating sealant colors for selection.

D. Manufacturer's Installation Instructions: Submit special procedures, surface preparation, and perimeter conditions requiring special attention.

E. Warranty: Include coverage for installed sealants and accessories failing to achieve watertight seal, exhibit loss of adhesion or cohesion, and sealants which do not cure.

1.04 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years’ experience.

B. Applicator: Company specializing in performing Work of this section with minimum three years’ experience.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

B. Maintain temperature and humidity recommended by sealant manufacturer during and after installation.

1.06 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Coordinate Work with sections referencing this section.

PART 2 PRODUCTS

2.01 JOINT SEALERS

A. Manufacturers:
1. Dow Corning Corp. www.dowcorning.com.
2. GE Silicones www.gesilicones.com.
3. Pecora Corp. www.pecora.com.
4. Sika Corp. www.sikaconstruction.com.
5. Tremco Sealants & Waterproofing www.tremco.com.
6. Substitutions: Section 01 60 00 - Product Requirements.

2.02 EXTERIOR SEALANTS:

A. Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
   1. Movement Capability: Plus and minus 50 percent, minimum.
      a. Non-Staining To Porous Stone: Non-staining to light-colored natural stone when tested in accordance with ASTM C1248.
   2. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
   3. Hardness Range: 15 to 35, Shore A, when tested in accordance with ASTM C661.
   4. Color: To be selected by Architect from manufacturer's standard range.
   5. Service Temperature Range: minus 65 to 180 degrees Fahrenheit (82.22 degrees Celsius).
   6. Applications: Use for:
      a. Exposed exterior joints between metal wall panels.
      b. Joints between unframed edges of glass panels without vertical mullions.
         1) Perimeter joints separating metal door frames, window frames, and louvers, vents and similar items from exterior wall materials.
   7. Manufacturers:
      a. Basis of Design: Dow Chemical Company; DOW 795 Silicone Building Sealant: Required for all exposed building sealant joints including masonry control and expansion joints, perimeter frame joints. May be used other concealed applications such as setting of thresholds and sill plates, or as substitute for butyl or polyisobutylene below. Color(s) selected by the Architect from manufacturer’s minimum of 15 colors.
      b. Alternate products:
         1) Pecora Corporation; Pecora AVB Silicone: www.pecora.com.
         2) Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
         3) Substitutions: See Section 01 60 00 - Product Requirements.

B. Exterior Metal Lap Joint Sealant: Butyl or polyisobutylene, non-drying, non-skinning, non-curing (or specified silicone above).
   1. Type: Butyl Sealant manufactured by Tremco.
   2. Applications: Use for concealed sealant bead in sheet metal work and concealed sealant bead in siding overlaps.

C. Exterior Foam Expansion Joint Sealer: Precompressed foam sealer; Polyurethane with water-repellent, +/- 25 percent movement capability.
   1. Color: Face color as selected.
   2. Size: As required to provide watertight and airtight seal when installed.
   3. Applications: Use for exterior wall expansion joints.
   4. Manufacturers:
   5. Basis of design: Colorseal; Emseal Corp. www.emseal.com.
   6. Alternate products:
      a. Polytite R or Polytite Standard; Dayton Superior www.daytonsuperior.com.
      b. Illmod 600; Tremco www.tremco.com.
      c. Willseal 600; Willseal USA LLP www.willsealusa.com.
      d. Substitutions: Section 01 60 00 - Product Requirements.

2.03 INTERIOR SEALANTS:

A. General Purpose Interior Sealant: Acrylic emulsion latex; ASTM C834, single component, paintable.
   1. Type: Tremflex 834 manufactured by Tremco.
   2. Color: Standard colors matching finished surfaces.
   3. Applications: Use for interior wall and ceiling control joints, joints between door and window frames and wall surfaces, and other interior joints for which no other type of sealant is indicated.
   4. For interior control joints in brick, unpainted concrete masonry, cast stone, or stone, use General Purpose Exterior Sealant.

B. General Purpose Interior Traffic Bearing Sealant: Polyurethane; ASTM C920, Type S, Grade P, Class 50, Use T; single- component, semi self-leveling.
   1. Type: Vulkem 45 SSL manufactured by Tremco.
   2. Color: Standard colors matching finished surfaces.
   3. Applications: Use for interior pedestrian traffic bearing joints.

2.04 ACCESSORIES

A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.
   1. Interior Sealants and Sealant Primers: Maximum volatile organic compound content in accordance with SCAQMD Rule 1168.
   2. Prime for every sealant joint – no exceptions.

B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.

C. Joint Backing: Round foam rod compatible with sealant; ASTM D1056, sponge or expanded rubber; oversized 30 to 50 percent larger than joint width.

D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

PART 3 EXECUTION

3.01 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify substrate surfaces and joint openings are ready to receive work.

C. Verify joint backing and release tapes are compatible with sealant.

3.02 PREPARATION

A. Remove loose materials and foreign matter impairing adhesion of sealant.

B. Clean and prime joints.

C. Perform preparation in accordance with ASTM C1193.

D. Protect elements surrounding Work of this section from damage or disfiguration.

3.03 INSTALLATION

A. Perform installation in accordance with ASTM C1193.

B. Measure joint dimensions and size joint backers to achieve the following:
   1. Width/depth ratio of 2: 1.
   2. Neck dimension no greater than 1/3 of joint width.
   3. Surface bond area on each side not less than 75 percent of joint width.

C. Install bond breaker where joint backing is not used.

D. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.

E. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

F. Tool joints concave.

G. Pre-compressed Foam Sealant: Do not stretch; avoid joints except at corners, ends, and intersections; install with face 1/8 to 1/4 inch (6.35 mm) below adjoining surface.

3.04 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Clean adjacent soiled surfaces.

3.05 PROTECTION OF INSTALLED CONSTRUCTION

A. Section 01 70 00 - Execution and Closeout Requirements: Protecting installed construction.

B. Protect sealants until cured.

END OF SECTION

SECTION 07 95 00

PREMANUFACTURED EXPANSION JOINT SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: The following types of metal expansion joint covers:
   1. Interior pedestrian traffic joints.
   2. Interior wall and ceiling joints.
   3. Interior soffit joints.

B. Related Sections:
   1. Section 03 30 00 - Cast-In-Place Concrete: Block-outs and cast-in anchorage and frames for expansion joint systems in concrete floors, parking decks, and walls.
   2. Section 07 62 00 - Sheet Metal Flashing and Trim: Sheet metal roof and wall joint systems.
   3. Section 07 90 00 - Joint Protection; Elastomeric sealants and preformed compressed-foam sealants without metal frames.

1.02 DEFINITIONS

A. Expansion Joint System: Any filler or cover used to span, fill, cover, or seal a joint, except expanding foam seals and applied sealants.

B. Cyclic Movement: Periodic change between widest and narrowest joint widths in an automatically mechanically controlled system.

C. Fire Barriers: Any material or material combination, when fire tested after cycling, designated to resist passage of flame and hot gases through a movement joint.

D. Movement Capability: Value obtained from the difference between widest and narrowest widths of a joint opening typically expressed in numerical values (mm or inches) or a percentage of nominal value of joint width.

E. Revise below if it is impossible either to indicate nominal joint widths based on a prediction when the joint system will be installed or, if none is indicated, to establish them based on maximum and minimum joint widths.

F. Nominal Joint Width: Width of linear gap indicated as representing the conditions existing when expansion joint systems will be installed or, if no nominal joint width is indicated, a width equal to the sum of maximum and minimum joint widths divided by two.

1.03 PERFORMANCE REQUIREMENTS

A. General: Provide factory-fabricated expansion joint systems capable of withstanding the types of loads and of accommodating the kinds of movement, and the other functions for which they are designed including those specified below, without failure. Types of failure include those listed in Appendix X3 of ASTM E1399.
   1. Pedestrian Traffic Joints: Support pedestrian traffic across joint.

2. Joints in Fire-Resistance-Rated Assemblies: Maintain fire-resistance ratings of assemblies.
3. Joints in Smoke Barriers: Maintain integrity of smoke barrier.
4. Joints in Acoustically Rated Assemblies: Inhibit passage of airborne noise.
5. Other Joints: Where indicated, provide joint systems that prevent penetration of water, moisture, and other substances deleterious to building components or content.
6. Joints in Surfaces with Architectural Finishes: Serve as finished expansion joint closures.

1.04 SUBMITTALS

A. Product Data: Include manufacturer's product specifications, construction details, material and finish descriptions, and dimensions of individual components and seals.

B. Shop Drawings: For each joint system specified, provide the following:
1. Placement Drawings: Include line diagrams showing entire route of each joint system, plans, elevations, sections, details, joints, splices, locations of joints and splices, and attachments to other Work. Where joint systems change planes, provide Isometric Drawings depicting how components interconnect to achieve continuity of joint covers and fillers.

C. Samples for Verification: Full-size units 6 inches (152.4 mm) long of each type of joint system indicated; in sets for each finish, color, texture, and pattern specified, showing the full range of variations expected in these characteristics.

D. Product Test Reports: From a qualified testing agency indicating expansion joint systems comply with requirements, based on comprehensive testing of current products.

E. Research/Evaluation Reports: Evidence of expansion joint system's compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.

1.05 QUALITY ASSURANCE

A. Source Limitations: Obtain expansion joint systems through one source from a single manufacturer. Coordinate compatibility with adjoining joint systems specified in other Sections.

B. Fire-Test-Response Characteristics: Where indicated, provide joint systems incorporating fire barriers that are identical to those of assemblies tested for fire resistance per ASTM E119 and UL 2079, including hose-stream test of vertical wall assemblies, by a testing and inspecting agency acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design Products: The design for each expansion joint system specified in Part 2 "Expansion Joint Systems" Article below is based on the products named. Subject to compliance with requirements, provide either the named products or comparable products by one of the other manufacturers listed.

2.02 MATERIALS

A. Aluminum: ASTM B221 (((ASTM B221M))), alloy 6063-T5 for extrusions; ASTM B 209 (ASTM B 209M), 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. Preformed Seals: Single or multicellular extruded elastomeric seals designed with or without continuous, longitudinal, internal baffles. Formed to be installed in frames or with anchored flanges, in color indicated or, if not indicated, as selected by Architect from manufacturer's standard colors.

C. 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.

D. Accessories: Manufacturer's standard anchors, clips, fasteners, set screws, spacers, flexible moisture barrier and filler materials, drain tubes, lubricants, adhesives, and other accessories compatible with material in contact, as indicated or required for complete installations.

2.03 EXPANSION JOINT SYSTEMS

A. General: Provide joint systems of design, basic profile, materials, and operation indicated. Provide units with the capability to accommodate joint widths indicated and variations in adjacent surfaces.
   1. Furnish units in longest practicable lengths to minimize number of end joints. Provide hairline mitered corners where joint changes directions or abuts other materials.
   2. Include closure materials and transition pieces, tee-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous joint systems.
   3. Public Arena Seals: Non-slip seals designed for installation on treads and risers and to lie flat with adjacent surfaces and complying with ADA guidelines for public areas.
   4. Nominal Joint Widths: As indicated.
   5. Type of Movement Capability: Expansion and contraction.
   6. Preformed Seal Material: Manufacturer's standard.
      a. Seal Color: Selected by Architect.
   7. Exposed Frame Material: Aluminum.
   8. Fire-Resistance Ratings: For joint systems at rated conditions, provide manufacturer's standard fire barrier with a rating not less than that of adjacent construction.

B. Basis-of-Design Products: The design for each expansion joint system specified below is based on the products named. Subject to compliance with requirements, provide either the named products or comparable products by one of the following manufacturers:
   1. Architectural Art Manufacturing, Inc. www.archart.com
   2. Balco Metalines, www.balcousa.com
   3. Construction Specialties, Inc. www.c-sgroup.com
   4. InPro Corp. www.inprocorp.com.
   5. MM Systems, Inc. www.mmsystemscorp.com

C. Expansion Joint System: Metal frames and preformed seals for the following interior conditions:
   1. Floor-to-Floor Joints, Basis-of-Design Product: Construction Specialties, Inc.; "ALS" Series.

2. Floor-to-Wall Joints, Basis-of-Design Product: Construction Specialties, Inc.; ″ALSW″ Series.
3. Wall-to-Wall Joints, Basis-of-Design Product: Construction Specialties, Inc.; ″AFW″ Series.
4. Wall-to-Ceiling Joints, Basis-of-Design Product: Construction Specialties, Inc.; ″FCSC″ Series
5. Ceiling-to-Ceiling Joints, Basis-of-Design Product: Construction Specialties, Inc.; ″FCS″ Series.
6. Wall-to-Soffit Joints, Basis-of-Design Product: Construction Specialties, Inc.; ″FCSC″ Series.
7. Soffit-to-Soffit Joints, Basis-of-Design Product: Construction Specialties, Inc.; ″FCS″ Series.

2.04 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.

2.05 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Mill Finish: AA-M10 (Mechanical Finish: as fabricated; no other applied finish unless buffing is required to remove scratches, welding, or grinding produced in fabrication process.
   1. Provide at floor conditions unless otherwise indicated.

C. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: Non-specular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0 inch (0.01 mm) or thicker) complying with AAMA 607.1.
   1. Provide at wall, ceiling, and soffit conditions unless otherwise indicated.

PART 3 EXECUTION

3.01 PREPARATION

A. Prepare substrates according to expansion joint system manufacturer's written instructions.

B. Coordinate and furnish anchorages, Placement Drawings, and instructions for installing joint systems to be embedded in or anchored to concrete or to have recesses formed into edges of concrete slab for later placement and grouting-in of frames.

C. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary to secure joint systems to in-place construction, including threaded fasteners with drilled-in expansion shields for masonry and concrete where anchoring members are not embedded in concrete. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of joint systems.

3.02 INSTALLATION

A. Comply with manufacturer's written instructions for handling and installing expansion joint assemblies and materials, unless more stringent requirements are indicated.

B. Coordinate installation of expansion joint assembly materials and associated work so complete assemblies comply with assembly performance requirements.

C. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required to install joint systems.
   1. Install joint cover assemblies in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
   2. Allow adequate free movement for thermal expansion and contraction of metal to avoid buckling.
   3. Set covers in horizontal surfaces at elevations that place exposed surfaces flush with adjoining finishes.
   4. Locate wall, ceiling, and soffit covers in continuous contact with adjacent surfaces.
   5. Securely attach in place with required accessories.
   6. Locate anchors at interval recommended by manufacturer, but not less than 3 inches (76.2 mm) from each end and not more than 24 inches (609.6 mm) o.c.

D. Continuity: Maintain continuity of joint systems with a minimum number of end joints and align metal members. Cut and fit ends to produce joints that will accommodate thermal expansion and contraction of metal to avoid buckling of frames. Adhere flexible filler materials, if any, to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.

E. Extruded Preformed Seals: Install seals to comply with manufacturer's written instructions and with minimum number of end joints.
   1. For straight sections, provide preformed seals in continuous lengths.
   2. Vulcanize or heat-weld field splice joints in preformed seal material to provide watertight joints using procedures recommended by manufacturer.
   3. Apply adhesive, epoxy, or lubricant adhesive approved by manufacturer to both frame interfaces before installing preformed seals.
   4. Seal transitions according to manufacturer's written instructions.

F. Seismic Seals: Install interior seals in continuous lengths. Install exterior seal in standard lengths and vulcanize or heat-weld field splice joints to provide watertight joints using manufacturer's recommended procedures. Seal transitions and end joints according to manufacturer's written instructions.

G. Fire Barriers: Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and end joints.

3.03 CLEANING AND 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.

END OF SECTION

SECTION 08 11 13

STANDARD STEEL DOORS AND FRAMES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Steel frames for doors, sidelights, and windows.

B. Related Sections:
   1. Section 08 14 16 - Flush Wood Doors: For wood veneered or plastic laminate clad doors set in steel frames.
   2. Section 08 71 00 - Door Hardware: For finish hardware requirements of steel frames.
   3. Section 08 80 00 - Glazing: For glazing panels set in steel frames and glass lights set in steel door faces.
   4. Section 09 90 00 - Painting and Coating: Field painting of shop-primed steel doors and frames.

1.02 REFERENCES

A. American National Standards Institute:
   1. ANSI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.

B. ASTM International:
   1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
   2. ASTM E413 - Standard Classification for Rating Sound Insulation.

C. National Fire Protection Association:
   1. NFPA 80 - Standard for Fire Doors, Fire Windows.
   2. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies.
   3. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

D. Steel Door Institute:
   1. SDI 108 - Recommended Selection and Usage Guide for Standard Steel Doors.

E. Underwriters Laboratories Inc.:
   1. UL 10B - Fire Tests of Door Assemblies.

1.03 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings: Indicate door elevations, frame elevations, internal reinforcement, anchor types and spacing, door closure method, and cut-outs for hardware, glazing, and louvers.

C. Product Data: Submit door configurations, frame configurations, location of cut-outs for hardware reinforcement.

D. Manufacturer's Installation Instructions: Submit special installation instructions.

E. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

F. Oversize Construction Certificates: For door assemblies required to be fire rated and exceeding size limitations of labeled assemblies.

1.04 QUALITY ASSURANCE

A. Perform Work in accordance with ANSI A250.8.

B. Fire Rated Door and Frame Construction: Conform to NFPA 252.

C. Installed Fire Rated Door Assembly: Conform to NFPA 80 for fire rated class as indicated on Drawings.

D. Attach label from agency approved by authority having jurisdiction to identify each fire rated door and frame.

E. Surface Burning Characteristics:
   1. Foam Insulation in Fire Rated Doors: Maximum 75/450 flame spread/smoke developed index when tested in accordance with ASTM E84.
   2. Apply label from agency approved by authority having jurisdiction to identify each foam plastic insulation board.

1.05 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years’ experience.

B. Installer: Company specializing in performing work of this section with minimum 3 years’ experience and approved by manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Accept doors and frames on site in manufacturer's packaging. Inspect for damage.

C. Break seal on site to permit ventilation.

1.07 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

B. Coordinate Work with door opening construction, door frame, and door hardware installation.

C. Coordinate installation to accommodate door hardware electric wire connections.

PART 2 PRODUCTS

2.01 STANDARD STEEL FRAMES

A. Manufacturers:
1. Amweld Building Products www.amweld.com
2. Ceco Door www.cecodoor.com
3. Curries www.curries.com
4. Deansteel Manufacturing, Inc. www.deansteel.com
5. Kewanee Corporation www.kewaneecorp.com
6. Mesker Door, Inc. www.meskerdoor.com
7. Pearland Industries
8. Pioneer Industries Inc. www.pioneerindustries.com
9. Republic Doors and Frames www.republicdoor.com
10. Substitutions: Section 01 25 00 – Substitution Procedures.

B. Product Description - Frames: Fully welded steel frames, to suit ANSI A250.8 and the following:
1. Exterior: Level 3 - Extra heavy Duty, 14 gage thick material, galvanized A60.
2. Interior: Level 3 - Extra heavy Duty, 16 gage thick material, ungalvanized.
a. Furnish 14 gage thick material for frames over 48 inches (1219.2 mm) wide.

2.02 FRAME COMPONENTS

A. Frames: Steel sheet in accordance with ANSI A250.

2.03 ACCESSORIES

A. Removable Stops: Rolled steel, channel shape, butted corners; prepared for countersink style screws.

B. Vision Lite Systems: Manufacturer's standard kits consisting of glass lite moldings to accommodate glass thickness and size of vision lite indicated.

C. Primer: ANSI A250.10, manufacturer’s standard rust inhibitive type.

D. Silencers: Specified in Section 08 71 00; resilient rubber fitted into drilled hole.

2.04 FABRICATION

A. Frames:
1. Fabricate frames as welded unit.
2. Mullions for Double Doors: Removable, specified in Section 08 71 00.
3. Transom Bars for Glazed Lights: Fixed type, of same profiles as jamb and head.
4. Fabricate frames with hardware reinforcement plates welded in place. Provide mortar guard boxes.
5. For frames installed in masonry walls, and which will receive stop-applied seals or weatherstripping, fill the stops with strips of rigid insulation to keep the grout out of the stops and to facilitate installation of the seals and weatherproofing.

6. Prepare frames for silencers. Provide three single silencers for single doors on strike side. Provide two single silencers on frame head at double doors.
7. Attach fire rated label to each fire rated frame.
8. Glazing Stops: Provide non-removable stops on the outside and removable, screw-applied stops on the room side of doors and frames for glass.

B. Acoustical Ratings:
1. Fabricate doors not scheduled as “Acoustical Door” to provide an STC rating of 33 or better.
2. Reference Section 08 34 73 for assemblies requiring STC ratings greater than specified herein.

2.05 SHOP FINISHING

A. Primer: Baked-on shop primer, ready for field finish painting.

PART 3 EXECUTION

3.01 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify opening sizes and tolerances are acceptable.

3.02 FRAME INSTALLATION

A. Install frames in accordance with ANSI A250.8.

B. Coordinate with masonry and gypsum board wall construction for anchor placement.

C. Provide at least three wall anchors per jamb. For openings 90 inches (2286 mm) or more in height, install four wall anchors per jamb.

D. Coordinate installation of glass and glazing specified in Section 08 80 00.

E. Coordinate installation of frames with doors and with hardware specified in Section 08 71 00.

F. Coordinate installation of frames with installation of doors specified in Section 08 14 16.

3.03 DOOR INSTALLATION

A. Install doors in accordance with ANSI A250.8.

B. Install door louvers and glazing frames plumb and level.

C. Coordinate installation of glass and glazing specified in Section 08 80 00.

D. Coordinate installation of doors with frames and with hardware specified in Section 08 71 00.

E. Touch-up damaged shop finishes.

3.04 ERECTION TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Maximum Diagonal Distortion: 1/16 inch (1.59 mm) measured with straight edge, corner to corner.

C. Clearances for Non-Fire-Rated Doors: Not more than 1/8 inch (3.18 mm) at jambs and heads, except not more than 1/4 inch (6.35 mm) between pairs of doors. Not more than 3/4 inch (19.05 mm) at bottom.

D. Clearances for Fire-Rated Doors: In accordance with NFPA 80.

3.05 ADJUSTING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for adjusting.

B. Adjust door for smooth and balanced door movement.

END OF SECTION

SECTION 08 14 16

FLUSH WOOD DOORS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Flush wood doors with plastic laminate faces.

B. Related Sections:
   1. Section 08 11 13 - Standard Steel Doors and Frames: Steel frames.
   2. Section 08 71 00 - Door Hardware: Finish hardware requirements for doors.
   3. Section 08 80 00 - Glazing: Glass lights set in door faces.

1.02 REFERENCES

A. ASTM International:
   1. ASTM E413 - Standard Classification for Rating Sound Insulation.

B. Architectural Woodwork Institute:
   1. AWI - Quality Standards Illustrated.

C. National Electrical Manufacturers Association:
   1. NEMA LD 3 - High Pressure Decorative Laminates.

D. National Fire Protection Association:
   1. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.

1.03 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Illustrate door opening criteria, elevations, sizes, types, swings, undercuts required, special beveling, special blocking for hardware, factory machining criteria, identify cutouts for glazing and louvers.

C. Product Data: Submit information on door core materials and construction.

D. Samples:
   1. Submit two samples of door construction, 12 x 12 inch (304.8 mm) in size, cut from top corner of door.
   2. Submit two samples of plastic laminate illustrating laminate pattern and color.
   3. Submit two samples of lite opening frames, 6 inches (152.4 mm) long, for each material, type, and finish required.

E. Manufacturer's Installation Instructions: Submit special installation instructions.

1.04 QUALITY ASSURANCE

A. Perform Work in accordance with AWI Quality Standard Section 1300, Custom Grade.

B. Finish doors in accordance with AWI Quality Standard Section 1500.

C. Fire Rated Door Construction: Conform to NFPA 252.

D. Attach label from agency approved by authority having jurisdiction to identify each fire rated door.

1.05 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Package, deliver and store doors in accordance with AWI Section 1300.

C. Accept doors on site in manufacturer's packaging. Inspect for damage.
   1. Break seal on site to permit ventilation.

1.07 PROJECT CONDITIONS

A. Do not deliver or install doors until building is enclosed, wet work is complete, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.

1.08 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Coordinate Work with door opening construction, door frame and door hardware installation.

1.09 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Include coverage for delamination, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

C. Furnish manufacturer's "Life of Installation" warranty for interior doors.

PART 2 PRODUCTS

2.01 FLUSH WOOD DOORS

A. Manufacturers:

1. Algoma Hardwoods Inc. www.algomahardwoods.com
2. Eggers Industries www.eggersind.com
3. Graham Manufacturing Corp. www.grahamdoors.com
4. IPIK Door Company www.ipikdoor.com
5. Marshfield Door Systems Inc. www.marshfielddoors.com
6. VT Industries www.vtindustries.com
7. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description: Solid core flush wood doors; 1-3/4 inches (44 mm) thick, five ply construction, plastic laminate facing material; fire and acoustic rated as indicated on Drawings.

2.02 COMPONENTS

A. Plastic Laminate Doors: Solid core, AWI Section 1300, core as follows:
1. Non-Rated: Solid stave wood core.
2. 20- and 45-Minute Rating: Solid stave wood core.
3. 60-Minute Rating: Mineral core.
4. 90-Minute Rating: Mineral core.

B. Acoustical Doors: Not applicable.

C. Plastic Laminate Facing (Interior): NEMA LD 3, General Purpose Type, 0.050-inch-thick, type as indicated on Drawings.

D. Cross Banding Behind Laminate Finish: 1 ply; manufacturer’s standard construction.

E. Facing Adhesive: Type II - water resistant.

2.03 ACCESSORIES

A. Glazing Stops - Plastic Laminate-Clad Doors:
1. Rolled steel, factory primed frames.

2.04 FABRICATION

A. Fabricate doors in accordance with AWI Quality Standards requirements.

B. Furnish lock blocks at lock edge and top of door for hardware reinforcement.

C. Vertical Exposed Edge of Stiles: Hardwood painted or stained to match laminate for plastic laminate doors.

D. Factory machine doors for finish hardware in accordance with hardware requirements and dimensions. Do not machine for surface hardware. Furnish solid blocking for through bolted hardware.

E. Factory fit doors for frame opening dimensions identified on shop drawings.

F. Provide edge clearances in accordance with AWI 1300.

2.05 EXTRA MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

B. Furnish direct to the Owner an additional two full 4’ x 8’ sheets of each plastic laminate color used for flush wood doors in the project. Roll and box sheets together for Owner storage.

C. Obtain a receipt from the Owner.

PART 3 EXECUTION

3.01 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify opening sizes and tolerances are acceptable.

C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.02 INSTALLATION

A. Install doors in accordance with AWI Quality Standards requirements.

B. Trim non-rated door width by cutting equally on both jamb edges.

C. Trim door height by cutting bottom edges to maximum of 3/4 inch (19.05 mm).
   1. Trim fire door height at bottom edge only, in accordance with fire rating requirements.

D. Machine cut doors for hardware installation.

E. Coordinate installation of doors with installation of frames specified in Section 08 11 13 and hardware specified in Section 08 71 00.

F. Coordinate installation of glass and glazing specified in Section 08 80 00.

3.03 INSTALLATION TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Conform to AWI requirements for fit and clearance tolerances.

C. Conform to AWI Section 1300 requirements for maximum diagonal distortion.

3.04 ADJUSTING

A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.

B. Adjust door for smooth and balanced door movement.

C. Adjust closer for full closure.

END OF SECTION

SECTION 08 31 00

ACCESS DOORS AND PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Section includes fire resistive rated and non-rated access doors and panels with frames for walls and ceilings.
   1. Provide for access to controls, valves, traps, dampers, cleanouts, and similar items requiring operation behind inaccessible finished surfaces.
   2. Coordinate exact locations with the various trades to assure proper placement of access doors and panels.

1.02 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work for each type of product and application.
   1. Include construction details, fire ratings for doors in rated assemblies, material descriptions, dimensions of individual components and profiles, and finishes.

C. Samples: For each type of access door and frame and for each finish specified, complete assembly minimum 6 by 6 inches (150 by 150 mm) in size.

D. Product Schedule: For access doors and frames.
   1. Obtain specific locations and sizes for required access doors from trades requiring access to concealed equipment, and indicate on submittal schedule.
   2. Special-Size Access doors: Use where required or requested, indicate on schedule.

E. Manufacturer's Installation Instructions: Indicate installation requirements and rough-in dimensions.

1.03 QUALITY ASSURANCE

A. Single Source Responsibility: Obtain access doors for entire project from one source from a single manufacturer.

B. Size Variations: Obtain Architect's acceptance of manufacturer's standard size units, which may vary slightly from sizes indicated.

C. Coordination: Furnish inserts and anchoring devices that must be built into other work for installation of access doors. Coordinate delivery with other work to avoid delay

D. Coordinate Work with work requiring controls, valves, traps, dampers, cleanouts, and similar items requiring operation being located behind finished surfaces.

E. Fire Resistance Ratings: Where indicated as fire rated provide assemblies from manufacturers listed in UL Directory or Intertek Testing Services (Warnock Hersey Listed) Directory.

F. Fire Rated Access Doors: Rating as indicated on Drawings.
   1. Tested Rating: Determined in accordance with ASTM E119.

G. Attach label from agency approved by authority having jurisdiction to identify each fire rated access door.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Fire-Rated Access Doors and Frames: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection **and temperature-rise limit** ratings indicated, according to NFPA 252 or UL 10B. At acoustically rated assemblies, provide acoustical rated doors and frames with STC ratings equal to or better than the STC rating of the assembly.

2.02 MANUFACTURERS

A. Subject to compliance with requirements, manufacturers offering products which may be incorporated in the Work include, but are not limited to, the following:
   1. Bauco: https://bauco.com/products/
   2. Karp Associates, Inc.: www.karpinc.com
   3. Milcor, Commercial Products Group of Hart & Cooley, Inc.: www.commercialproductsgroup.com
   4. Nystrom, Inc.: www.nystrom.com
   5. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 ACCESS DOORS AND PANELS ASSEMBLIES

A. Flush Framed Access Doors: Frames and nominal 1-inch wide exposed flanges of 16-gage steel and door panels of 14-gage steel (see Finishes for stainless steel).

B. Gypsum Board Access Doors: Frames and nominal 1-inch wide flanges of 16-gage steel and door panels of 14-gage steel. Design flanges to be concealed by gypsum board joint finishing compound specified in Section 09 21 16.

C. Plaster Access Doors: Frames and nominal 1-inch wide flanges of 16-gage steel and door panels of 14-gage steel. Design flanges to be concealed by plaster specified in Section 09 24 00.

D. Fire Rated Access Doors: Frames and nominal - inch wide exposed flanges of minimum 16-gage steel and door panels of 20-gage steel. Provide self-closing and latching doors with keyed lock to match cylinders specified in Section 08 71 00.

E. Gypsum Board Fire Rated Access Doors: 16-gage steel frames with minimum 22-gage galvanized steel drywall bead flanges and door panels of 20-gage steel. Design flanges to be concealed by gypsum board joint finishing compound specified in Section 09 21 16. Provide self-closing and latching doors with keyed lock to match cylinders specified in Section 08 71 00.

2.04 MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

D. Retain the more expensive "Type 316" option in "Stainless-Steel Sheet, Strip, Plate, and Flat Bars" Paragraph below for more corrosion resistance; verify availability with manufacturers.

E. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304. Remove tool and die marks and stretch lines, or blend into finish.

F. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063.

G. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

H. Frame Anchors: Same material as door face.

I. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

2.05 FABRICATION

A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

B. Fabricate units of continuous welded construction; weld, fill, and grind joints to assure flush and square unit.

C. Size Variations: Obtain acceptance of manufacturer’s standard size units which vary slightly from sizes shown or scheduled.

D. Wall and Ceiling Access Door and Panel Hardware:
   1. Hinge: Standard continuous or concealed spring pin type, 175 degree steel hinges.
   2. Lock: Self-latching lock. Screw driver slot for quarter turn cam lock.

E. 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.

F. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.
   1. For concealed flanges with drywall bead, provide edge trim for gypsum panels securely attached to perimeter of frames.
   2. For concealed flanges with plaster bead for full-bed plaster applications, provide zinc-coated expanded-metal lath and exposed casing bead welded to perimeter of frames.

G. Recessed Access Doors: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling. Provide access sleeves for each latch operator and install in holes cut through finish.
   1. For recessed doors with plaster infill, provide self-furring expanded-metal lath attached to door panel.

H. Latch and Lock Hardware:
   1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.
   2. Keys: Furnish two keys per lock and key all locks alike.
   3. Mortise Cylinder Preparation: Where indicated, prepare door panel to accept cylinder specified in Section 08 71 00 Door Hardware.

2.06 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: 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.

D. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
   1. Base Metal Protection: Galvanized, hot dipped wiped coat finish.
   2. Factory Finished: Apply manufacturer's standard baked-enamel or powder-coat finish immediately after cleaning and pretreating, with minimum dry-film thickness of 1 mil (0.025 mm) for topcoat. Color as selected by Architect from full range of industry colors.

E. Stainless-Steel Finishes:

F. Provide series 300 brushed stainless steel panels and frames for all restrooms.
   1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

PART 3 EXECUTION

3.01 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify that rough openings are correctly sized and located.

C. Begin installation only after substrates have been properly prepared, and if the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to proceeding with this work.

B. Prepare surfaces using methods recommended by manufacturer for applicable substrates in accordance with project conditions.

3.03 INSTALLATION

A. Install units in accordance with manufacturer's instructions.

B. Install frames plumb and level in openings, and secure units rigidly in place.

C. Install frames with plane of door and panel face aligned with adjacent finished surfaces.
   1. Set concealed frame type units flush with adjacent finished surfaces.

D. Install fire rated units in accordance with NFPA 80 and requirements for fire listing.

E. Position units to provide convenient access to concealed equipment when necessary.

END OF SECTION

SECTION 08 33 13

OVERHEAD COILING COUNTER SHUTTERS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Prefinished steel overhead coiling counter shutter at Concession opening.
   2. Interior location.
   3. Motorized operation.

B. Related Sections
   1. 09 90 00 - Painting: Field painting of steel hood and recessed end guides.
   2. Division 26 sections: Power, conduit, boxes, conductors and final electrical connections.

1.02 REFERENCES

A. ASTM International:
   1. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   2. ASTM A924/A924M - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.

B. National Electrical Manufacturers Association:
   1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
   2. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
   3. NEMA MG 1 - Motors and Generators.

1.03 DESIGN REQUIREMENTS

A. Operation: Design door assembly to operate for not less than 10,000 cycles.

B. Rating: Not applicable.

1.04 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, and installation details.

C. Product Data: Submit manufacturer’s general material and construction description, component connections and details.

D. Samples: Submit two door slats of each material, 12 inch long, illustrating shape, color and finish texture.

E. Manufacturer's Installation Instructions: Indicate installation sequence and procedures, and adjustment and alignment procedures.

1.05 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

B. Operation and Maintenance Data: Submit lubrication requirements and frequency, and periodic adjustments required.

1.06 MANUFACTURER'S WARRANTY

A. Counter door manufacturer shall provide written warranty against defects in materials and workmanship for the door, motor, and operator system for a minimum period of 1-year after date of Substantial Completion of the Project.

1.07 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience.

B. Installer: Company specializing in performing work of this section with minimum three years' experience and approved by manufacturer.

PART 2 PRODUCTS

2.01 OVERHEAD COUNTER SHUTTERS

A. Manufacturers:
1. The Cookson Company, www.cooksondoor.com
2. Cornell Iron Works, Inc., www.cornelliron.com
3. McKeon Rolling Steel Door Company, Inc., www.mckeondoor.com
4. Overhead Door Corporation, www.overheaddoor.com
5. Wayne-Dalton Corporation, www.wayne-dalton.com
6. Substitutions: Section 01 60 00 - Product Requirements.

2.02 COMPONENTS

A. Curtain: Conform to following:
1. Steel Slats: Interlocking, minimum 24 gage.
   a. Type: Single thickness flat slat.
2. Nominal Slat Size: 2 inches wide by required length.
3. Slat Ends: Alternate slats fitted with end locks to act as wearing surface in guides and to prevent lateral movement.
4. Curtain Bottom:Steel tube-shape, providing reinforcement and vinyl astragal.
5. Finish: Factory-applied powder coat. Color as selected by the Architect.

B. Guides: Material to match curtain. Provide continuous integral wear strips to prevent metal-to-metal contact and minimize noise of travel. Provide removable stops on guides to prevent overtravel of curtain. Provide weatherstripping for exterior units.

C. Roller Shaft Counterbalance: Steel pipe and helical steel spring system, capable of producing torque sufficient to ensure smooth operation of curtain from any position and capable of holding position at mid-travel; with adjustable spring tension.

D. Hood Enclosure: Square shape, minimum 24 gage steel; internally reinforced to maintain rigidity and shape.

2.03 ELECTRIC OPERATOR:

A. General: Provide electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operational life specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, remote-control stations, control devices, integral gearing for locking door, and accessories required for proper operation.

B. Comply with NFPA 70.

C. Disconnect Device for Manual Operation: Provide hand-operated disconnect or mechanism for automatically engaging sprocket-chain operator and releasing brake while disconnecting motor, without affecting timing of limit switch. Mount disconnect and operator so they are accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

D. Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency auxiliary operator.

E. Provide control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V, ac or dc.

F. Door-Operator Type: Provide wall-, hood-, or bracket-mounted, jackshaft, gear-head hoist-type door operator unit consisting of electric motor, enclosed worm-gear running-in-oil primary drive, chain and sprocket secondary drive, and auxiliary chain-hoist and floor level disconnect.

G. Electric Motors: Provide high-starting torque, reversible, continuous-duty, Class A insulated, electric motors, complying with NEMA MG 1, with overload protection, sized to start, accelerate, and operate door in either direction, from any position, at not less than 2/3 fps or more than 1 fps, without exceeding nameplate ratings or considering service factor.
   1. Type: Polyphase, medium-induction type.
   2. Service Factor: According to NEMA MG 1, unless otherwise indicated.
   3. Coordinate wiring requirements and electric characteristics of motors with building electrical system.
   4. Provide open dripproof-type motor, and controller with NEMA ICS 6, Type 1 enclosure.

H. Remote-Control Station: Provide keyed control station with spring-release switch. Dorr will operate only when key is held in OPEN or CLOSE position. Release of key immediately stops door movement.
   1. Provide one control station on secure side of door.
   2. Provide switch body accepting removable cylinder keyed to Owner’s master keying requirements (Sargent Large Format). Removable cylinder provided under the Hardware Section.

I. Provide interior units, full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.

J. Limit Switches: Provide adjustable switches, interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify opening sizes, tolerances and conditions are acceptable.

3.02 INSTALLATION

A. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.

B. Securely and rigidly brace components suspended from structure.

C. Fit and align assembly including hardware; level and plumb, to provide smooth operation.

D. Coordinate installation of sealants and backing materials at frame perimeter as specified in Section 07 90 00.

E. Install perimeter trim and closures.

3.03 ERECTION TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Maintain dimensional tolerances and alignment with adjacent Work.

C. Maximum Variation from Plumb: 1/16 inch.

D. Maximum Variation from Level: 1/16 inch.

E. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch per 10 ft straight edge.

3.04 ADJUSTING

A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.

B. Adjust door, hardware and operating assemblies for smooth and noiseless operation.

3.05 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Clean door and components.

C. Remove labels and visible markings.

END OF SECTION

SECTION 08 33 23

OVERHEAD COILING DOORS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Overhead coiling doors.
   2. Electric operation with manual override.

B. Related Sections:
   1. Section 05 50 00 - Metal Fabrications: Support framing.
   2. Section 08 71 00 - Hardware: Removable cylinder keyed to Owner's building system for coiling door control stations.
   3. Section 09 90 00 - Painting and Coating: Field painted finish of factory-primed guides and hood enclosure.
   4. Division 26 and 28 Sections:
      a. Power and final connections.
      b. Coordination with emergency generator circuit and fire/smoke alarm activation.

1.02 REFERENCES

A. ASTM International:
   1. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   2. ASTM A924/A924M - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.

B. National Electrical Manufacturers Association:
   1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
   2. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
   3. NEMA MG 1 - Motors and Generators.

1.03 SYSTEM DESCRIPTION

A. Electric Operation: Electric motor operated unit with manual override in case of power failure.

1.04 DESIGN REQUIREMENTS

A. Wind Loads: Design exterior door assembly to withstand wind/suction loads indicated on Drawings, with maximum deflection of 1/120, and without damage to door shutter or assembly components.

B. Operation: Design door assembly, including operator, to operate for not less than 10,000 cycles.

1.05 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details, including wiring diagrams for electric operators.

C. Product Data: Submit general construction, component connections and details, wiring diagram and electrical equipment.

D. Samples: Submit two door slats, 12 inches (304.8 mm) long, illustrating shape, color and finish texture.

E. Manufacturer's Installation Instructions: Indicate installation sequence and procedures, and adjustment and alignment procedures.

1.06 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

B. Operation and Maintenance Data: Submit lubrication requirements and frequency, and periodic adjustments required.

1.07 QUALITY ASSURANCE

A. Products Requiring Electrical Connection: Listed and classified by UL or another testing firm acceptable to authority having jurisdiction.

B. Surface Burning Characteristics:
1. Foam Insulation: Maximum 75/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

C. Apply label from agency approved by authority having jurisdiction to identify each foam plastic insulation board.

1.08 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years’ experience.

B. Installer: Company specializing in performing work of this section with minimum years’ experience and approved by manufacturer.

PART 2 PRODUCTS

2.01 OVERHEAD COILING DOORS

A. Manufacturers:
1. The Cookson Company www.cooksondoor.com/index
2. Cornell Iron Works Inc. www.cornelliron.com
3. McKeon Rolling Steel Door Company, Inc. www.mckeondoor.com
4. Overhead Door Corporation. www.overheaddoor.com

5. Raynor Garage Doors. www.raynor.com/index.cfm
6. Southwestern Steel Rolling Door Co.
7. Windsor Door www.windsordoor.com.
8. Substitutions: Section 01 60 00 - Product Requirements.

2.02 COMPONENTS

A. Curtain for Exterior Doors: Conforming to the following:
   1. Steel Slats: Interlocking, minimum 24 gage of ASTM A653/A653M steel, with galvanized coating designation G90 in accordance with ASTM A924/A924M.
      a. Type: Sandwich slat construction with insulated core.
   2. Nominal Slat Size: 2 inches (50.8 mm) wide x required length.
   3. Slat Ends: Alternate slats fitted with end locks to act as wearing surface in guides and to prevent lateral movement.
   4. Windlocks: Malleable-iron castings secured to curtain slats with galvanized rivets or high-strength nylon, as required to comply with wind load.
   5. Curtain Bottom: Fitted with minimum 1-1/2 x 1-1/2 x 1/8 inch (3.18 mm) angles to provide reinforcement and positive contact with floor in closed position; galvanized.
      a. Provide motor-operated doors with combination bottom astragal/sensor edge.

B. Guides: Minimum 3/16 inch (4.76 mm) thick; galvanized steel conforming to ASTM A653/A653M, minimum galvanized coating designation G90 in accordance with ASTM A924/A924M.
   1. Furnish continuous angles of profile to retain door in place; mounting brackets of same metal. Roller Shaft Counterbalance: Steel pipe and helical steel spring system, capable of producing torque sufficient to ensure smooth operation of curtain from any position and capable of holding position at mid-travel; with adjustable spring tension.

C. Hood Enclosure: Round shape, minimum 24 gage galvanized steel; internally reinforced to maintain rigidity and shape.

D. Electric Operator:
   1. General: Provide electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operational life specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, remote-control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
   2. Comply with NFPA 70.
   3. Disconnect Device for Manual Operation: Provide hand-operated disconnect or mechanism for automatically engaging sprocket-chain operator and releasing brake while disconnecting motor, without affecting timing of limit switch. Mount disconnect and operator so they are accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
   4. Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency auxiliary operator.
   5. Provide control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V, ac or dc.
   6. Door-Operator Type: Provide wall-, hood-, or bracket-mounted, jackshaft, gear-head hoist-type door operator unit consisting of electric motor, enclosed worm-gear running-in-oil primary drive, chain and sprocket secondary drive, and auxiliary chain-hoist and floor level disconnect.

7. Electric Motors: Provide high-starting torque, reversible, continuous-duty, Class A insulated, electric motors, complying with NEMA MG 1, with overload protection, sized to start, accelerate, and operate door in either direction, from any position, at not less than 2/3 fps or more than 1 fps, without exceeding nameplate ratings or considering service factor.
    a. Type: Polyphase, medium-induction type.
    b. Service Factor: According to NEMA MG 1, unless otherwise indicated.
    c. Coordinate wiring requirements and electric characteristics of motors with building electrical system.
    d. Provide open dripproof-type motor, and controller with NEMA ICS 6, Type 1 enclosure.
8. Remote-Control Station: Provide keyed control station with 3-position controls labeled "Open," "Close," and "Stop."
    a. Provide one control station on each side of door where doors are installed across corridors or other traffic areas.
    b. Provide switch body accepting removable cylinder keyed to Owner’s master keying requirements (Sargent Large Format). Removable cylinder provided under the Hardware Section.
9. Provide interior units, full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
10. Obstruction Detection Device: Provide each motorized door with indicated external automatic safety sensor able to protect full width of door opening. Activation of sensor immediately stops and reverses downward door travel.
    a. Sensor Edge: Provide each motorized door with an automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor immediately stops and reverses downward door travel. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.
    b. Provide electrically actuated automatic bottom bar.
    c. Self-Monitoring Type: Provide self-monitoring, 4-wire configured device.
11. Limit Switches: Provide adjustable switches, interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.

2.03 SHOP FINISHING

A. Curtain Slats: Steel, with factory powder coat finish, color as selected by Architect from manufacturer’s full range.

B. Steel Guides and Hood Enclosure: Prime for field painting.

PART 3 EXECUTION

3.01 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify opening sizes, tolerances and conditions are acceptable.

3.02 INSTALLATION

A. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.

B. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.

C. Fit and align assembly including hardware; level and plumb, to provide smooth operation.

D. Coordinate installation of electrical service. Complete wiring from disconnect to unit components and from fire alarm system to door operator.

E. Coordinate installation of sealants and backing materials at frame perimeter as specified in Section 07 90 00. Provide a continuous, non-hardening sealant bead behind the exterior guide angles prior to mechanical fastening to prevent 'wicking' of wind-driven rain into the building envelope.

F. Install perimeter trim and closures.

3.03 ERECTION TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Maintain dimensional tolerances and alignment with adjacent Work.

C. Maximum Variation from Plumb: 1/16 inch (1.59 mm).

D. Maximum Variation from Level: 1/16 inch (1.59 mm).

E. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch (3.18 mm) per 10 ft straight edge.

3.04 ADJUSTING

A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.

B. Adjust door, hardware and operating assemblies for smooth and noiseless operation.

3.05 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Clean door and components.

C. Remove labels and visible markings.

END OF SECTION

SECTION 08 33 26

OVERHEAD COILING GRILLES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Overhead coiling grilles.
   2. Electric operation.

B. Related Sections:
   1. Section 05 50 00 - Metal Fabrications: Support framing. Framed opening.

1.02 REFERENCES

A. ASTM International:
   1. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

B. National Electrical Manufacturers Association:
   1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
   2. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
   3. NEMA MG 1 - Motors and Generators.

1.03 SYSTEM DESCRIPTION

A. Electric Operation: Electric motor operated unit with manual override in case of power failure.

B. Self-Opening: Designated units self-opening in case of alarm or power failure without the need for power or battery back-up.

1.04 DESIGN REQUIREMENTS

A. Operation: Design grille assembly, including operator, to operate for not less than 10,000 cycles.

1.05 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details, including wiring diagrams for electric operators.

C. Product Data: Submit general construction, component connections and details, and electrical equipment.

D. Samples: Submit portion of grille members, 12 x 12 inch in size illustrating pattern, shape, color and finish texture.

E. Manufacturer's Installation Instructions: Submit installation sequence and procedures, adjustment and alignment procedures.

1.06 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

B. Operation and Maintenance Data: Indicate lubrication requirements and frequency, and periodic adjustments required.

1.07 QUALITY ASSURANCE

A. Products Requiring Electrical Connection: Listed and classified by UL., or another testing firm acceptable to authority having jurisdiction.

B. Installer: Company specializing in performing Work of this section with minimum three years' experience and approved by manufacturer.

PART 2 PRODUCTS

2.01 OVERHEAD COILING GRILLES

A. Manufacturers:
1. Cornell Iron Works, Inc. www.cornelliron.com
2. McKeon Rolling Steel Door Company, Inc. www.mckeondoor.com
3. Overhead Door Corporation www.overheaddoor.com
4. Raynor Garage Doors. www.raynor.com
5. Windsor Door www.windsordoor.com
6. Substitutions: Section 01 60 00 - Product Requirements.

2.02 COMPONENTS

A. Grilles: Straight pattern grilles conforming to the following.
1. Material: Aluminum conforming to ASTM B221.
2. Sizes: Fabricated of 5/16 inch minimum diameter horizontal members spaced at 2 inches oc.
3. Vertical Connecting Members: 5/8 x 1/8 inch flat bar, links spaced at 9 inches oc.
4. Ends: Members with nylon or wool pile runners for quiet operation.
5. Bottom Bar: Tube or back-to-back angles, of material to match grille.
    a. Provide motor-operated grilles with combination bottom astragal and sensor edge.

B. Guides: Extruded aluminum conforming to ASTM B221. Provide continuous integral wear strips to prevent metal-to-metal contact and minimize noise of travel. Provide removable stops on guides to prevent overtravel of curtain.

C. Roller Shaft Counterbalance: Steel pipe and helical steel spring system, capable of producing torque sufficient to assure smooth operation of grille from any position; with adjustable spring tension.

D. Hood Enclosure: round shape, minimum 0.040-inch thick aluminum; internally reinforced to maintain rigidity and shape.

E. Mounting Tube Frame: Provide manufacturer's standard mounting tube frame designed to support grille; factory fabricated from structural-steel tubes; fastened to floor and structure above grille; to be built into wall construction; and complete with anchors, connections, and fasteners. Hardware: Specified in Section 08 71 00.

F. Electric Operator:
   1. General: Provide electric grille operator assembly of size and capacity recommended and provided by grille manufacturer for grille and operational life specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, remote-control stations, control devices, integral gearing for locking grille, and accessories required for proper operation.
   2. Comply with NFPA 70.
   3. Disconnect Device: Provide hand-operated disconnect or mechanism for automatically engaging sprocket-chain operator and releasing brake for emergency manual operation while disconnecting motor, without affecting timing of limit switch. Mount disconnect and operator so they are accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
   4. Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency auxiliary operator.
   5. Provide control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V, ac or dc.
   6. Grille-Operator Type: Provide wall-, hood-, or bracket-mounted, jackshaft, gear-head-type grille operator unit consisting of electric motor, enclosed worm-gear running-in-oil primary drive, chain and sprocket secondary drive, and quick disconnect-release for manual operation.
   7. Electric Motors: Provide high-starting torque, reversible, continuous-duty, Class A insulated, electric motors, complying with NEMA MG 1, with overload protection, sized to start, accelerate, and operate grille in either direction, from any position, at not less than 2/3 fps and not more than 1 fps, without exceeding nameplate ratings or considering service factor.
      a. Type: Polyphase, medium-induction type.
      b. Service Factor: According to NEMA MG 1, unless otherwise indicated.
      c. Coordinate wiring requirements and electric characteristics of motors with building electrical system.
      d. Provide open dripproof-type motor, and controller with NEMA ICS 6, Type 1 enclosure.
   8. Remote-Control Station: Provide momentary-contact, keyed control station with 3-position controls labeled "Open," "Close," and "Stop."
      a. Provide interior units, full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
      b. Provide one control station on each side of grille where grilles are installed across corridors or other traffic areas.
   9. Obstruction Detection Device: Provide each motorized grille with indicated external automatic safety sensor able to protect full width of grille opening. Activation of sensor immediately stops and reverses downward grille travel.

10. Sensor Edge: Provide each motorized grille with an automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor immediately stops and reverses downward grille travel. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.
    a. Provide electrically actuated automatic bottom bar.
    b. Self-Monitoring Type: Provide self-monitoring, 4-wire configured device.
11. Limit Switches: Provide adjustable switches, interlocked with motor controls and set to automatically stop grille at fully opened and fully closed positions.
12. Self-Opening Mechanism: Automatic release mechanism triggered by fire alarm system or power failure. When activated, the grille shall self-open by means of a fail-safe operator to the fully open position without the need of power operation or battery backup systems. When the alarm is cleared and power is restored, the grille shall operate normally. Provide adjustable time delay of up to 10 seconds from signal or power failure until start of grille opening.

2.03 FINISHES

A. Grille Components: Aluminum, clear anodized.

B. Guides and Hood Enclosure: Match grille finish.

PART 3 EXECUTION

3.01 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify opening sizes, tolerances and conditions are acceptable.

3.02 INSTALLATION

A. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.

B. Securely and rigidly brace components suspended from structure.

C. Fit and align assembly including hardware; level and plumb, to provide smooth operation.

D. Coordinate installation of electrical. Complete wiring from disconnect to unit components.

E. Coordinate installation of sealants and backing materials at frame perimeter as specified in Section 07 90 00.

F. Install perimeter trim and closures.

3.03 ERECTION TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Maintain dimensional tolerances and alignment with adjacent Work.

C. Maximum Variation from Plumb: 1/16 inch.

D. Maximum Variation from Level: 1/16 inch.

E. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch per 10 ft straight edge.

3.04 ADJUSTING

A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.

B. Adjust grille, hardware and operating assemblies for smooth and noiseless operation.

C. Engage a factory-authorized service representative to perform startup service.
   1. Perform installation and startup checks according to manufacturer's instructions.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
   3. Test grille opening when activated by fire-alarm system and power failure. Reset grille-opening mechanism after successful test.

3.05 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Clean grille and components.

C. Remove labels and visible markings.

END OF SECTION

SECTION 08 34 73

SOUND CONTROL DOOR ASSEMBLIES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Steel sound-control doors, frames, seals, and certain hardware for special sound doors as scheduled.

B. Related Sections:
   1. Section 08 71 00 - Door Hardware: For required hardware not provided under this section.
   2. Section 09 90 00 - Painting and Staining: For field-applied paint finishes for steel doors and frames.

1.02 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: For each type of product indicated. Include sound ratings, construction details, material descriptions, core descriptions, and finishes.

C. Shop Drawings: Include the following:
   1. Elevations of each door design.
   2. Details of sound-control seals, door bottoms, and thresholds.
   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 anchorages, joints, field splices, and connections.
   8. Details of accessories.
   9. Details of moldings, removable stops, and glazing.
   10. Details of conduit and preparations for power, signal, and control systems.

D. Samples:
   1. Finishes: For each type of exposed finish required, prepared on Samples of not less than 3 by 5-inches.
   2. Retain both subparagraphs below if fabrication Samples are required.
   3. Doors: Include section of vertical-edge, top, and bottom construction; automatic door bottom or gasket; core construction; glazing; and hinge and other applied hardware reinforcement.
   4. Frames: Include profile, corner joint, floor and wall anchors, and seals. Include separate section showing fixed sound panels if applicable.

E. Schedule: Provide a schedule of sound-control door assemblies prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with the Door Hardware Schedule.

F. Product Certificates: For each type of sound-control door assembly, from manufacturer.

G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of sound-control door assembly.

H. Warranty: Samples of special warranty.

1.03 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sound-control door assemblies to include in maintenance manuals.

1.04 QUALITY ASSURANCE

A. Source Limitations: Obtain sound-control door assemblies, including doors, frames, sound-control seals, hinges (when integral for sound control), thresholds, and other items essential for sound control, from single source from single manufacturer.

B. Sound Rating: Provide sound-control door assemblies identical to those of assemblies tested as sound-retardant units by an acoustical testing agency, and have the following minimum rating:
   1. STC Rating(s): STC 50 or as indicated in the drawings, and as determined by ASTM E413 when tested in an operable condition according to ASTM E90 and ASTM E 1408.

1.05 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in the section with minimum three years' experience.

B. Installer: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

C. Acoustical Testing Agency: An independent agency accredited as an acoustical laboratory according to the National Voluntary Laboratory Accreditation Program of NIST.

1.06 PRE-INSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Deliver doors and frames palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use non-vented plastic.
   1. Provide additional protection to prevent damage to finish of factory-finished wood doors.

C. Shipping Spreaders: Deliver welded frames with two removable spreader bars across bottom of frames, tack welded or mechanically attached to jambs and mullions.

D. Store doors and frames under cover at Project site. Place units in a vertical position with heads up, spaced by blocking, on minimum 4-inch high, wood blocking. Avoid using non-vented plastic or canvas shelters that could create a humidity chamber.
   1. If wrappers on doors become wet, remove cartons immediately. Provide a minimum of 1/4-inch space between each stacked door to permit air circulation.

1.08 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.09 COORDINATION

A. Coordinate installation of anchorages for sound-control door assemblies. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.10 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of sound-control door assemblies that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Failure to meet sound rating requirements.
      b. Faulty operation of sound seals.
      c. Deterioration of metals, metal finishes, and other materials beyond normal use or weathering.
   2. Warranty Period for Steel Doors: Five-years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 STEEL SOUND-CONTROL DOOR ASSEMBLIES

A. Manufacturers:
   1. Assa Abloy, www.assaabloydooraccessories.us.com.
   2. Krieger Specialty Products Company, www.kriegerproducts.com
   3. Overly Door Company, www.overly.com
   4. Protective Door Industries, www.protectivedoor.com
   5. Wenger Corporation, www.wengercorp.com
   6. Substitutions: Section 01 60 00 - Product Requirements.

B. Basis of Design: Acoustical Door and Frame as manufactured by Wenger, or approved equivalent by specified manufacturer.

C. Description: Provide flush-design sound-control doors, minimum 1-3/4” thick or greater where required to meet specified STC rating, of seamless construction; with manufacturer's standard sound-retardant core as required to provide STC ratings indicated. Construct doors with smooth, flush surfaces without visible joints or seams on exposed faces or stile edges. Fabricate according to ANSI/NAAMM HMMA 865.
   1. Interior Doors: Fabricate from cold-rolled steel sheet unless otherwise indicated, 14-ga. outside face and 16-ga. inside face, or thicker as required to achieve STC rating indicated.
   2. Loose Stops for Glazed Lites in Doors: Same material as face sheets.
   3. Top and Bottom Channels: Closed with continuous channels of same material as face sheets, spot welded to face sheets not more than 6-inches o.c.
   4. Hardware Reinforcement: Same material as face sheets.

D. Materials:
   1. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
   2. Glazing: As required by sound-control door assembly manufacturer to comply with sound-control requirements.

2.02 SOUND-CONTROL FRAMES

A. Description: Fabricate sound-control door frames with corners mitered, reinforced, and continuously welded full depth and width of frame. Fabricate according to ANSI/NAAMM HMMA 865.
   1. Weld frames according to NAAMM-HMMA 820.
   2. Interior Frames: Fabricate from cold-rolled steel sheet unless otherwise indicated, 0.075-inch nominal thickness, or thicker as required to provide STC rating indicated.
   3. Sound-Control Panel Stops: Formed integral with frames, a minimum of 5/8-inch high, unless otherwise indicated.
   4. Hardware Reinforcement: Fabricate according to ANSI/NAAMM HMMA 865 of same material as face sheets.
   5. Head Reinforcement: Reinforce frames with metallic-coated steel channel or angle stiffener, 0.108-inch nominal thickness, welded to head.
   6. Jamb Anchors:
      a. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.064-inch nominal thickness metallic-coated steel with corrugated or perforated straps not less than 2-inches wide by 10-inches long; or wire anchors not less than 0.156-inch thick.
      b. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.048-inch nominal thickness uncoated steel unless otherwise indicated.
      c. Post-installed Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch diameter, metallic-coated steel bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.
   7. Floor Anchors: Not less than 0.079-inch nominal thickness metallic-coated steel, and as follows:
      a. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

B. Materials:
   1. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B, suitable for exposed applications.

2. Supports and Anchors: After fabricating, galvanize units to be built into exterior walls according to ASTM A153/A153M, Class B.
3. Inserts, Bolts, and Fasteners: Provide items to be built into exterior walls, hot-dip galvanized according to ASTM A153/A153M or ASTM F 2329.
4. 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 sound-control door frames of type indicated.
5. Mineral-Fiber Insulation: Insulation composed of rock-wool fibers, slag-wool fibers, or glass fibers.

2.03 FINISHES

A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.

B. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and scheduled field-applied coatings.

C. Final Finish: Field applied.

2.04 SOUND-CONTROL HARDWARE

A. Description: Provide manufacturer's standard sound-control system, including head and jamb seals, door bottoms, cam-lift hinges, and thresholds, as required by testing to achieve STC rating indicated.
1. Compression Seals: One-piece units; consisting of closed-cell sponge neoprene seal held in place by metal retainer; with retainer cover of same material as door frame; attached to door frame with concealed screws.
2. Magnetic Seals: One-piece units; consisting of closed-cell sponge neoprene seal and resiliently mounted magnet held in place by metal retainer; with retainer cover of same material as door frame; attached to door frame with concealed screws.
3. Automatic Door Bottoms: Neoprene or silicone gasket, held in place by metal housing, that automatically drops to form seal when door is closed; mounted to bottom edge of door with screws.
    a. Mounting: Mortised or semi-mortised into bottom of door as required by testing to achieve STC rating indicated.
    b. Cam-Lift Hinges: Full-mortise template type that raises door 1/2-inch when door is fully open; with hardened pin; fabricated from stainless steel.

B. Other Hardware: Comply with requirements in Division 08 Section "Door Hardware".

2.05 SOUND-CONTROL ACCESSORIES

A. Glazing: Comply with requirements in Division 08 Section "Glazing."

B. Grout: Comply with ASTM C476, with a slump of not more than 4-inches as measured according to ASTM C143/C143M.

C. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.06 FABRICATION

A. Sound-Control Steel Door Fabrication: Sound-control doors 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.
   1. Seamless Edge Construction: Fabricate doors with faces joined at vertical edges by welding; welds shall be ground, filled, and dressed to make them invisible and to provide a smooth, flush surface.
   2. Glazed Lites: Factory install glazed lites according to requirements of tested assembly to achieve STC rating indicated. Provide fixed stops and moldings welded on secure side of door.
      a. Double pane glazing as with have combination of 1/4” and 3/8” thick panes.
   3. Hardware Preparation: Factory prepare sound-control doors to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping, according to the Door Hardware Schedule and templates furnished as specified in "Door Hardware".
      a. Reinforce doors to receive non-templated mortised and surface-mounted door hardware.
      b. Locate door hardware as indicated, or if not indicated, according to NAAMM HMMA 831, "Recommended Hardware Locations for Custom Hollow Metal Doors and Frames."
   4. Tolerances: Fabricate doors to tolerances indicated in ANSI/NAAMM HMMA 865.

B. Sound-Control Frame Fabrication: Fabricate sound-control frames 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. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
   1. Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated from same thickness metal as frames.
   2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
   3. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
   4. Jamb Anchors: Provide number and spacing of anchors as follows:
      a. Masonry Type: Locate anchors not more than 18-inches from top and bottom of frame. Space anchors not more than 32-inches o.c. and as follows:
         1) Two anchors per jamb up to 60-inches in height.
         2) Three anchors per jamb from 60 to 90-inches in height.
         3) Four anchors per jamb from 90 to 96-inches in height.
      b. Stud Wall Type: Locate anchors not more than 18-inches from top and bottom of frame. Space anchors not more than 32-inches o.c. and as follows:
         1) Three anchors per jamb up to 60-inches in height.
         2) Four anchors per jamb from 60 to 90-inches in height.
         3) Five anchors per jamb from 90 to 96-inches in height.
         4) Two anchors per head for frames more than 42-inches wide and mounted in metal stud partitions.

c. Post-installed Expansion Type: Locate anchors not more than 6-inches from top and bottom of frame. Space anchors not more than 26-inches o.c.

5. Head Reinforcement: For frames more than 48 inches (1219.2 mm) wide, provide continuous head reinforcement for full width of opening, welded to back of frame at head.
6. Hardware Preparation: Factory prepare sound-control frames to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping, according to the Door Hardware Schedule and templates furnished as specified in "Door Hardware."
   a. Reinforce frames to receive non-templated mortised and surface-mounted door hardware.
   b. Locate hardware as indicated, or if not indicated, according to NAAMM HMMA 831, "Recommended Hardware Locations for Custom Hollow Metal Doors and Frames."
7. Plaster Guards: Weld guards to frame at back of hardware cutouts and glazing-stop screw and sound-control seal preparations to close off interior of openings in frames to be grouted.
8. Tolerances: Fabricate frames to tolerances indicated in ANSI/NAAMM HMMA 865.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of sound-control door assemblies.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations of sound-control door frame connections before frame installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. 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.

B. Prior to installation and with installation spreaders in place, adjust and securely brace sound-control door frames to the following tolerances:
   1. Squareness: Plus or minus 1/16-inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
   2. Alignment: Plus or minus 1/16-inch, measured at jambs on a horizontal line parallel to plane of wall.
   3. Twist: Plus or minus 1/16-inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
   4. Plumbness: Plus or minus 1/16-inch, measured at jambs on a perpendicular line from head to floor.

C. Drill and tap doors and frames to receive non-templated mortised and surface-mounted door hardware.

3.03 INSTALLATION

A. General: Install sound-control door assemblies plumb, rigid, properly aligned, and securely fastened in place; comply with manufacturer's written instructions.

B. Frames: Install sound-control door frames in sizes and profiles indicated.
   1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
      a. Install sound-control frames with removable glazing stops located on secure side of opening.
      b. Remove temporary braces only after frames or bucks have been properly set and secured.
      c. Check squareness, twist, and plumbness of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
      d. Apply corrosion-resistant coatings coating to backs of frames to be filled with mortar or grout.
   2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor and secure with post-installed expansion anchors.
      a. Floor anchors may be set with powder-actuated fasteners instead of post-installed expansion anchors, if so indicated and approved on Shop Drawings.
   3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.
   4. 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.
   5. Grouted Frames: Solidly fill space between frames and substrate with grout. Take precautions, including bracing frames, to ensure that frames are not deformed or damaged by grout forces.
   6. Installation Tolerances: Adjust sound-control door frames for squareness, alignment, twist, and plumbness to the following tolerances:
      a. Squareness: Plus or minus 1/16-inch, measured at door rabbet on a line 90-degrees from jamb perpendicular to frame head.
      b. Alignment: Plus or minus 1/16-inch, measured at jambs on a horizontal line parallel to plane of wall.
      c. Twist: Plus or minus 1/16-inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
      d. Plumbness: Plus or minus 1/16-inch, measured at jambs on a perpendicular line from head to floor.

C. Doors: Fit sound-control doors accurately in frames, within clearances indicated below. Shim as necessary.
   1. Non-Fire-Rated Doors: Fit non-fire-rated doors accurately in frames with the following clearances:
      a. Jambs: 1/8-inch.
      b. Head with Butt Hinges: 1/8-inch.
      c. Head with Cam-Lift Hinges: As required by manufacturer, but not more than 3/8-inch.
      d. Sill: Manufacturer's standard.
      e. Between Edges of Pairs of Doors: 1/8-inch.

D. Sound-Control Seals: Where seals have been prefit and preinstalled in the factory and subsequently removed for shipping, reinstall seals and adjust according to manufacturer's written instructions.

E. Cam-Lift Hinges: Install hinges according to manufacturer's written instructions.

F. Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with sound-control door assembly manufacturer's written instructions.
   1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9-inches o.c. and not more than 2-inches o.c. from each corner.

3.04 ADJUSTING AND CLEANING

A. Final Adjustments: Check and adjust seals, door bottoms, and other sound-control hardware items right before final inspection. Leave work in complete and proper operating condition.

B. Remove and replace defective work, including defective or damaged sound seals and doors and frames that are warped, bowed, or otherwise unacceptable.
   1. Adjust gaskets, gasket retainers, and retainer covers to provide contact required to achieve STC rating.

C. Clean grout off sound-control door frames immediately after installation.

D. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.

E. Metallic-Coated Surfaces: Clean abraded areas of doors and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION

SECTION 08 41 13

ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
1. Aluminum-framed storefronts, interior and exterior.
2. Aluminum entrance doors, interior and exterior.
3. Exterior and interior fixed window frames.
4. Aluminum frames for butt-jointed glazing panels.

B. Related Sections:
1. Section 07 90 00 - Joint Protection.
2. Section 08 71 00 - Door Hardware.
3. Section 08 80 00 - Glazing.

1.02 REFERENCES

A. American Architectural Manufacturers Association:
1. AAMA 501 - Methods of Test for Exterior Walls.
2. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum.
3. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections.
4. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site.
5. AAMA SFM-1 - Aluminum Store Front and Entrance Manual.

B. ASTM International:
1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
2. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
3. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
4. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
5. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
6. ASTM E330 - Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors By Uniform Static Air Pressure Difference.

C. SSPC: The Society for Protective Coatings:
1. SSPC-Paint 20 - Zinc-Rich Primers (Type I - Inorganic and Type II - Organic).

1.03 SYSTEM DESCRIPTION

A. Aluminum-framed storefront system includes: tubular aluminum sections; aluminum and glass entrances; shop fabricated, factory finished, with glass and glazing specified in Section 08 80 00 and installed by this Section; related flashings, anchorage and attachment devices.

B. System Assembly: Site assembled.

1.04 PERFORMANCE REQUIREMENTS

A. System Design: Design and size components to withstand dead and live loads caused by positive and negative wind pressure acting normal to plane of wall, including building corners.
   1. To design pressure indicated on Drawings, as tested in accordance with ASTM E330.

B. Deflection: Limit mullion deflection to 1/175 for spans under 13’-6” and 1/240 plus 1/4 inch (6.35 mm) for spans over 13’-6”, with full recovery of glazing materials.

C. System Assembly: Accommodate without damage to components or deterioration of seals, movement within system, movement between system and peripheral construction, dynamic loading and release of loads, deflection of structural support framing.

D. Air Infiltration: Limit air leakage through assembly to 0.06 cfm/min/sq ft of wall area, measured at reference differential pressure across assembly of 1.57 psf as measured in accordance with AAMA 501.

E. Air and Vapor Seal: Maintain continuous air barrier and vapor retarder throughout assembly, primarily in line with glass.

F. Water Leakage: None, when measured in accordance with AAMA 501 with test pressure difference of 20 percent of design pressure, with minimum differential of 2.86 lbf/sq ft and maximum of 12.00 lbf/sq ft.

G. Thermal Transmittance of Assembly (Excluding Entrances): Maximum U Value of 0.69 Btu/sq ft per hour per deg F when measured in accordance with AAMA 1503.

H. Expansion / Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees Fahrenheit (76.67 degrees Celsius) over 12 hour period without causing detrimental effect to system components and anchorage.

I. System Internal Drainage: Drain water entering joints, condensation occurring in glazing channels, or migrating moisture occurring within system, to exterior by weep drainage network.

1.05 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work and expansion and contraction joint location and details.

C. Product Data: Submit component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, and internal drainage details.

D. Samples: Submit two samples 12 x 12 inches (304.8 mm) in size illustrating finished aluminum surface.

E. Design Data: Indicate framing member structural and physical characteristics and dimensional limitations.

F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.06 QUALITY ASSURANCE

A. Perform Work in accordance with AAMA SFM-1 and AAMA MCWM-1 - Metal Curtain Wall, Window, Store Front and Entrance - Guide Specifications Manual.

1.07 QUALIFICATIONS

A. Manufacturer and Installer: Company specializing in manufacturing aluminum glazing systems with minimum three years' experience.

1.08 PRE-INSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.09 DELIVERY, STORAGE, AND PROTECTION

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Handle Products of this section in accordance with AAMA MCWM-1 - Curtain Wall Manual #10.

C. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

B. Do not install sealants nor glazing materials when ambient temperature is less than 40 degrees Fahrenheit (4.44 degrees Celsius) during and 48 hours after installation.

1.11 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Special Assembly Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that deteriorate as defined in this Section within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including, but not limited to, excessive deflection.
      b. Noise or vibration caused by thermal movements.
      c. Deterioration of metals and other materials beyond normal weathering.
      d. Adhesive or cohesive sealant failures.

e. Water leakage through fixed glazing and framing areas.
f. Failure of operating components to function properly.

2. Warranty Period: Two years from date of Substantial Completion.

C. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.

1. Warranty Period: 5 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 ALUMINUM-FRAMED STOREFRONTS

A. Manufacturers:

1. Arch Aluminum & Glass Co., Inc. www.arch.amarlite.com
2. Columbia Commercial Building Products, www.ccbpwin.com
3. EFCO Corporation www.efcocorp.com
4. Kawneer www.kawneer.com
5. Ranger Glass, www.rangerglass.com
6. United States Aluminum. www.usalum.com
7. Vistawall Architectural Products. www.vistawall.com/
8. YKK AP America Inc., www.ykkap.com.
9. Substitutions: Section 01 60 00 - Product Requirements.

B. Basis-of Design:

1. Exterior Storefront Door and Window Frames: Kawneer Trifab 601T.
2. Exterior Entrance Doors: Kawneer Heavy Wall Series Entrance.
3. Interior Door and Window Frames: Kawneer Trifab VG 450.

C. Product Description:

1. Exterior Aluminum Frames: Thermally broken; flush glazing stops; center glazed to accommodate specified glazing units.
   a. For exterior entry systems and exterior fixed windows.
   b. Size: 6” deep with 2” profile.
   c. Basis of Design: Trifab 601T as manufactured by Kawneer.
   d. Furnish closed backs at heads and jambs of exterior frames
2. Interior Aluminum Frames: Non-thermally broken; flush glazing stops; center glazed to accommodate specified glazing units at interior.
   a. For interior entry systems and interior fixed windows.
   b. Size: 4” deep with 1-3/4” profile.
   c. Basis of Design: Trifab 450 as manufactured by Kawneer
3. Doors: Aluminum Framed Glass Doors; 2-inches thick, nominal 5 inch (127 mm) wide top rail and vertical stiles, 10-1/4 inch (260 mm) wide bottom rail to meet ADA requirements; 3/16” wall thickness; beveled glazing stops.
   a. All-welded corners. Provide intermediate rail for mounting of exit device hardware
   b. Basis of Design: Heavy Wall, Wide Stile as manufactured by Kawneer.

2.02 COMPONENTS

A. Extruded Aluminum: ASTM B221; 6063 alloy, T5 temper typical, 6061 alloy, T6 temper for extruded structural members.

B. Sheet Aluminum: ASTM B209, 5005 alloy, H15 or H34 temper.

C. Sheet Steel: ASTM A653/A653M; galvanized to minimum G90.

D. Steel Sections: ASTM A36/A36M; shaped to suit mullion sections where needed for reinforcing, galvanized.

E. Glass: Specified in Section 08 80 00.

F. Glazing Materials: Storefront manufacturer’s standard types to suit application and to achieve weather, moisture, and air infiltration requirements.

G. Flashings: Minimum 0.032 inch (0.81 mm) thick aluminum to match mullion sections where exposed.

H. Hardware: In accordance with Section 08 71 00 and as follows:
   1. Weather Stripping: Manufacturer's standard replaceable components.
      a. AAMA 701, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.

I. Flashings: Minimum 0.032 inch (0.81 mm) thick aluminum to match mullion sections where exposed.

J. Sealant and Backing Materials:
   1. Sealant Used Within System (not used for glazing): Manufacturer’s standard materials to achieve weather, moisture, and air infiltration requirements.
   2. Perimeter Sealant: Specified in Section 07 90 00.

K. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum brackets and reinforcements. Provide non-staining, nonferrous shims for aligning system components.

L. Fasteners: Manufacturer’s standard stainless steel, compatible with adjacent materials.

M. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

2.03 FABRICATION

A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.

B. Fabricate sill pans with sealed end dams at jambs and changes in sill height.

C. Fabricate frames for glazing from inside.

D. Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.

E. Prepare components to receive anchor devices. Fabricate anchors.

F. Arrange fasteners and attachments to conceal from view.

G. Prepare components with internal reinforcement for door hardware.
   1. Coordinate with hardware provider, obtain approved hardware submittal(s), and fabricate doors and frames to receive approved hardware items.
   2. At exterior door frames, provide weatherstripping at fixed stops.
   3. At interior door frames, provide weatherstripping or silencers at stops to prevent door-to-frame contact.

H. Reinforce framing members for imposed loads.

2.04 SHOP FINISHING

A. As scheduled in the drawings, provide the following finishes:
   1. Class I, Clear Anodic Finish: AA-M12C22A31 Mechanical Finish: Nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.7 mil (0.01778 mm) or thicker) complying with AAMA 607.1 and AAMA 611.

B. Concealed Steel Items: Galvanized to ASTM A123/A123M; minimum 1.2 oz/sq ft coating thickness; galvanize after fabrication.

C. Apply bituminous paint to concealed aluminum surfaces in contact with cementitious materials or dissimilar metals.

D. Touch-Up Primer for Galvanized Steel Surfaces: SSPC-Paint 20 zinc rich.

E. Extent of Finish:
   1. Apply factory coating to surfaces exposed at completed assemblies.
   2. Apply touch-up materials recommended by coating manufacturer for field application to cut ends and minor damage to factory applied finish.

2.05 SUNSHADE SYSTEM

A. Refer to Section 08 44 13 Glazed Aluminum Curtain Walls.

B. Integration: Provide specialized mounting brackets and internal steel reinforcement for the Trifab 601T Storefront to accommodate the specific sunshade cantilever and project wind loads.

PART 3 EXECUTION

3.01 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify dimensions, tolerances, and method of attachment with other Work.

C. Verify wall openings and adjoining air and vapor seal materials are ready to receive Work of this Section.

3.02 INSTALLATION

A. Install systems in accordance with AAMA MCWM-1 - Metal Curtain Wall, Window, Store Front and Entrance - Guide Specifications Manual.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

C. Provide alignment attachments and shims to permanently fasten system to building structure.

D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent Work.

E. Install sill pans. Turn up ends and edges; seal to adjacent Work to form water tight dam.

F. Coordinate attachment and seal of perimeter air and vapor retarder materials.

G. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

H. Install integral flashings and integral joint sealers.

I. Set thresholds in sealant and secure.

J. Install hardware using templates provided. Refer to Section 08 71 00 for installation requirements.

K. Coordinate installation of glass with Section 08 80 00; separate glass from metal surfaces.

L. Coordinate installation of perimeter sealants with Section 07 90 00.

M. Provide expansion mullions maximum 20 feet (609.6 cm) oc at window runs of 25 feet (762 cm) or more.

3.03 INSTALLATION - SUNSHADES

A. Coordination: Coordinate the placement of internal steel reinforcement within the storefront mullions prior to the installation of glazing.

B. Sealing: Provide high-performance sealant (Section 07 90 00) at all sunshade mounting penetrations to ensure the integrity of the storefront's water-management system.

3.04 ERECTION TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Maximum Variation from Plumb: 0.06 inches (1.52 mm) every 3 ft non-cumulative or 1/16 inches (1.59 mm) per 10, feet (304.8 cm) whichever is less.

C. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch (0.79 mm).

3.05 ADJUSTING

A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting and balancing.

B. Adjust operating hardware and sash for smooth operation.

3.06 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Remove protective material from pre-finished aluminum surfaces.

C. Wash down surfaces with solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.

D. Remove excess sealant by method acceptable to sealant manufacturer.

3.07 PROTECTION OF INSTALLED CONSTRUCTION

A. Section 01 70 00 - Execution and Closeout Requirements: Protecting installed construction.

B. Protect finished Work from damage.

END OF SECTION

SECTION 08 44 13

GLAZED ALUMINUM CURTAIN WALLS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Aluminum-framed thermally improved curtain wall system.
   2. Cantilevered sunshade attached to curtain wall.
   3. Delegated design.
      a. The design of the complete aluminum-framed curtain wall system, including but not limited to, all framing members, internal reinforcing, fasteners, clips, gaskets, and anchorage to the primary building structure, shall be the responsibility of the Contractor.
      b. The Contractor shall retain a qualified professional engineer, licensed in the State of Texas, to perform the delegated design and provide all necessary engineering calculations and sealed drawings.
      c. The delegated design must be based on, and fully comply with, the criteria specified in the "Performance Requirements" article of this Section and the design loads indicated on the Structural Drawings.

B. Related Sections:
   1. Section 07 90 00 - Joint Protection: For perimeter joint sealing.
   2. Section 08 41 13 - Aluminum-Framed Entrances and Storefronts: Glazed doors for curtain wall systems.
   3. Section 08 71 00 - Door Hardware.
   4. Section 08 80 00 - Glazing.

1.02 REFERENCES

A. American Architectural Manufacturers Association:
   1. AAMA 501 - Methods of Test for Exterior Walls.
   2. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum.
   3. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections.
   4. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site.
   5. AAMA MCWM-1 - Metal Curtain Wall Manual.
   6. AAMA SFM-1 - Aluminum Store Front and Entrance Manual.

B. ASTM International:
   1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
   2. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   3. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   4. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

5. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
6. ASTM E330 - Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors By Uniform Static Air Pressure Difference.

C. SSPC: The Society for Protective Coatings:
1. SSPC-Paint 20 - Zinc-Rich Primers (Type I - Inorganic and Type II - Organic).

1.03 SYSTEM DESCRIPTION

A. Glazed aluminum curtain wall system includes: tubular aluminum sections; shop fabricated, factory finished, with glass and glazing specified in Section 08 80 00 and installed by this Section; related flashings, anchorage and attachment devices.
1. System to include manufacturer’s sunshade attached to curtainwall framing as indicatd in Drawings.
2. System Assembly: Site assembled.

1.04 PERFORMANCE REQUIREMENTS

A. General: Provide a curtain wall system capable of meeting or exceeding the requirements of AAMA/WDMA/CSA 101/I.S.2/A440 (NAFS), designated as a CW-PG50 Performance Class, in addition to the specific requirements below.

B. Structural Performance (Wind Loads):
1. Design and size all components to withstand all applicable loads, including dead loads and live loads caused by positive and negative wind pressure acting normal to the plane of the wall, including at building corners.
2. Design Wind Loads: Shall be as indicated on the Structural Drawings.
3. Design and Test Pressures: Meet designed and tested pressures for Structural, Water Resistance, and Air Leakage in accordance with ANSI/AAMA/NWWDA-97.
4. Design and size components to withstand dead and live loads caused by positive and negative wind pressure acting normal to plane of wall, including building corners to design pressure indicated on Drawings, as tested in accordance with ASTM E330
5. Design glazed system to withstand positive and negative wind loads normal to the plane of the wall in excess of 20 psi (137.90 kPa).

C. Deflection Limits:
1. Deflection: Limit mullion deflection to 1/175 for spans under 13’-6” and 1/240 plus 1/4-inch for spans over 13’-6”, with full recovery of glazing materials.
2. Parallel to Wall Plane: Deflection of any member abutting interior construction (e.g., partition walls) shall not exceed 1/16 inch (1.6 mm) to prevent damage to adjacent finishes.
3. Dead Load: Deflection of horizontal members supporting glass shall not exceed L/175 of the clear span or 1/8 inch (3.2 mm), whichever is less.
a. Provide fully concealed steel reinforcement as may be required to meet design requirements.

D. Thermal Performance:
1. Provide curtain wall assemblies (including frame and glass) capable of meeting the following performance values for the complete assembly when tested by an accredited laboratory.

2. Thermal Transmittance (U-Factor): The overall assembly shall have a maximum U-Factor of 0.50 Btu/hr·ft²·°F when determined in accordance with NFRC 100.
3. Solar Heat Gain Coefficient (SHGC): The overall assembly shall have a maximum SHGC of 0.25 when determined in accordance with NFRC 200.
4. Condensation Resistance Factor (CRF): The assembly shall have a minimum CRF (frame) of 50 when tested in accordance with AAMA 1503.

E. Reinforcing: Provide fully concealed steel reinforcement as may be required to meet all specified design and performance requirements.

F. Air Infiltration: Limit air leakage through assembly to 0.06 cfm/min/sq ft of wall area, measured at reference differential pressure across assembly of 1.57 psf as measured in accordance with AAMA 501.

G. Air and Vapor Seal: Maintain continuous air barrier and vapor retarder throughout assembly, primarily in line with glass.

H. Water Leakage: None, when measured in accordance with AAMA 501 with test pressure difference of 20 percent of design pressure, with minimum differential of 2.86 lbf/sq ft and maximum of 12.00 lbf/sq ft.
1. Coordinate with Contractor to provide water spray testing in accordance with AAMA 501 installed on at least two completed installation locations to ensure watertightness.

I. Thermal Transmittance of Assembly for fixed glazing and entrance doors shall not exceed maximum allowable U-factors listed in ASHRAE 90.1-2022.

J. Expansion / Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees Fahrenheit (76.67 degrees Celsius) over 12 hour period without causing detrimental effect to system components and anchorage.

K. System Internal Drainage: Drain water entering joints, condensation occurring in glazing channels, or migrating moisture occurring within system, to exterior by weep drainage network.

1.05 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Delegated Design Submittals: Submit the following items as a single, coordinated package for review. Submittals shall not be split.
1. Shop Drawings:
   a. Submit comprehensive drawings signed and sealed by the responsible professional engineer.
   b. Drawings must show all plans, elevations, sections, and connection details.
   c. Clearly indicate all framing member profiles, sizes, and all required internal steel or aluminum reinforcing.
   d. Detail all anchorage methods, showing fastener types, sizes, spacing, embedment, and edge distances, as verified by the structural calculations.
   e. Detail all joinery, corner connections, expansion joints, and intersections with adjacent construction (e.g., air barrier tie-ins, flashings, roofing).
2. Structural Calculations:
   a. Submit comprehensive calculations, signed and sealed by the professional engineer, demonstrating compliance with all specified Performance Requirements.

b. Calculations must clearly identify the design loads (wind, seismic, dead) and building code used.
c. Include analysis of all components, including framing members, reinforcing, fasteners, and anchorage, verifying they are not overstressed and do not exceed specified deflection limits.

3. Engineer’s Qualifications:
a. Submit documentation (e.g., resume, statement of qualifications, proof of licensure) for the delegated design engineer, verifying compliance with the "Quality Assurance" article.
b. Product Data: Submit component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, and internal drainage details.

C. Samples: Submit two samples 12 x 12 inches (304.8 mm) in size illustrating finished aluminum surface.

D. Design Data: Indicate framing member structural and physical characteristics and dimensional limitations.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.06 QUALITY ASSURANCE

A. Perform Work in accordance with AAMA MCWM-1 - Metal Curtain Wall, Window, Store Front and Entrance - Guide Specifications Manual.

B. Systems specified under this section and Section 08 41 13 Aluminum-Framed Entrances and Storefronts shall be provided by the same manufacturer.

1.07 QUALIFICATIONS

A. Manufacturer and Installer: Company specializing in manufacturing aluminum glazing systems with minimum three years’ experience.

1.08 PRE-INSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.09 DELIVERY, STORAGE, AND PROTECTION

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Handle Products of this section in accordance with AAMA MCWM-1 - Curtain Wall Manual.

C. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

B. Do not install sealants nor glazing materials when ambient temperature is less than 40 degrees Fahrenheit (4.44 degrees Celsius) during and 48 hours after installation.

1.11 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Special Assembly Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that deteriorate as defined in this Section within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including, but not limited to, excessive deflection.
      b. Noise or vibration caused by thermal movements.
      c. Deterioration of metals and other materials beyond normal weathering.
      d. Adhesive or cohesive sealant failures.
      e. Water leakage through fixed glazing and framing areas.
      f. Failure of operating components to function properly.
   2. Warranty Period: Two years from date of Substantial Completion.

C. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.
   1. Warranty Period: 5 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 GLAZED ALUMINUM CURTAIN WALLS

A. Manufacturers:
   1. Kawneer; www.kawneer.us
   2. YKK AP America Inc.; www.ykkap.com
   3. Oldcastle Building Envelope; www.obe.com
   4. Apogee Architectural Metals; apogeearchmetals.com
   5. Substitutions: Section 01 60 00 – Product Requirements.

B. Basis-of Design: Kawneer *1600UT*, 7-1/2 inch depth as indicated on drawings, plus attached sunshade, thermally-improved for specified glazing units and front-glazed system.

2.02 COMPONENTS

A. Extruded Aluminum: ASTM B221; 6063 alloy, T5 temper typical, 6061 alloy, T6 temper for extruded structural members.

B. Sheet Aluminum: ASTM B209, 5005 alloy, H15 or H34 temper.

C. Sheet Steel: ASTM A653/A653M; galvanized to minimum G90.

D. Steel Sections: ASTM A36/A36M; shaped to suit mullion sections where needed for reinforcing; galvanized.

E. Glass: Specified in Section 08 80 00.

F. Glazing Materials: Curtain wall manufacturer’s standard types to suit application and to achieve weather, moisture, and air infiltration requirements.

G. Manufacturer’s Hardware and Seals: In accordance with Section 08 71 00 and as follows:
   1. Weather Stripping: Manufacturer's standard replaceable components.
      a. AAMA 701, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing

H. Flashings: Minimum 0.032 inch (0.81 mm) thick aluminum to match mullion sections where exposed.

I. Sealant and Backing Materials:
   1. Sealant Used Within Framing System (Not Used for Glazing): Manufacturer’s standard materials to achieve weather, moisture, and air infiltration requirements.
   2. Glazing Joint Sealant: Specified in Section 08 80 00 Glazing.
   3. Perimeter Sealant: Specified in Section 07 90 00 Joint Protection.

J. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum brackets and reinforcements. Provide non-staining, nonferrous shims for aligning system components.

K. Fasteners: Manufacturer’s standard stainless steel, compatible with adjacent materials.

L. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

2.03 FABRICATION

A. Take accurate job measurements of openings prior to fabrication.

B. Fabricate components with minimum clearances and shim spacing around perimeter of assembly yet enabling installation and dynamic movement of perimeter seal.

C. Fabricate sill pans with welded end dams at jambs and changes in sill height.

D. Fabricate frames for glazing from exterior.

E. Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.

F. Prepare components to receive anchor devices. Fabricate anchors.

G. Arrange fasteners and attachments to conceal from view.

H. Where framing members cannot be installed in one-piece length, provide concealed internal splice plates and tight hairline joints in exposed members.

I. Provide internal galvanized carbon steel reinforcing for aluminum framing members requiring for imposed loads.

J. Provide splayed sections specially fabricated for designed angles where glazing panels are not in-line. Do not combine standard sections to form angular changes.

2.04 SHOP FINISHING

A. Anodized Aluminum Surfaces for Framing: AAMA 611, AA-M12C22A44 non-specular as fabricated mechanical finish, medium matte chemical finish, and Architectural Class I, 0.7 mils (0.01778 mm) clear black anodized coating. Class ll coating allowable for interior systems only.

B. Concealed Steel Items: Galvanized to ASTM A123/A123M; minimum 1.2 oz/sq ft coating thickness; galvanize after fabrication.

C. Apply bituminous paint to concealed aluminum surfaces in contact with cementitious materials or dissimilar metals.

D. Touch-Up Primer for Galvanized Steel Surfaces: SSPC-Paint 20 zinc rich.

E. Extent of Finish:
   1. Apply factory coating to surfaces exposed at completed assemblies.
   2. Apply touch-up materials recommended by coating manufacturer for field application to cut ends and minor damage to factory applied finish.

2.05 SUNSHADE SYSTEM

A. Manufacturers:
   1. Construction Specialties; www.c-sgroup.com
   2. YKK AP America Inc; www.ykkap.com
   3. Kawneer; www.kawneer.us
   4. Oldcastle Building Envelope; www.obe.com
   5. Apogee Architectural Metals; apogeearchmetals.com
   6. Substitutions: See Division 01.

B. System: Louvered aluminum sun control devices cantilevered from storefront framing. All extruded aluminum construction.

C. Thermal Isolation: Brackets shall include thermal isolation gaskets or separators to prevent thermal bridging between the exterior sunshade and the interior curtain wall framing.

D. Design Requirements: Design and size components to withstand design loads indicated on Drawings without damage or permanent set.

E. Basis of Design: *Versoleil™ SunShade Outrigger System* with square fascia as manufactured by Kawneer.
   1. Note: Sun control devices shall be covered under the frame manufacturer’s warranty.
   2. Size: 20-in. deep or as indicated on drawings.
   3. Blade Design: “Airfoil”.
   4. Finish and Color: Match frames.

PART 3 EXECUTION

3.01 EXAMINATION

A. Division 01 - Administrative Requirements: Coordination and project conditions.

B. Verify dimensions, tolerances, and method of attachment with other Work.

C. Verify wall openings and adjoining air and vapor seal materials are ready to receive Work of this Section.

3.02 INSTALLATION

A. Install wall system in accordance with AAMA MCWM-1 - Metal Curtain Wall, Window, Store Front and Entrance - Guide Specifications Manual.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

C. Provide alignment attachments and shims to permanently fasten system to building structure. Shims shall be galvanized (ASTM A36 or ASTM A283) or series 300 stainless steel. Do not use aluminum or plastic shims.

D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent Work.

E. Install sill pans. Turn up ends and edges; seal to adjacent Work to form water tight dam.

F. Coordinate attachment and seal of perimeter air and vapor retarder materials.

G. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

H. Install integral flashings and integral joint sealers.

I. Coordinate installation of glass with Section 08 80 00; separate glass from metal surfaces.

J. Coordinate installation of perimeter sealants with Section 07 90 00.

K. Separate dissimilar metals, such as reinforcing, using one of the following concealed materials:
   1. Bituminous Paint: FS TT-C494 or MIL-P6883A.
   2. Mastic Bulk Compound: FS SS-S-153, Type I or Type II.
      a. Preformed Mastic Tape: NAAMM Specifications for Non-Shrinking, Non-Resilient Preformed Sealing Compound.
   3. Zinc- Rich Paint: MIL-P38 336.

3.03 INSTALLATION - CURTAIN WALL INTEGRATED SUNSHADES

A. Structural Coordination:
   1. Internal Reinforcement: Install internal steel or aluminum stiffeners within curtain wall mullions at all sunshade attachment points as required by the manufacturer’s structural calculations to resist wind-induced torque and dead loads.

B. Weatherproofing and Sealing:
   1. Penetration Sealing: Seal all bracket penetrations through the curtain wall pressure plate and cover cap using high-performance silicone sealant (Section 07 90 00) to ensure the continuity of the system's air and water barriers.

C. Alignment and Tolerances:

1. Visual Continuity: Align sunshade blades accurately across multiple curtain wall bays. Maintain a horizontal tolerance of 1/8 inch (3 mm) in 20 feet (6 meters).

3.04 ERECTION TOLERANCES

A. Division 01 - Quality Requirements: Tolerances.

B. Maximum Variation from Plumb: 0.06 inches (1.52 mm) every 3 ft non-cumulative or 1/16 inches (1.59 mm) per 10, feet (304.8 cm) whichever is less.

C. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch (0.79 mm).

3.05 ADJUSTING

A. Division 01 - Execution and Closeout Requirements: Testing, adjusting and balancing.

B. Adjust operating hardware and sash for smooth operation.

3.06 CLEANING

A. Division 01 - Execution and Closeout Requirements: Final cleaning.

B. Remove protective material from pre-finished aluminum surfaces.

C. Wash down surfaces with solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.

D. Remove excess sealant by method acceptable to sealant manufacturer.

3.07 PROTECTION OF INSTALLED CONSTRUCTION

A. Division 01 - Execution and Closeout Requirements: Protecting installed construction.

B. Protect finished Work from damage.

END OF SECTION

SECTION 08 56 53

OPERABLE TRANSACTION WINDOWS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
1. Horizontal sliding transaction windows mounted within interior storefront framing system.
2. Factory-installed security glazing.

B. Related Sections:
1. Section 08 80 00 - Glazing: General glass requirements.
2. Section 08 87 23 - Impact Resistant Glazing Film: Field applied film for all glass this unit.

1.02 PERFORMANCE REQUIREMENTS

A. Forced-Entry Resistance: Comply with Performance Level 10 requirements when tested according to ASTM F588.

1.03 REFERENCES

A. Glass Association of North America:
1. GANA - Sealant Manual.
2. GANA - Glazing Manual.
3. GANA - Laminated Glass Design Guide.

1.04 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product Data for each type of window required, including the following:
1. Construction details and fabrication methods.
2. Profiles and dimensions of individual components.
3. Data on hardware, accessories, and finishes.
4. Recommendations for maintaining and cleaning exterior surfaces.

C. Shop Drawings showing fabrication and installation of each type of window required including information not fully detailed in manufacturer's standard Product Data and the following:
1. Layout and installation details, including anchors.
2. Elevations at 1/4 inch (6.35 mm) = 1 foot (30.48 cm) scale and typical window unit elevations at 3/4 inch (19.05 mm) = 1 foot (30.48 cm) scale.
3. Full-size section details of typical composite members, including reinforcement and stiffeners.
4. Hardware, including operators.
5. Glazing details.

6. Accessories.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has completed installation of aluminum windows similar in material, design, and extent to those required for this Project and with a record of successful in-service performance.

B. System Qualifications: Fully shop-assembled and finished, including security glazing, prior to delivery to the Project.

C. Single-Source Responsibility: Obtain aluminum windows from one source and by a single manufacturer.

D. Product Options: The Drawings indicate sizes, profiles, dimensional requirements, and aesthetic effects of aluminum windows and are based on the specific window types and models indicated. Other aluminum window manufacturers whose products have equal performance characteristics may be considered provided deviations in size, profile, and dimensions are minor and do not alter the aesthetic effect. Refer to Division 1 Section "Substitutions."

1.06 PROJECT CONDITIONS

A. Field Measurements: Check window openings by field measurements before fabrication and show recorded measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
   1. Where field measurements cannot be made without delaying the Work, guarantee opening dimensions and proceed with fabricating aluminum windows without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to guaranteed dimensions.

1.07 WARRANTY

A. General Warranty: The special warranty specified in this Article 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. Warranty Period: Minimum 1 year after date of Substantial Completion. Warranted failures include but are not limited to:
   1. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
   2. Structural failures including deflections exceeding 1/4 inch (6.35 mm).
   3. Failure of welds.
   4. Faulty operation of sliding window hardware or locking hardware.

PART 2 PRODUCTS

2.01 SYSTEM

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amortex, www.amortex.com.
2. Insulgard Security Products, www.insulgard.com.
3. Quickserv Corporation, www.quikserv.com.
4. U.S. Bulet Prooing, www.usbulletproofing.com.
5. Substitutions: Section 01 60 00 - Product Requirements.

B. Basis-of-Design: Custom horizontal slider as manufactured by Quikserv or approved equivalent by specified manufacturer.
   1. Self-closing horizontal slider without magnetic hold-open.
   2. Top-hung ball bearing glide system.
   3. Offset bottom guide to prevent push-in from outside. Bottom track recessed into counter top.
   4. Custom size to fit closely within aluminum storefront framing based on finished frame job measurements.
   5. Heavy duty maximum security lock with hook bolt and inside thumb-turn.
   6. Automatically locks each time door closes to prevent outside penetration.
   7. Frame flush to wall at customer-side, or as indicated.
   8. Configuration: Combination of fixed and sliding units with triple track as indicated.

2.02 MATERIALS

A. Aluminum Extrusions: Provide alloy and temper recommended by manufacturer for strength, corrosion resistance, and application of required finish, but not less than 22,000-psi (150-MPa) ultimate tensile strength and not less than 0.125 inch (3.18 mm) thick at any location for main frame and sash members.

B. Fasteners: Provide mechanical fasteners that are noncorrosive and compatible with aluminum window members, trim, hardware, anchors, and other components of window units.
   1. Reinforcement: Where fasteners screw anchor into aluminum less than 0.125-inch thick, reinforce interior with aluminum or nonmagnetic stainless steel to receive screw threads or provide standard, noncorrosive, pressed-in, splined grommet nuts.
   2. Exposed Fasteners: Except where unavoidable for application of hardware, do not use exposed fasteners. For application of hardware, use fasteners that match finish of member or hardware being fastened, as appropriate.

C. Anchors, Clips, and Window Accessories: Fabricate anchors, clips, and window accessories of aluminum, nonmagnetic stainless steel, or hot-dip zinc-coated steel complying with requirements of ASTM B633.

D. Sealant: For sealants required within fabricated window units, provide type recommended by manufacturer for joint size and movement. Sealant shall remain permanently elastic, nonshrinking, and nonmigrating. Comply with Division 7 Section "Joint Sealants" of these Specifications for selection and installation of sealants.

2.03 HARDWARE

A. General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, or other corrosion-resistant material compatible with aluminum system and of sufficient strength to perform the function for which it is intended.

B. In addition to automatic latching, provide factory-installed lock body that will accept removable cylinder keyed to building system. Cylinder provided under the hardware section.

2.04 FABRICATION

A. General: Fabricate aluminum window units to comply with indicated standards. Include a complete system for assembly of components and anchorage of window units.

B. Preglazed Fabrication: Preglaze window units at the factory:
   1. Multi-ply laminated pane: 1/4-inch clear annealed glass + 0.08-inch Clear PVB interlayer + 1/4-inch clear annealed glass. Total unit thickness: 9/16-inch.
   2. Provide units that are reglazable without dismantling sash or ventilator framing.

2.05 FINISHES

A. Comply with NAAMM "Metal Finishes Manual" 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. Clear anodized finish or as indicated.

PART 3 EXECUTION

3.01 INSPECTION

A. Inspect openings before installation. Verify that rough opening is correct and sill condition is level.
   1. Masonry surfaces shall be visibly dry and free of excess mortar, sand, and other construction debris.
   2. Metal surfaces shall be dry; clean; free of grease, oil, dirt, rust and corrosion, and welding slag; without sharp edges or offsets at joints.
   3. Drywall surfaces shall be taped and floated and ready for painting.

3.02 INSTALLATION

A. Comply with manufacturer's specifications and recommendations for installing window units, hardware, operators, and other components of the Work.

B. Set window units plumb, level, and true to line, without warp or rack of frames or sash. Provide proper support and anchor securely in place.

C. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials by complying with requirements specified under "Dissimilar Materials" Paragraph in appendix to AAMA 101.

D. Refer to Division 7 Section "Joint Sealants" for compounds, fillers, and gaskets to be installed concurrently with window units. Coordinate installation with wall flashings and other components of the Work.

3.03 ADJUSTING

A. Adjust operating sash and hardware to provide a tight fit at contact points for smooth operation.

3.04 CLEANING

A. Clean aluminum surfaces promptly after installing windows. Exercise care to avoid damage to protective coatings and finishes. Remove excess glazing and sealant compounds, dirt, and other substances. Lubricate hardware and other moving parts.

B. Clean glass of pre-glazed units promptly after installing windows. Comply with requirements of Division 8 Section "Glazing" for cleaning and maintenance.

3.05 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to aluminum window manufacturer, that ensure window units are without damage or deterioration at the time of Substantial Completion.

END OF SECTION

SECTION 08 71 00
DOOR HARDWARE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hardware for wood, aluminum, hollow metal, and miscellaneous doors as noted.

B. Hardware for fire-rated doors.

C. Thresholds.

D. Smoke and draft control seals.

E. Weatherstripping and gasketing.

1.02 RELATED REQUIREMENTS

A. Section 06 20 00 - Finish Carpentry.

B. Section 08 11 13 - Hollow Metal Doors and Frames.

C. Section 08 14 16 - Flush Wood Doors.

D. Section 08 43 13 - Aluminum-Framed Storefronts:

E. Division 28 – Security Access

1.03 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.

B. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen 2019.

C. DHI (H&S) - Sequence and Format for the Hardware Schedule 2019.

D. DHI (KSN) - Keying Systems and Nomenclature 2019.

E. DHI (LOCS) - Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames 2004.

F. DHI WDHS.3 - Recommended Locations for Architectural Hardware for Flush Wood Doors 1993; also in WDHS-1/WDHS-5 Series, 1996.

G. ICC (IBC) - International Building Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.

I. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

J. NFPA 80 - Standard for Fire Doors and Other Opening Protectives 2022.

K. NFPA 101 - Life Safety Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

L. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives 2022.

M. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies 2022.

N. TDI - Texas Department of Insurance.

O. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the manufacture, fabrication, and installation of products that door hardware is installed on.

B. Sequence installation to ensure facility services connections are achieved in an orderly and expeditious manner.

C. Preinstallation Meeting: Convene a preinstallation meeting one week prior to commencing work of this section; require attendance by affected installers and the following:
   1. Architect.
   2. Hardware Supplier’s Architectural Hardware Consultant (AHC).

3. Hardware Installer.
4. Owner's Security Consultant.

D. Furnish templates for door and frame preparation to manufacturers and fabricators of products requiring internal reinforcement for door hardware.

E. Keying Requirements Meeting:
1. Schedule meeting at project site prior to Contractor occupancy.
2. Attendance Required:
   a. Contractor.
   b. Owner.
   c. Hardware Supplier’s Architectural Hardware Consultant (AHC).
   d. Door Hardware Installer.
   e. Owner's Security Consultant.
   f. Cylinder Manufacturer’s Keying Consultant
3. Agenda:
   a. Establish keying requirements.
   b. Verify locksets and locking hardware are functionally correct for project requirements.
   c. Verify that keying and programming complies with project requirements.
   d. Establish keying submittal schedule and update requirements.
4. Incorporate "Keying Requirements Meeting" decisions into keying submittal upon review of door hardware keying system including, but not limited to, the following:
   a. Access control requirements.
   b. Key control system requirements.
5. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.
6. Deliver established keying requirements to manufacturers.

1.05 SUBMITTALS

A. See Division 1 - Administrative Requirements for submittal procedures.

B. Product Data: Manufacturer's catalog literature for each type of hardware, marked to clearly show products to be furnished for this project, and includes construction details, material descriptions, finishes, and dimensions and profiles of individual components.

C. Shop Drawings - Door Hardware Schedule: A detailed listing that includes each item of hardware to be installed on each door.
1. Prepared by or under supervision of Architectural Hardware Consultant (AHC).
2. Comply with DHI (H&S) using door numbering scheme and hardware set numbers as indicated in Contract Documents.
   a. Submit in vertical format.
3. List groups and suffixes in proper sequence.
4. Include complete description for each door listed.
5. Include manufacturer's and product names, and catalog numbers; include functions, types, styles, sizes and finishes of each item.
6. Include account of abbreviations and symbols used in schedule.

D. Shop Drawings - Electrified Door Hardware: Include diagrams for power, signal, and control wiring for electrified door hardware that include details of interface with building safety and security systems. Provide elevations and diagrams for each electrified door opening as follows:
1. Prepared by or under supervision of Architectural Hardware Consultant (AHC) and/or Electrified Hardware Consultant (EHC).
2. Elevations: Include front and back elevations of each door opening showing electrified devices with connections installed and an operations narrative describing how opening operates from either side at any given time.
3. Diagrams: Include point-to-point wiring diagrams that show each device in door opening system with related colored wire connections to each device.

E. Samples for Verification:
1. If requested, submit one (1) sample of any hardware items illustrating style, color, and finish.
2. Architect will return full-size samples to Contractor.

3. Include product description with samples.

F. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

G. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.
1. Bitting List: List of combinations as furnished.

H. Keying Schedule:
1. Submit three (3) copies of Keying Schedule in compliance with requirements established during Keying Requirements Meeting unless otherwise indicated.

I. Warranty: Submit manufacturer's warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

J. Maintenance Materials and Tools: Furnish the following for Owner's use in maintenance of project.
1. See Division 1 - Product Requirements, for additional provisions.
2. Tools: One set of each special wrench or tool applicable for each different or special hardware component, whether supplied by hardware component manufacturer or not.

1.06 QUALITY ASSURANCE

A. Standards for Fire-Rated Doors: Maintain one copy of each referenced standard on site, for use by Architect and Contractor.

B. Installer Qualifications: Company specializing in performing work of the type specified for commercial door hardware with at least three years of documented experience.

C. Supplier Qualifications: Company with certified Architectural Hardware Consultant (AHC) and Electrified Hardware Consultant (EHC) to assist in work of this section.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Package hardware items individually; label and identify each package with door opening code to match door hardware schedule.

1.08 WARRANTY

A. Manufacturer Warranty: Provide manufacturer warranty against defects in material and workmanship for period indicated, from Date of Substantial Completion. Complete forms in Owner's name and register with manufacturer.
1. Closers: Thirty Five, minimum.
2. Exit Devices: Five years, minimum.
3. Locksets and Cylinders: Five years, minimum.
4. Other Hardware: Two years, minimum.
5. Where the manufacturer’s standard warranty does not meet the above requirements, provide a letter of compliance from the manufacturer or the manufacturer’s representative for the owner’s use.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Provide specified door hardware as required to make doors fully functional, compliant with applicable codes, and secure to extent indicated.

B. Door Pulls and Push Plates:
1. Provide door pulls and push plates on doors without a lockset, latchset, exit device, or auxiliary lock unless otherwise indicated.

C. Closers:
1. Provide door closer on each exterior door, unless otherwise indicated.
2. Provide door closer on each fire-rated and smoke-rated door.

D. Thresholds:
1. Exterior Applications: Provide at each exterior door, unless otherwise indicated.

E. Smoke and Draft Control Seals:
1. Provide gasketing for smoke and draft control doors (Indicated as "S" on Drawings) that complies with local codes, requirements of assemblies tested in accordance with UL 1784.

F. Weatherstripping and Gasketing:
   1. Provide weatherstripping on each exterior door at head, jambs, and meeting stiles of door pairs, unless otherwise indicated.
   2. Provide door bottom sweep on each exterior door, unless otherwise indicated.
   3. Fabricate as continuous gasketing, do not cut or notch gasketing material.

G. Electrically Operated and/or Controlled Hardware: Provide necessary power supplies, power transfer hinges, relays, and interfaces as required for proper operation; provide wiring between hardware and control components and to building power connection in compliance with NFPA 70.

H. Fasteners:
   1. Provide fasteners of proper type, size, quantity, and finish that comply with commercially recognized standards for proposed applications.
   2. Provide machine screws for attachment to reinforced hollow metal and aluminum frames.
   3. Provide stainless steel machine screws and lead expansion shields for concrete and masonry substrates.
   4. Provide wall grip inserts for hollow wall construction.
   5. Fire-Resistance-Rated Applications: Comply with NFPA 80.
   6. Concealed Fasteners: Do not use through or sex bolt type fasteners on door panel sides indicated as concealed fastener locations, unless otherwise indicated or required per manufacturer's testing requirements.

2.02 PERFORMANCE REQUIREMENTS

A. Provide door hardware products that comply with the following requirements:
   1. Applicable provisions of federal, state, and local codes.
      a. ICC (IBC).
      b. NFPA 101.
      c. Local codes as required.
   2. Accessibility: ADA Standards and ICC A117.1.
   3. Fire-Resistance-Rated Doors: NFPA 80, listed and labeled by qualified testing agency for fire protection ratings indicated, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
   4. Hardware Preparation for Steel Doors and Steel Frames: BHMA A156.115.
   5. Hardware Preparation for Wood Doors with Wood or Steel Frames: BHMA A156.115W.
   6. Regulatory and Operational Requirements:
      a. Provide hardware for all openings, whether specified or not, in compliance with NFPA Standard No. 80, proper operation and local building code requirements. Where required, provide only hardware which has been tested and listed by UL or FM for types and sizes of doors required and complies with requirements of door and door frame labels. Label hardware, as required, for compliance with pressure testing criteria as dictated in IBC.
      b. Provide hardware which meets or exceeds handicap accessibility per local building code requirements. Conform to the Americans with Disabilities Act (ADA) of 1990 as amended by the D.O.J. September 15, 2010, as adopted by the Authority Having Jurisdiction (AHJ).
      c. At smoke partition doors, verify with local jurisdiction that doors specified with gaskets and latching do not need to be self-closing. Refer to hardware sets and provide door closers if required.
   7. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified.

2.03 HINGES

A. Manufacturers:
   1. Listed in Door Hardware Schedule: Best
   2. Substitutions: Hager, McKinney
   3. Continuous hinges are as manufactured by Best. Equal products by ABH or Select are acceptable.

B. Butt Hinges: As applicable to each item specified.

a. Standard Weight Hinges: Minimum of two (2) permanently lubricated non-detachable bearings.
b. Heavy Weight Hinges: Minimum of four (4) permanently lubricated bearings on heavy weight hinges.
c. Template screw hole locations.
d. Pins: Easily seated, non-rising pins.
e. UL 10C listed for fire-resistance-rated doors.

C. Continuous Hinges: As applicable to each item specified.
a. Geared Continuous Hinges: As applicable to each item specified.
1) Non-handed.
2) UL 10C listed for fire-resistance-rated doors.
3) Sufficient size to permit door to swing 180 degrees

D. Finishes: See Door Hardware Schedule.

E. Grades:
1. Butt Hinges: Comply with BHMA A156.1 and BHMA A156.7 for templated hinges.
2. Continuous Hinges: Comply with BHMA A156.26, Grade 1.

F. Types:
1. Butt Hinges: Include full mortise hinges.
2. Continuous Hinges: Include geared hinges.

G. Options: As applicable to each item specified.

H. Quantities:
1. Butt Hinges: Three (3) hinges per leaves up to 90 inches in height. Add one (1) for each additional 30 inches in height or fraction thereof.
a. Hinge weight and size unless otherwise indicated in hardware sets:
1) For doors up to 36 inches wide and up to 1-3/4 inches thick provide hinges with a minimum thickness of 0.134 inch and a minimum of 4-1/2 inches in height.
2) For doors from 36 inches wide up to 42 inches wide and up to 1-3/4 inches thick provide hinges with a minimum thickness of 0.145 inch and a minimum of 4-1/2 inches in height.
3) For doors from 42 inches wide up to 48 inches wide and up to 1-3/4 inches thick provide hinges with a minimum thickness of 0.180 inch and a minimum of 5 inches in height.
4) For doors greater than 1-3/4 inches thick provide hinges with a minimum thickness of 0.180 inch and a minimum of 5 inches in height.
2. Continuous Hinges: One per door leaf.

I. Applications: At swinging doors.
1. Provide non-removable pins at out-swinging doors with locking hardware and all exterior doors.

J. Products:
1. Butt Hinges:
a. Concealed or Exposed bearing, five (5) knuckle.
b. Plain Bearing, Five (5) Knuckle.
2. Continuous Hinges:
a. Aluminum geared hinges.

2.04 BOLTS

A. Manufacturers:
1. Listed in Door Hardware Schedule: Trimco
2. Substitutions: ABH, Glynn Johnson, as approved per division 1

B. Properties:
1. Flush Bolts:
a. Pairs of Swing Doors: At inactive leaves, provide flush bolts of type as required to comply with code.
b. Manual Flush Bolts: Manually latching upon closing of door leaf.
1) Bolt Throw: 3/4 inch, minimum.

c. Provide automatic flush bolts where required by code.

C. Options:
1. Flush Bolts: In leading edge of door, one bolt into floor, one bolt into top of frame. Fire bolt if required or as specified.

D. Products:
1. Manual flush bolts.
2. Automatic flush bolts.

2.05 LOCK CYLINDERS

A. Manufacturers:
1. Listed in Door Hardware Schedule: Best
2. Substitutions: None – facility standard

B. Properties:
1. Lock Cylinders: Provide key access on outside of each lock, unless otherwise indicated.
a. Provide cylinders from same manufacturer as locking device.
b. Provide cams and/or tailpieces as required for locking devices.
c. Provide cylinders with appropriate format interchangeable cores where indicated.

C. Material:
1. Manufacturer's standard corrosion-resistant brass alloy.

D. Products:
1. Rim/mortise.

2.06 KEYS AND CORES

A. Manufacturers:
1. Listed in Door Hardware Schedule: Best Cormax Patented
2. Substitutions: None – facility standard

B. Properties: Complying with guidelines of BHMA A156.28.
1. Provide small format interchangeable core.
2. Provide keying information in compliance with DHI (KSN) standards.
3. Keying Schedule: Arrange for a keying meeting, with Architect, Owner and hardware supplier, and other involved parties to ensure locksets and locking hardware, are functionally correct and keying complies with project requirements.
4. Keying: Master keyed.
a. Contractor to coordinate all hardware delivery schedules and end user key meetings.
5. Include construction keying and control keying with removable core cylinders.
6. Do not make brass construction cores and construction control and operating keys a part of Owner's permanent keying system, nor furnish in the same keyway (or key section) as Owner, permanent keying system.
7. Key to new keying system.
8. Supply keys in following quantities:
a. Master Keys: 4 each.
b. Construction Keys: 20 each.
c. Construction Control Keys: 2 each.
d. Control Keys: 2 each.
e. Change Keys: 2 each for each keyed core.
f. Spare Cylinder Cores: 20 each
9. Deliver keys with identifying tags to Owner by security shipment direct from manufacturer.
10. Permanent Keys and Cores: Stamped with applicable key marking for identification. Do not include actual key cuts within visual key control marks or codes. Stamp permanent keys "Do Not Duplicate."

2.07 MORTISE LOCKS

A. Manufacturers:
1. Listed in Door Hardware Schedule: Best 45H
2. Substitutions: None – facility standard

B. Properties:
1. Mechanical Locks: Manufacturer's standard.
a. Fitting modified ANSI A115.1 door preparation.
b. Door Thickness Coordination Fitting 1-3/4 inch to 2-1/4 inch thick doors.
c. Latch: Solid, one-piece, anti-friction, self-lubricating stainless steel or manufacturer’s standard anti friction as required.
1) Latchbolt Throw: 3/4 inch, minimum.
d. Auxiliary Deadlatch: One piece stainless steel, permanently lubricated.
e. Backset: 2-3/4 inch.
f. Lever Trim:
1) Functionality: Allow the lever handle to move up to 45 degrees from horizontal position prior to engaging the latchbolt assembly.
2) Strength: Locksets outside locked lever designed to withstand minimum 1,400 inch-lbs of torque. In excess of that, a replaceable part will shear. Key from outside and/or inside lever will still operate lockset.
3) Spindle: Designed to prevent forced entry from attacking of lever.
4) Independent spring mechanism for each lever.
(a) Trim to be self-aligning and thru bolted.
2. Electrified Locks: Same properties as standard locks, and as follows:
a. Voltage: 24 VDC.
b. Function: Electrically locked (Fail Safe) or unlocked (Fail Secure), as indicated for each lock in Door Hardware Schedule.

C. Finishes: See Door Hardware Schedule.
1. Core Faces: Match finish of lockset.

D. Products: Mortise locks, including standard and electrified types.

2.08 EXIT DEVICES

A. Manufacturers:
1. Listed in Door Hardware Schedule: Precision 2000
2. Substitutions: None – facility standard

B. Properties:
1. Touchpads: “T” style metal touchpads and rail assemblies with matching chassis covers end caps.
2. Latch Bolts: Stainless steel deadlocking with 3/4 inch projection using latch bolt.
3. Cylinder: Include where cylinder dogging or locking trim is indicated.
4. Strike as recommended by manufacturer for application indicated.
5. Sound dampening on touch bar.
6. Dogging:
a. Non-Fire-Resistance-Rated Devices: Manual dogging feature UNO
b. Fire-Resistance-Rated Devices: Manual dogging not permitted.
7. Handing: Field-reversible.

C. Grades: Complying with BHMA A156.3, Grade 1.

D. Standards Compliance:
1. Provide UL (DIR) listed exit device assemblies for fire-resistance-rated doors.
2. Comply with UL 10C.

E. Code Compliance: As required by authorities having jurisdiction in the State in which the Project is located.

2.09 REMOVABLE MULLIONS

A. Manufacturers:
1. Listed in Door Hardware Schedule: Precision 2000
2. Substitutions: None – facility standard

B. Properties:
1. Rectangular shape 3 inches by 2 inches tubes with minimum 1/8 inch wall thickness.
2. Furnished by the same manufacturer as exit devices.
3. Spacers: Provide as required for proper installation, based on frame profile and dimensions.

C. Grades: Complying with BHMA A156.3.

D. Materials: Manufacturer's standard for items specified.
   1. Top and Bottom Brackets: Investment-cast steel.

E. Options:

F. Applications: As indicated on drawings and in Door Hardware Schedule.

2.10 DOOR PULLS, PUSH/PULL SETS AND PUSH PLATES

A. Manufacturers:
   1. Listed in Door Hardware Schedule: Trimco
   2. Substitutions: Rockwood, Ives, per Division 1

B. Properties:
   1. Pull Type: Straight, unless otherwise indicated.
   2. Push Plate Type: Flat, with square corners, unless otherwise indicated.

C. Grades: Comply with BHMA A156.6.

D. Material: Stainless steel, unless otherwise indicated.

E. Products:
   1. Push-Pull Systems.

2.11 CLOSERS

A. Manufacturers:
   1. Listed in Door Hardware Schedule: Best 8016 Series
   2. Substitutions: None – facility standard

B. Properties:
   1. Surface Mounted Closers: Manufacturer's standard.
      a. Construction: R14 high silicon aluminum alloy or cast iron.
      b. Covers:
         1) Type: Standard for product selected.
            (a) Full.
         2) Material: Plastic.
         3) Finish: Painted.

C. Grades:
   1. Closers: Comply with BHMA A156.4, Grade 1.
      a. Underwriters Laboratories Compliance:
      b. Testing Standards Compliance: Meeting requirements of UL 10C for positive pressure.

D. Code Compliance: As required by authorities having jurisdiction in the State in which the Project is located.

E. Types:
   1. Rack-and-pinion, surface-mounted. 36MM minimum bore.

F. Installation:
   1. Mounting: Includes surface mounted installations.
   2. Mount closers on non-public side of door and stair side of stair doors unless otherwise noted in hardware sets.
   3. At outswinging exterior doors, mount closer on interior side of door.
   4. Provide adapter plates, shim spacers, and blade stop spacers as required by frame and door conditions.
   5. Where an overlapping astragal is included on pairs of swinging doors, provide coordinator to ensure door leaves close in proper order when automatic flush bolts are used

2.12 PROTECTION PLATES

A. Manufacturers:
   1. Listed in Door Hardware Schedule: Trimco
   2. Substitutions: Rockwood, Ives, per Division 1

B. Properties:
   1. Plates:

a. Kick Plates: Provide along bottom edge of push side of every wood door with closer, except aluminum storefront and glass entry doors, unless otherwise indicated.
b. Edges: Beveled, on four (4) unless otherwise indicated.

2. Provide UL fire rated stamp/sticker where required.

C. Grades: Comply with BHMA A156.6.

D. Material: As indicated for each item by BHMA material and finish designation.
1. Metal Properties: Stainless steel.

E. Installation:
1. Fasteners: Countersunk screw fasteners
2. .

2.13 STOPS AND HOLDERS

A. Manufacturers:
1. Listed in Door Hardware Schedule: Trimco
2. Substitutions: Rockwood, Ives, per Division 1

B. General: Provide overhead stop/holder when wall or floor stop is not feasible.

C. Grades:
1. Door Holders, Wall Bumpers, and Floor Stops: Comply with BHMA A156.16 and Resilient Material Retention Test as described in this standard.

D. Material: Base metal as indicated for each item by BHMA material and finish designation.

E. Types:
1. Wall Bumpers: Bumper, concave, wall stop.
2. Floor Stops: Provide with rubber bumper floor stop, heavy duty as specified.

F. Installation:
1. Non-Masonry Walls: Confirm adequate wall reinforcement has been installed to allow lasting installation of wall bumpers.

2.14 THRESHOLDS

A. Manufacturers:
1. Listed in Door Hardware Schedule: National Guard
2. Substitutions: Reese, Pemko, per Division 1

B. Properties:
1. Threshold Surface: Fluted horizontal grooves across full width.

C. Grades: Thresholds: Comply with BHMA A156.21.

D. Types: As applicable to project conditions. Provide barrier-free type at every location where specified.

2.15 WEATHERSTRIPPING AND GASKETING

A. Manufacturers:
1. Listed in Door Hardware Schedule: National Guard
2. Substitutions: Reese, Pemko, per Division 1

B. Grades: Comply with BHMA A156.22.

C. Products:
1. Weatherstripping: See Door Hardware Schedule.
2. Door Bottom Seals:
a. Door Sweeps: See Door Hardware Schedule.
b. Door Shoes: See Door Hardware Schedule.

2.16 MISCELLANEOUS ELECTRIFIED HARDWARE

A. Manufacturers:
1. Listed in Door Hardware Schedule: Best/RCI
2. Substitutions: Rixson, ABH, per Division 1

B. Properties:
1. Wire Harnesses: Of sufficient length, with quick connectors.

a. Wire Harness End Connection to Power Supply or Junction Box: One end with bare leads.

C. Products:
1. Power Supplies:
a. RCI DKPS as noted
2. Wire Harnesses:
a. BEST wire harnesses as noted

2.17 FINISHES

A. Finishes: Provide door hardware of same finish, unless otherwise indicated.
1. Finish: 630; satin stainless steel. 652; satin chromium plated with steel base material, 626, satin chromium plated with brass/bronze base material and 689; aluminum painted, with any base material

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that doors and frames are ready to receive this work; labeled, fire-rated doors and frames are properly installed, and dimensions are as indicated on shop drawings.

B. Correct all defects prior to proceeding with installation.

C. Verify that electric power is available to power operated devices and of correct characteristics.

3.02 INSTALLATION

A. Install hardware in accordance with manufacturer's instructions and applicable codes.

B. Install hardware using the manufacturer’s fasteners provided. Drill and tap all screw holes located in metallic materials. Do not use “Riv-Nuts” or similar products.

C. Install hardware on fire-rated doors and frames in accordance with applicable codes and NFPA 80.

D. Install hardware for smoke and draft control doors in accordance with NFPA 105.

E. Use templates provided by hardware item manufacturer.

F. Do not install surface mounted items until application of finishes to substrate are fully completed.

G. Wash down masonry walls and complete painting or staining of doors and frames.

H. Complete finish flooring prior to installation of thresholds.

I. Door Hardware Mounting Heights: Distance from finished floor to center line of hardware item. As indicated in following list; unless noted otherwise in Door Hardware Schedule or on drawings.
1. For Steel Doors and Frames: Install in compliance with DHI (LOCS) recommendations.
2. For Wood Doors: Install in compliance with DHI WDHS.3 recommendations.
3. Mounting heights in compliance with operational and ADA Standards:

J. Set exterior door thresholds with full-width bead of elastomeric sealant at each point of contact with floor providing a continuous weather seal; anchor thresholds with stainless steel countersunk screws.

K. Include in installation for existing doors and frames any necessary field modification and field preparation of doors and frames for new hardware. Provide necessary fillers, reinforcements, and fasteners for mounting new hardware and to cover existing door and frame preparations.

3.03 FIELD QUALITY CONTROL

A. Perform field inspection and testing under provisions of Division 1 - Quality Requirements.

B. Provide an Architectural Hardware Consultant (AHC) to inspect installation and certify that hardware and installation has been furnished and installed in accordance with manufacturer's instructions and as specified.

3.04 ADJUSTING

A. Adjust work under provisions of Division 1 - Execution and Closeout Requirements.

3.05 CLEANING

A. Clean finished hardware in accordance with manufacturer's written instructions after final adjustments have been made.

B. Clean adjacent surfaces soiled by hardware installation activities.

C. Replace items that cannot be cleaned to manufacturer's level of finish quality at no additional cost.

D. See Division 1 - Construction Waste Management and Disposal, for additional requirements.

3.06 PROTECTION

A. Protect finished Work under provisions of Division 1 - Execution and Closeout Requirements.

B. Do not permit adjacent work to damage hardware or finish.

3.07 MAINTENANCE

A. Approximately six months after the acceptance of hardware in each area, the hardware installer shall:
   1. Return to the project and re-adjust every item of hardware to restore proper function of doors and hardware.
   2. Consult with and instruct Owner's personnel in recommended additions to the maintenance procedures.
   3. Replace hardware items which have deteriorated or failed due to faulty design, materials or installation of hardware units.
   4. Prepare a written report of current and predictable problems (of substantial nature) in the performance of the hardware and submit to the Architect.

3.08 HARDWARE SCHEDULE

Manufacturer list

ABH	Architectural Builders Hardware
BES	Best
PRE	BEST (Precision)
BRN	Burns Manufacturing
NGP	National Guard Products
SIM	Simplex
TRI	Trimco

Option list

Code:	Name:
R	Classroom Function
TS	Touchbar Monitoring Switch
N	Passage Function
16	16 adjustable size 1-6
7	7 Pin
50	50
B	I/C Best and Equivalents
14	No label saved for the current or all languages
20	1 1/2"
VD	Anti-Vandal Pull without Astragal For Von Duprin 98/99
SDS90	SDS90 HD comp
WL	Winston Lever

RQE	Request to Exit
D	Storeroom Function
FL	Fire Rated Hardware
VIBE	Double Visual Indicator
PATD	Patented keyed core
CE	CONCEALED ELECTRIC WIRES
TD	Dormitory Function
2	Standard Length
NCA-03	Cylinder Attachment Kit
3	Push Plate 4" x 16"
PHI	Anti-Vandal Pull without Astragal For Precision PHI Apex 2000 Series
MLR	Motorized Latch Retraction
4" ODW	4" Over Door Width
C	Pre-Terminated Quick Connect Plug
L	Privacy Function
PATD	Patented
Head & Jambs (2)	Provide at the head and both jambs
3B	Pull Plate 4" x 16" with 10" CTC Pull
LAR	Length As Required
A	Office Function
1	Cyl. 1/2" TL, FFP, 2 3/4" BS.
2	Cylindrical Lock
NRP	NON-REMOVABLE PINS
DEU	Single Key Latch Fail Secure
STC 2 x PR	Sound seal

Finish list

Code:	Name:
B	Brown
689	Aluminum
32D	Satin Stainless Steel
US26D	Satin Chrome
630	Satin stainless steel
626	Satin chromium plated
26D	Satin Chrome (626)
US27	Mill Aluminum
A	Anodized Aluminum
S1	Painted Aluminum
AL	ALUM CLEAR COATED

Specification Report

Set #101

Doors: B127.1, B127.2, B131.1, B131.2

2.0	Hinge	661HD	AL	BES
1.0	Removeable Mullion	KR822	689	PRE
1.0	Exit Device	2403 NCA-03	630	PRE
1.0	Exit Device	2402	630	PRE
1.0	Pull	1097 PHI-NC	630	TRI
1.0	Pull	1097 PHI	630	TRI
2.0	Rim Cylinder	12E 7 2 PATD	626	BES
2.0	Door Closer	EHD90 16 SDS90	689	BES
1.0	Gasketing	BY ALUMINUM DOOR/FRAME MANUFACTURER		

Set #102

Doors: C100B.2

2.0	Hinge	661HD	AL	BES
1.0	Removeable Mullion	KR822	689	PRE
1.0	Exit Device	2403 NCA-03	630	PRE
1.0	Exit Device	2402	630	PRE
1.0	Pull	1097 PHI	630	TRI
1.0	Pull	1097 PHI-NC	630	TRI
2.0	Rim Cylinder	12E 7 2 PATD	626	BES
2.0	Door Closer	EHD90 16 SDS90	689	BES
1.0	Drip Cap	16 4" ODW	A	NGP
1.0	Gasketing	BY ALUMINUM DOOR/FRAME MANUFACTURER		
2.0	Sweep	200S LAR	A	NGP
1.0	Threshold	426 LAR	A	NGP

Set #103

Doors: B102.2

2.0	Hinge	CE 661HD 12EA	AL	BES
1.0	Removeable Mullion	KR822	689	PRE
1.0	Exit Device	2403 C MLR TS NCA-03	630	PRE
1.0	Exit Device	C MLR TS 2402	630	PRE
1.0	Pull	1097 PHI	630	TRI
1.0	Pull	1097 PHI-NC	630	TRI
2.0	Rim Cylinder	12E 7 2 PATD	626	BES
2.0	Door Closer	EHD90 16 SDS90	689	BES
1.0	Gasketing	BY ALUMINUM DOOR/FRAME MANUFACTURER		
1.0	Power Supply	BY SECURITY CONTRACTOR		
2.0	Door Position Switch	BY SECURITY CONTRACTOR		
1.0	Card Reader	BY SECURITY CONTRACTOR		
2.0	Wiring Harness	WH-XXP		BES
2.0	Wiring Harness	WH-192P		BES

2.0	Wiring Harness	WH-6E		BES

NOTE: DOOR NORMALLY CLOSED AND LOCKED. PRESENTING VALID CREDENTIAL RETRACTS LATCH AND ALLOWS FOR INGRESS. EMERGENCY KEY OVERRIDE. TS SWITCH IN PUSHBAR TO SHUNT ALARM. FREE EGRESS AT ALL TIMES.

Set #104

Doors: A100A, A100C

2.0	Hinge	CE 661HD 12EA	AL	BES
1.0	Removeable Mullion	KR822	689	PRE
1.0	Exit Device	2403 C MLR TS NCA-03	630	PRE
1.0	Exit Device	C MLR TS 2402	630	PRE
1.0	Pull	1097 PHI	630	TRI
1.0	Pull	1097 PHI-NC	630	TRI
2.0	Rim Cylinder	12E 7 2 PATD	626	BES
2.0	Door Closer	EHD90 16 SDS90	689	BES
1.0	Gasketing	BY ALUMINUM DOOR/FRAME MANUFACTURER		
2.0	Sweep	200S LAR	A	NGP
1.0	Drip Cap	16 4" ODW	A	NGP
1.0	Threshold	426 LAR	A	NGP
1.0	Power Supply	BY SECURITY CONTRACTOR		
1.0	Card Reader	BY SECURITY CONTRACTOR		
2.0	Door Position Switch	BY SECURITY CONTRACTOR		
2.0	Wiring Harness	WH-XXP		BES
2.0	Wiring Harness	WH-6E		BES
2.0	Wiring Harness	WH-192P		BES

NOTE: DOOR NORMALLY CLOSED AND LOCKED. PRESENTING VALID CREDENTIAL RETRACTS LATCH AND ALLOWS FOR INGRESS. EMERGENCY KEY OVERRIDE. TS SWITCH IN PUSHBAR TO SHUNT ALARM. FREE EGRESS AT ALL TIMES.

Set #105

Doors: B101, B102.1, B140.1, B140.2, C100B.1, C100C

2.0	Hinge	CE 661HD 12EA	AL	BES
1.0	Removeable Mullion	KR822	689	PRE
1.0	Exit Device	C MLR TS 2402	630	PRE
1.0	Exit Device	2403 C MLR TS NCA-03	630	PRE
1.0	Pull	1097 PHI	630	TRI
1.0	Pull	1097 PHI-NC	630	TRI
2.0	Rim Cylinder	12E 7 2 PATD	626	BES
2.0	Door Closer	EHD90 16 SDS90	689	BES
1.0	Gasketing	BY ALUMINUM DOOR/FRAME MANUFACTURER		
1.0	Drip Cap	16 4" ODW	A	NGP
2.0	Sweep	200S LAR	A	NGP
1.0	Threshold	426 LAR	A	NGP

1.0	Power Supply	BY SECURITY CONTRACTOR		
2.0	Door Position Switch	BY SECURITY CONTRACTOR		
1.0	Card Reader	BY SECURITY CONTRACTOR		
2.0	Wiring Harness	WH-XXP		BES
2.0	Wiring Harness	WH-6E		BES
2.0	Wiring Harness	WH-192P		BES

NOTE: DOOR NORMALLY CLOSED AND LOCKED. PRESENTING VALID CREDENTIAL RETRACTS LATCH AND ALLOWS FOR INGRESS. EMERGENCY KEY OVERRIDE. TS SWITCH IN PUSHBAR TO SHUNT ALARM. FREE EGRESS AT ALL TIMES.

Set #106

Doors: B128, D114.1, D114.2, D114.3

6.0	Hinge	FBB168 NRP 45X45	26D	BES
1.0	Flushbolt	1860P	US26D	ABH
1.0	Dust Proof Strike	1870	US26D	ABH
1.0	Mortise Lock	45H 7 D 14 H PATD	630	BES
2.0	Door Closer	EHD90 16 SDS90	689	BES
2.0	Kick Plate	KP50 10" LDW CSK B4E	630	BRN
1.0	Coordinator	3721	S1	ABH
2.0	Mounting Bracket	3751/3752 AS REQ'D	S1	ABH
1.0	Astragal	1390SP-83		NGP
1.0	Gasketing	5050 Head & Jambs (2)	B	NGP

Set #107

Doors: B147, B147.2

6.0	Hinge	FBB168 NRP 45X45	26D	BES
1.0	Removeable Mullion	KR822	689	PRE
1.0	Exit Device	2103 CA-03	630	PRE
1.0	Exit Device	2102	630	PRE
1.0	Pull	1097 PHI-NC	630	TRI
1.0	Pull	1097 PHI	630	TRI
2.0	Rim Cylinder	12E 7 2 PATD	626	BES
2.0	Door Closer	EHD90 16 SDS90	689	BES
2.0	Kick Plate	KP50 10" LDW CSK B4E	630	BRN
1.0	Gasketing	5050 Head & Jambs (2)	B	NGP
1.0	Gasketing	5100N Head & Jambs (2)		NGP

Set #108

Doors: D100.1, D100.2

6.0	Hinge	FBB168 NRP 45X45	26D	BES
1.0	Removeable Mullion	KR822	689	PRE
1.0	Exit Device	2103 CA-03	630	PRE
1.0	Exit Device	2102	630	PRE

2.0	Rim Cylinder	12E 7 2 PATD	626	BES
1.0	Pull	1097 PHI-NC	630	TRI
1.0	Pull	1097 PHI	630	TRI
2.0	Door Closer	EHD90 16 SDS90	689	BES
2.0	Kick Plate	KP50 10" LDW CSK B4E	630	BRN
1.0	Gasketing	5100N Head & Jambs (2)		NGP
1.0	Gasketing	5050 Head & Jambs (2)	B	NGP

Set #109

Doors: A102, A102.1, A102.2, B133, B135, B137, D111, A202.1, A202.2

6.0	Hinge	FBB168 NRP 45X45	26D	BES
1.0	Flushbolt	1860P	US26D	ABH
1.0	Dust Proof Strike	1870	US26D	ABH
1.0	Mortise Lock	45H 7 D 14 H PATD	630	BES
2.0	Door Closer	EHD90 16 SIS90	689	BES
2.0	Kick Plate	KP50 10" LDW CSK B4E	630	BRN
1.0	Coordinator	3721	S1	ABH
2.0	Mounting Bracket	3751/3752 AS REQ'D	S1	ABH
1.0	Gasketing	5050 Head & Jambs (2)	B	NGP
1.0	Astragal	1390SP-83		NGP

Set #110

Doors: D200

3.0	Hinge	FBB199 NRP 45X45	32D	BES
1.0	Flushbolt	1860P	US26D	ABH
1.0	Dust Proof Strike	1870	US26D	ABH
1.0	Mortise Lock	45H 7 D 14 H PATD	630	BES
2.0	Door Closer	EHD90 16 SDS90	689	BES
2.0	Kick Plate	KP50 10" LDW CSK B4E	630	BRN
1.0	Coordinator	3721	S1	ABH
2.0	Mounting Bracket	3751/3752 AS REQ'D	S1	ABH
1.0	Astragal	1390SP-83		NGP
1.0	Drip Cap	16 4" ODW	A	NGP
1.0	Gasketing	700S Head & Jambs (2)	A	NGP
2.0	Sweep	200S LAR	A	NGP
1.0	Threshold	426 LAR	A	NGP

Set #111

Doors: A115.1, A115.2

3.0	Hinge	FBB168 NRP 45X45	26D	BES
1.0	Exit Device	FL 2103 CA-03	630	PRE
1.0	Pull	1097 PHI	630	TRI
1.0	Rim Cylinder	12E 7 2 PATD	626	BES
1.0	Door Closer	EHD90 16 AF90P	689	BES

1.0	Kick Plate	KP50 10" LDW CSK B4E	630	BRN
1.0	Gasketing	5050 Head & Jambs (2)	B	NGP
1.0	Wall Stop	575	630	BRN

Set #112

Doors: C107

3.0	Hinge	FBB168 NRP 45X45	26D	BES
1.0	Mortise Lock	45H 7 R 14 H PATD	630	BES
1.0	Gasketing	5050 Head & Jambs (2)	B	NGP
1.0	Wall Stop	575	630	BRN

Set #113

Doors: B103.4, B103

1.0	Hinge	CE 661HD 12EA	AL	BES
1.0	Electromechanical Lock	45HW 7 DEU 14 H PATD RQE	630	BES
1.0	Door Closer	EHD90 16 SDS90	689	BES
1.0	Gasketing	BY ALUMINUM DOOR/FRAME MANUFACTURER		
1.0	Power Supply	BY SECURITY CONTRACTOR		
1.0	Door Position Switch	BY SECURITY CONTRACTOR		
1.0	Card Reader	BY SECURITY CONTRACTOR		
1.0	Wiring Harness	WH-6E		BES
1.0	Wiring Harness	WH-XXP		BES
1.0	Wiring Harness	WH-192P		BES

NOTE: DOOR NORMALLY CLOSED AND LOCKED. PRESENTING VALID CREDENTIAL RELEASES LEVER AND ALLOWS FOR INGRESS. EMERGENCY KEY OVERRIDE. RQE SWITCH IN LEVERSET TO SHUNT ALARM. FREE EGRESS AT ALL TIMES.

Set #114

Doors: A132, B122.2, B123, C103, A232

3.0	Hinge	FBB168 NRP 45X45	26D	BES
1.0	Power Transfer	EPT-12C		PRE
1.0	Electromechanical Lock	45HW 7 DEU 14 H PATD RQE	630	BES
1.0	Door Closer	EHD90 16 SDS90	689	BES
1.0	Kick Plate	KP50 10" LDW CSK B4E	630	BRN
1.0	Gasketing	5050 Head & Jambs (2)	B	NGP
1.0	Power Supply	BY SECURITY CONTRACTOR		
1.0	Card Reader	BY SECURITY CONTRACTOR		
1.0	Door Position Switch	BY SECURITY CONTRACTOR		
1.0	Wiring Harness	WH-6E		BES
1.0	Wiring Harness	WH-192P		BES
1.0	Wiring Harness	WH-XXP		BES

NOTE: DOOR NORMALLY CLOSED AND LOCKED. PRESENTING VALID CREDENTIAL RELEASES LEVER AND ALLOWS FOR INGRESS. EMERGENCY KEY OVERRIDE. RQE SWITCH IN LEVERSET TO SHUNT ALARM. FREE EGRESS AT ALL TIMES.

Set #115

Doors: B108,1

3.0	Hinge	FBB168 NRP 45X45	26D	BES
1.0	Power Transfer	EPT-12C		PRE
1.0	Electromechanical Lock	45HW 7 DEU 14 H PATD RQE	630	BES
1.0	Door Closer	EHD90 16 SIS90	689	BES
1.0	Kick Plate	KP50 10" LDW CSK B4E	630	BRN
1.0	Gasketing	5050 Head & Jambs (2)	B	NGP
1.0	Power Supply	BY SECURITY CONTRACTOR		
1.0	Door Position Switch	BY SECURITY CONTRACTOR		
1.0	Card Reader	BY SECURITY CONTRACTOR		
1.0	Wiring Harness	WH-XXP		BES
1.0	Wiring Harness	WH-192P		BES
1.0	Wiring Harness	WH-6E		BES

NOTE: DOOR NORMALLY CLOSED AND LOCKED. PRESENTING VALID CREDENTIAL RELEASES LEVER AND ALLOWS FOR INGRESS. EMERGENCY KEY OVERRIDE. RQE SWITCH IN LEVERSET TO SHUNT ALARM. FREE EGRESS AT ALL TIMES.

Set #116

Doors: B107.2, B122.1, D102

3.0	Hinge	FBB168 NRP 45X45	26D	BES
1.0	Power Transfer	EPT-12C		PRE
1.0	Electromechanical Lock	45HW 7 DEU 14 H PATD RQE	630	BES
1.0	Door Closer	EHD90 16 AF90P	689	BES
1.0	Kick Plate	KP50 10" LDW CSK B4E	630	BRN
1.0	Gasketing	5050 Head & Jambs (2)	B	NGP
1.0	Card Reader	BY SECURITY CONTRACTOR		
1.0	Door Position Switch	BY SECURITY CONTRACTOR		
1.0	Power Supply	BY SECURITY CONTRACTOR		
1.0	Wiring Harness	WH-6E		BES
1.0	Wiring Harness	WH-192P		BES
1.0	Wiring Harness	WH-XXP		BES

NOTE: DOOR NORMALLY CLOSED AND LOCKED. PRESENTING VALID CREDENTIAL RELEASES LEVER AND ALLOWS FOR INGRESS. EMERGENCY KEY OVERRIDE. RQE SWITCH IN LEVERSET TO SHUNT ALARM. FREE EGRESS AT ALL TIMES.

Set #117

Doors: A102.5

1.0	Hinge	CE 661HD 12EA	AL	BES
1.0	Exit Device	2403 C MLR TS NCA-03	630	PRE
1.0	Pull	1097 PHI	630	TRI
1.0	Rim Cylinder	12E 7 2 PATD	626	BES
1.0	Door Closer	EHD90 16 SDS90	689	BES
1.0	Gasketing	BY ALUMINUM DOOR/FRAME MANUFACTURER		
1.0	Drip Cap	16 4" ODW	A	NGP
1.0	Sweep	200S LAR	A	NGP
1.0	Threshold	426 LAR	A	NGP
1.0	Wiring Harness	WH-6E		BES
1.0	Wiring Harness	WH-192P		BES
1.0	Wiring Harness	WH-XXP		BES
1.0	Card Reader	BY SECURITY CONTRACTOR		
1.0	Power Supply	BY SECURITY CONTRACTOR		
1.0	Door Position Switch	BY SECURITY CONTRACTOR		

NOTE: DOOR NORMALLY CLOSED AND LOCKED. PRESENTING VALID CREDENTIAL RETRACTS LATCH AND ALLOWS FOR INGRESS. EMERGENCY KEY OVERRIDE. TS SWITCH TO SHUNT ALARM. FREE EGRESS AT ALL TIMES.

Set #119

Doors: C102.2, D100.3, D100.4

1.0	Hinge	661HD	AL	BES
1.0	Exit Device	2403 NCA-03	630	PRE
1.0	Pull	1097 PHI	630	TRI
1.0	Rim Cylinder	12E 7 2 PATD	626	BES
1.0	Door Closer	EHD90 16 SDS90	689	BES
1.0	Gasketing	BY ALUMINUM DOOR/FRAME MANUFACTURER		
1.0	Sweep	200S LAR	A	NGP
1.0	Threshold	426 LAR	A	NGP

Set #120

Doors: B138.2

3.0	Hinge	FBB199 NRP 45X45	32D	BES
1.0	Exit Device	2103 CA-03	630	PRE
1.0	Pull	1097 PHI	630	TRI
1.0	Rim Cylinder	12E 7 2 PATD	626	BES
1.0	Door Closer	EHD90 16 SDS90	689	BES
1.0	Kick Plate	KP50 10" LDW CSK B4E	630	BRN
1.0	Drip Cap	16 4" ODW	A	NGP
1.0	Gasketing	700S Head & Jambs (2)	A	NGP
1.0	Sweep	200S LAR	A	NGP

1.0	Threshold	426 LAR	A	NGP

Set #121

Doors: A112, D114.4

3.0	Hinge	FBB168 NRP 45X45	26D	BES
1.0	Exit Device	2103 CA-03	630	PRE
1.0	Pull	1097 PHI	630	TRI
1.0	Rim Cylinder	12E 7 2 PATD	626	BES
1.0	Door Closer	EHD90 16 SDS90	689	BES
1.0	Kick Plate	KP50 10" LDW CSK B4E	630	BRN
1.0	Gasketing	5050 Head & Jambs (2)	B	NGP

Set #122

Doors: C109

3.0	Hinge	FBB168 45X45	26D	BES
1.0	Mortise Lock	45H 0 N 14 H	630	BES
1.0	Door Closer	EHD90 16 AF90P	689	BES
1.0	Kick Plate	KP50 10" LDW CSK B4E	630	BRN
1.0	Gasketing	5050 Head & Jambs (2)	B	NGP
1.0	Wall Stop	575	630	BRN

Set #123

Doors: C108, C113, B118, B107.1, B111

3.0	Hinge	FBB168 45X45	26D	BES
1.0	Mortise Lock	45H 0 N 14 H	630	BES
1.0	Gasketing	5050 Head & Jambs (2)	B	NGP
1.0	Wall Stop	575	630	BRN

Set #124

Doors: B143.1, B143.2

3.0	Hinge	FBB168 45X45	26D	BES
1.0	Mortise Lock	45H 0 N 14 H	630	BES
1.0	Door Closer	EHD90 16 SDS90	689	BES
1.0	Kick Plate	KP50 10" LDW CSK B4E	630	BRN
1.0	Gasketing	5050 Head & Jambs (2)	B	NGP

Set #125

Doors: B104.1, B104.2, B105, B109, B113, B114, B115, B116, B117, B132, B149, D107

3.0	Hinge	FBB168 NRP 45X45	26D	BES
1.0	Mortise Lock	45H 7 A 14 H PATD	630	BES

1.0	Gasketing	5050 Head & Jambs (2)	B	NGP
1.0	Wall Stop	575	630	BRN

Set #126

Doors: B106, B112, B119, B120, C110

3.0	Hinge	FBB168 45X45	26D	BES
1.0	Mortise Lock	45H 0 L 14 H VIBE	630	BES
1.0	Door Closer	EHD90 16 AF90P	689	BES
1.0	Kick Plate	KP50 10" LDW CSK B4E	630	BRN
1.0	Gasketing	5050 Head & Jambs (2)	B	NGP
1.0	Wall Stop	575	630	BRN

Set #127

Doors: D105, D106

3.0	Hinge	FBB168 45X45	26D	BES
1.0	Push Plate	AB70C 4" x 16"	630	TRI
1.0	Pull Plate	AB111 X AB70C 4" x 16"	630	TRI
1.0	Door Closer	EHD90 16 AF90P	689	BES
1.0	Kick Plate	KP50 10" LDW CSK B4E	630	BRN
1.0	Gasketing	5050 Head & Jambs (2)	B	NGP
1.0	Wall Stop	575	630	BRN

Set #128

Doors: D110

3.0	Hinge	FBB168 NRP 45X45	26D	BES
1.0	Mortise Lock	45H 7 TD 14 H PATD VIBE	630	BES
1.0	Door Closer	EHD90 16 SDS90	689	BES
1.0	Kick Plate	KP50 10" LDW CSK B4E	630	BRN
1.0	Gasketing	5050 Head & Jambs (2)	B	NGP

Set #129

Doors: B144.1, B144.2, A122, A222

3.0	Hinge	FBB168 NRP 45X45	26D	BES
1.0	Mortise Lock	45H 7 TD 14 H PATD VIBE	630	BES
1.0	Door Closer	EHD90 16 AF90P	689	BES
1.0	Kick Plate	KP50 10" LDW CSK B4E	630	BRN
1.0	Gasketing	5050 Head & Jambs (2)	B	NGP
1.0	Wall Stop	575	630	BRN

Set #130

Doors: B146

1.0	Hinge	661HD	AL	BES
1.0	Mortise Lock	45H 7 D 14 H PATD	630	BES
1.0	Door Closer	EHD90 16 AF90P	689	BES
1.0	Gasketing	BY ALUMINUM DOOR/FRAME MANUFACTURER		
1.0	Wall Stop	575	630	BRN

Set #131

Doors: D103, D109, A212

3.0	Hinge	FBB168 NRP 45X45	26D	BES
1.0	Mortise Lock	45H 7 D 14 H PATD	630	BES
1.0	Door Closer	EHD90 16 SDS90	689	BES
1.0	Kick Plate	KP50 10" LDW CSK B4E	630	BRN
1.0	Gasketing	5050 Head & Jambs (2)	B	NGP

Set #132

Doors: B108.2

3.0	Hinge	FBB168 NRP 45X45	26D	BES
1.0	Mortise Lock	45H 7 D 14 H PATD	630	BES
1.0	Door Closer	EHD90 16 SIS90	689	BES
1.0	Kick Plate	KP50 10" LDW CSK B4E	630	BRN
1.0	Gasketing	5050 Head & Jambs (2)	B	NGP

Set #133

Doors: B124, B126, B134, B136

3.0	Hinge	FBB168 NRP 45X45	26D	BES
1.0	Mortise Lock	45H 7 D 14 H PATD	630	BES
1.0	Door Closer	EHD90 16 AF90P	689	BES
1.0	Kick Plate	KP50 10" LDW CSK B4E	630	BRN
1.0	Gasketing	5075 Head & Jambs (2)	B	NGP
1.0	Gasketing	5060 Head & Jambs (2)	B	NGP
1.0	Automatic Door Bottom	225S STC 2 x PR	US27	NGP
2.0	Gasketing	60FP		NGP
1.0	Threshold	8144 LAR | Smooth Side Up	A	NGP
1.0	Wall Stop	575	630	BRN

Set #134

Doors: A100, A101, A103, A104, A105, A107, A109, A110, A113, A114, A118, A119, A120, A121, A123, A124, A125, A128, A129, A131, A133, A134, A135, A136, A137, A138, B125, B138.1, B139, B141, B142.1, B142.2, B145, B148, C102.1, C104, D101, D104, D108, A200, A201, A203, A204, A205,

A207, A209, A210, A213, A214, A218, A219, A220, A221, A223, A224, A225, A226, A229, A231, A233, A234, A235, A236, A237, A238

3.0	Hinge	FBB168 NRP 45X45	26D	BES
1.0	Mortise Lock	45H 7 D 14 H PATD	630	BES
1.0	Door Closer	EHD90 16 AF90P	689	BES
1.0	Kick Plate	KP50 10" LDW CSK B4E	630	BRN
1.0	Gasketing	5050 Head & Jambs (2)	B	NGP
1.0	Wall Stop	575	630	BRN

Set #135

Doors: B110, B121, B146A

3.0	Hinge	FBB168 45X45	26D	BES
1.0	Mortise Lock	45H 7 D 14 H PATD	630	BES
1.0	Gasketing	5050 Head & Jambs (2)	B	NGP
1.0	Wall Stop	575	630	BRN

Set #136

Doors: C106, C105.1, C101, C105

3.0	Hinge	FBB168 NRP 45X45	26D	BES
1.0	Mortise Lock	45H 7 R 14 H PATD	630	BES
1.0	Door Closer	EHD90 16 SDS90	689	BES
1.0	Kick Plate	KP50 10" LDW CSK B4E	630	BRN
1.0	Gasketing	5050 Head & Jambs (2)	B	NGP

Set #137

Doors: A106.1, A106.2, A108.1, A108.2, A206.1, A206.2, A208.1, A208.2, A215.1, A215.2

3.0	Hinge	FBB168 NRP 45X45	26D	BES
1.0	Exit Device	2103 CA-03	630	PRE
1.0	Pull	1097 PHI	630	TRI
1.0	Rim Cylinder	12E 7 2 PATD	626	BES
1.0	Door Closer	EHD90 16 AF90P	689	BES
1.0	Kick Plate	KP50 10" LDW CSK B4E	630	BRN
1.0	Gasketing	5050 Head & Jambs (2)	B	NGP
1.0	Wall Stop	575	630	BRN

Set #138 NOT USED

Set #139

Doors: C105.2, C105.3, C105.4, B100C, B100E, D101.1

1.0	Padlock	11B 7 20 PATD	626	BES

SECTION 08 80 00

GLAZING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes glass and glazing for the following:
   1. Doors and sidelites.
   2. Aluminum glazed framing for interior and exterior.
   3. Applied decorative films for certain interior glazing.
   4. Glazing and glazing materials and installation requiremnets are included in this section for other sections referencing this section.

B. Related Sections:
   1. Section 01 23 00 - Alternates.
   2. Section 05 73 00 - Glazed Decorative Metal Railings.
   3. Section 07 90 00 - Joint Protection: Sealant and back-up material other than glazing sealants.
   4. Section 08 11 13 - Standard Steel Doors and Frames: Glazing in steel doors and fixed windows.
   5. Section 08 14 16 - Flush Wood Doors: Glazing in door-lights.
   6. Section 08 41 13 - Aluminum-Framed Glazing Systems.
   7. Section 08 44 13 - Glazed Aluminum Curtain Walls.
   8. Section 08 87 23 - Impact Resistant Glazing Film - Alternate.

1.02 REFERENCES

A. American National Standards Institute:
   1. ANSI Z97.1 - Safety Glazing Materials Used in Buildings Safety.

B. American Society of Civil Engineers:
   1. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.

C. ASTM International:
   1. ASTM C509 - Standard Specification for Elastomeric Cellular Preformed Gasket and Sealing Material.
   2. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.
   3. ASTM C1036 - Standard Specification for Flat Glass.
   4. ASTM C1048 - Standard Specification for Heat-Treated Flat Glass-Kind HS, Kind FT Coated and Uncoated Glass.
   5. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation.

D. Consumer Products Safety Commission:
   1. CPSC 16 CFR 1201 - Safety Standard for Architectural Glazing.

E. Glass Association of North America:
   1. GANA - Sealant Manual.
   2. GANA - Glazing Manual.
   3. GANA - Laminated Glass Design Guide.

1.03 PERFORMANCE REQUIREMENTS

A. Glass Thickness: Glass thickness designations indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites in the thickness designations indicated for various size openings, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:
   1. Wind Loads: As indicated, but not less than wind loads required by ASCE 7 "Minimum Design Loads for Buildings and Other Structures": Section 6.0 "Wind Loads."
   2. Probability of Breakage for Vertical Glazing: 8 lites per 1000 for lites set vertically or not more than 15 degrees off vertical and under wind action.
      a. Load Duration: 3-seconds.
   3. Maximum Lateral Deflection: For exterior glass supported on all 4 edges, provide thickness required that limits center deflection at design wind pressure to 1/50 times the short side length or 1-inch, whichever is less.
   4. Minimum Glass Thickness for Exterior Lites: Not less than 1/4 inch (6.35 mm).

B. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components.
   1. Temperature Change (Range): 120 degrees Fahrenheit (48.89 degrees Celsius), ambient; 180 degrees Fahrenheit (82.22 degrees Celsius), material surfaces.

C. Thermal and Solar Optical Performance: Measured or calculated in accordance with the following:
   1. U-Values: NFRC 100.
   2. Solar Heat Gain Coefficients: NFRC 200.
   3. Solar Optical Properties: NFRC 300.

1.04 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

1.05 PRODUCT DATA:
   1. Glass and Plastic: Provide structural, physical, and thermal and solar optical performance characteristics, size limitations, special handling or installation requirements.
   2. Glazing Sealants, Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors where exposed.

B. Samples:
   1. Glass: Submit two samples 12x12 inch in size, of each type and color of glass specified, including spandrel and wire glass.
   2. Glazing Materials: Submit 12-inch long bead of glazing sealant for each color other than black.

C. Manufacturer's Certificate: Certify sealed insulating glass and low-E coated glass meet or exceed specified requirements.

D. Installer's Certificate: Certify glass furnished without identification label is installed in accordance with Construction Documents and applicable code.

1.06 QUALITY ASSURANCE

A. Perform Work in accordance with GANA Glazing Manual for glazing installation methods.

B. Safety Glazing Products: Comply with testing requirements in 16 CFR 1201 and, for wired-glass, ANSI Z97.1.
   1. Obtain safety glazing products permanently marked with certification label of the Safety Glazing Certification Council or another certification agency or manufacturer acceptable to authorities having jurisdiction.
   2. Where glazing units are specified for lites more than 9 sq. ft. in exposed surface area, and lites of any size in certain hazardous locations such as sliding glass doors, doors and enclosures for bathtubs, showers, hot tubs, whirlpools, saunas, and steam rooms, provide glazing products that comply with Category II materials; for lites 9 sq. ft. or less in exposed surface area, provide glazing products that comply with Category I or II materials.

1.07 QUALIFICATIONS

A. Installer: Company specializing in performing Work of this section with minimum three years' experience.

1.08 PRE-INSTALLATION MEETING

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
   1. Convene minimum one week before starting Work of this section.

1.09 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

B. Do not install liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 40 degrees Fahrenheit (4.44 degrees Celsius).

1.10 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

1.11 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

B. In addition to General Contractor's one-year warranty, provide the following:
   1. Furnish ten-year warranty to include coverage for coated glass units from coating deterioration or failure, and replacement of same.

2. Furnish ten-year warranty to include coverage for sealed glass units from seal failure, interpane dusting or misting, and replacement of same.

PART 2 PRODUCTS

2.01 MATERIALS

A. Manufacturers:
   1. Guardian Industries Corp.; www.guardianglass.com/us/en
   2. Oldcastle Building Envelope; www.obe.com
   3. Vitro Architectural Glass; www.vitroglazings.com
   4. Pilkington North America, Inc.; www.pilkington.com
   5. Viracon www.viracon.com
   6. Substitutions: Section 01 60 00 - Product Requirements.

B. Tempered Glass: ASTM C1048, Type 1 transparent flat, Quality Q3, Kind FT fully tempered, Condition A uncoated, float glass with horizontal tempering; furnish tempered glass conforming to CPSC 16 CFR 1201 Category II.
   1. Clear Tempered Glass: Class 1 Clear; 1/4 inch (6.35 mm) thick, as manufactured by Guardian or approved equivalent by specified manufacturer.
      a. Used for typical interior glazing unless otherwise indicated.
   2. Tinted Tempered Glass: Class 2 tinted and spectrally selective, 1/4 inch (6.35 mm) thick.
      a. Used for exterior glazing unless otherwise indicated.
      b. Colors: Tint colors standard for Guardian, or approved equivalent by specified manufacturer.
      c. Locations: As indicated.
   3. Low-E Coating: ASTM C1376, vacuum deposited, low-E coating applied to No. 2 surface of exterior glass; Guardian SNX70 or equal alternative, to meet Code minimum.

C. Exterior Insulating Glass Panels: ASTM E2190 certified by Insulating Glass Certification Council (IGCC) with glass lites separated by a dehydrated airspace that is hermetically dual sealed with a primary seal of polyisobutylene (PIB), or thermo plastic spacer (TPS) and a secondary seal of silicone or an organic sealant as determined by the manufacturer for the specific application. At typical exterior glazing fabricate for typical aluminum framing conditions with resilient glazing gaskets.
   1. Fully Tempered: Glazing units above 7 ft. shall include two fully-tempered panes. One tinted, and one clear. Tint is integral with the glass pane.
   2. Tempered plus Laminated: Glazing units below 7 ft. shall include one fully-tempered pane and one laminated pane. Tint is provided in the plastic interlayer of the laminated pane.
   3. Matching: Selected gray tint for fully tempered and tempered plus laminated shall match in color and color density when observed from the exterior.

D. Glazing Types – As Scheduled on the Drawings.
   1. **Type GL-1** - Tinted, Insulated Glazing Units (use at exterior glazing above 7 ft):
      a. Total unit thickness: 1-inch.
         1) Outer Pane:1/4-inch thick fully tempered tinted, with low-E coating on No. 2 surface, Class 2.
         2) 1/2-in dry air core.
         3) Inner Pane: 1/4-inch thick fully tempered, Class 1, with *Crystal Gray* tint.

b. Edge Condition: Black edge seal color.

2. **Type GL-2**: Insulated Spandrel Glazing Units:
   a. Total unit thickness: 1-inch.
      1) Outer Pane: 1/4-inch thick fully tempered clear with low-E coating on No. 2 surface. Class 2.
      2) 1/2-in dry air core.
      3) Inner Pane: 1/4-inch thick fully tempered spandrel glass with semi-opaque ceramic coating on No. 3 surface. ASTM C1048. Color: As selected by Architect or indicated on drawings.
   b. Edge Condition: Black edge seal color.
3. Type **GL-3**: Insulated Glazing Unit (use at exterior glazing below 7 ft.).
   a. Total Unit Thickness: 1-5/16 inch.
      1) Outer Pane: Clear tempered glass 1/4-inch thickness with specified low-E coating applied to number 2 surface.
      2) 1/2-inch dry air core.
      3) Inner Pane: Clear laminated glass consisting of 2-plies of 1/4-inch annealed clear glass bonded together with 0.080-in PVB clear interlayer. Pane thickness nominal 9/16-inch. Color *Crystal Gray.*
   b. Installed system shall meet TEA requirements and UL 972 for Delayed Forced Entry.
4. **Type GL-4**: Typical Interior Glazing Units:
   a. Class 1 clear, fully tempered.
   b. Minimum 1/4-inch thick.
5. **Type GL-5a and GL-5b:**
   a. GL-5a: Clear laminated glass: ASTM C1172 (use interior storefront glazing below 7 ft., including factory-glazed transaction window specified in Section 08 56 53).
      1) Fabrication: 1/4-inch clear annealed glass + 0.08-inch Clear PVB interlayer + 1/4-inch clear annealed glass. Total unit thickness: 9/16-inch.
   b. GL-5b: Same as GL-5a but with the addition of ½" thick Mape's finished panel on back side of mullions to conceal Reception counter.
6. **Type GL-6**: Fire-Rated Glazing Units:
   a. Composed of multiple sheets of clear tempered glass laminated with intumescent interlayers meeting requirements of ASTM E119 and safety standards of ANSI Z97.1 and/or CPSC 16CFR1201 (Cat. I and II).
   b. Basis of Design: *SuperLite II-XL* as manufactured by SaftiFirst or approved equivalent by Firelite.
   c. Thickness minimum 5/8" thick or greater as required to meet indicated rating.
   d. Labeling: Each piece of fire-rated glazing shall be labeled with a permanent logo including name of product, manufacturer, testing laboratory (UL), fire rating period, safety glazing standards, and date of manufacture.
7. **Type GL-7:** Grey-Colored, Transleucent Laminated Glass: ASTM C1172, with plastic interlayer (use at Dance Room)
   a. Total unit thickness: 9/16-inch.
      1) Fabrication: 1/4-inch clear annealed glass + 0.06-inch Grey-Colored PVB interlayer + 1/4-inch clear annealed glass.
   b. PVB Interlayer: *LamiGlass Color Grey* as manufactured by Guardian, or approved alternate matching Architect's sample.
8. **Type GL-8:** Red-Colored, Transleucent Laminated Glass: ASTM C1172, with plastic interlayer.

a. Total unit thickness:
1) Fabrication: 1/4-inch clear annealed glass + 0.06” Red-Colored PVB interlayer + 1/4-inch clear annealed glass.
b. PVB Interlayer: *LamiGlass Colour Deep Red* as manufactured by Guardian, or approved alternate matching Architect's sample.

9. **Type GL-9:** White-Colored, Transleucent Laminated Glass: ASTM C1172, (use at Dance Room) with plastic interlayer.
a. Total unit thickness: 9/16-inch.
1) Fabrication: 1/4-inch clear annealed glass + 0.06-inch Transleucent White-Colored PVB interlayer + 1/4-inch clear annealed glass.
b. PVB Interlayer: *LamiGlass Color TransWhite* as manufactured by Guardian, or approved alternate matching Architect's sample.

10. **Type GL-10:** Laminated Glass for Horizontal Sliders at Reception: ASTM C1172, with plastic interlayer.
a. Total unit thickness: 9/16-inch
1) Fabrication: 1/4-inch clear annealed glass + 0.09-inch PVB interlayer + 1/4-inch clear annealed glass.
b. Installed system shall meet TEA requirements and UL 972 for Delayed Forced Entry.

2.02 GLAZING ACCESSORIES

A. Dense Gaskets: Resilient extruded shape to suit glazing channel retaining slot; black color.
1. Neoprene: ASTM C864.
2. EPDM: ASTM C864.
3. Silicone: ASTM C1115.

B. Soft Gaskets: ASTM C509 Type II; resilient extruded shape to suit glazing channel retaining slot; black color.
1. Neoprene.
2. EPDM.
3. Silicone.

C. Pre-Formed Glazing Tape: Size to suit application.
1. Preformed butyl compound with or without integral resilient tube spacing device; 10 to 15 Shore A durometer hardness; coiled on release paper; black color.
a. Butyl Corner Sealant: ASTM C920 single component non-skinning butyl compatible with glazing tape; color to match tape.
b. Interior Sealants and Sealant Primers: Maximum volatile organic compound content in accordance with SCAQMD Rule 1168.

D. Setting Blocks: Elastomeric material recommended by glass manufacturer, 80 to 90 Shore A durometer hardness, length of 0.1 inch (2.54 mm) for each square foot of glazing or minimum 4 inch (101.6 mm) x width of glazing rabbet space minus 1/16 inch (1.59 mm) x height to suit glazing method and pane weight and area.

E. Spacer Shims: Elastomeric material recommended by glass manufacturer, 50 to 60 Shore A durometer hardness, minimum 3-inch long x one half the height of glazing stop x thickness to suit application, self-adhesive on one face.
1. Clear Acoustical Sealant for Interior Glazed Butt Joints: Clear, non-structural silicone.

a. GE5000 as manufactured by General Electric, or approved equivalent by Dow Corning.
b. Use at open joints at glazing without vertical mullions where indicated.

F. Applied Decorative Films: Dimensionally stable cast vinyl graphics film with permanent, pressure-activated adhesive back; suitable for adhering to glass surfaces.
1. Product: Solyx Films, www.solyxfilms.com.
2. Size: As indicated.
3. Description: Minimum 2-m self-adhering vinyl graphics film for glass. Patterns and colors as scheduled.
4. Flammability Characteristics: Class A, tested in accordance with ASTM E84.
5. Printing: Digitally-imaged graphics using solvent inkjet or screen printing method as recommended by manufacturer for intended purpose.
6. Warranty: 4-year manufacturer's warranty against defects in materials.
7. Installation
a. Provide wet application of decorative films for bubble-free and wrinkle-free surface.
b. Install protective Schotchcal Gloss Overlaminate 8518 for additional protection.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
1. Verify openings for glazing are correctly sized and within acceptable tolerance.

B. Verify surfaces of glazing channels or recesses are clean, free of obstructions impeding moisture movement, weeps are clear, and ready to receive glazing.

3.02 PREPARATION

A. Clean contact surfaces with solvent and wipe dry.
1. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
2. Prime surfaces scheduled to receive sealant.

3.03 INSTALLATION

A. Perform installation in accordance with GANA Glazing Manual.
1. Glazing Sealants: Comply with ASTM C1193.
2. Do not allow metal-to-glass contact.

B. Exterior Dry Method (Gasket Glazing):
1. Cut glazing gasket to length; install on glazing pane. Seal corners by butting tape and sealing junctions with compatible butyl sealant.
2. Place setting blocks at 1/4 points with edge block no more than 6 inches (152.4 mm) from corners.
3. Rest glazing on setting blocks and push against fixed stop with sufficient pressure to attain full contact.
4. Install removable stops without displacing glazing spline. Exert pressure for full continuous contact.

C. Interior Dry Method (Tape and Tape) Installation:
   1. Cut glazing tape to length and set against permanent stops, projecting 1/16 inch (1.59 mm) above sight line.
   2. Place setting blocks at 1/4 points with edge block no more than 6 inches (152.4 mm) from corners. Provide additional setting blocks where recommended by the glazing panel manufacturer.
   3. Rest glazing on setting blocks and push against tape for full contact at perimeter of pane or unit.
   4. Place glazing tape on free perimeter of glazing in same manner described above.
   5. Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.
   6. Knife trim protruding tape.
      a. Interior Wet Method Installation – for butt-jointed supported at top and bottom edges only:
         1) Place setting blocks at 1/4 points with edge block no more than 6 inches (152.4 mm) from corners.
         2) Rest glazing on setting blocks and push against tape for full contact at perimeter of pane or unit.
         3) Install resilient spacers on both sides of glass marker board panels to maintain glazing in center of glazing channel.
         4) Fill both sides of glazing channels of top and bottom aluminum framing with black color structural silicone glazing, and apply light pressure to consolidate.
         5) Where indicated for vertical butt joints to be sealant filled, install clear silicone sealant flush with faces of glazing panels.
         6) Prior to all sealant applications, mask-off glazing faces with temporary tape to ensure sharp sealant lines.
            (a) Silicone-Filled Butt Joints.
         7) Apply masking tape backer over one face of open joint. Tool along glazing edges to ensure maximum adhesion.
         8) Apply masking tape along each edge of opposing face, leaving open joint. Tool along glazing edges to ensure maximum adhesion.
         9) Fill joint with silicone from open face, and tool joint to remove air bubbles and compress sealant fully against glazing edges and backing tape.
         10) After silicone has cured, remove tape from both faces of glass.

3.04 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.
   1. Remove glazing materials from finish surfaces.
   2. Remove labels after Work is complete.
   3. Clean glass and adjacent surfaces.

3.05 PROTECTION OF INSTALLED CONSTRUCTION

A. Section 01 70 00 - Execution and Closeout Requirements: Protecting installed construction.

B. After installation, mark pane with an 'X' by using removable plastic tape or paste. Do not mark heat absorbing or reflective glass units.

END OF SECTION

SECTION 08 83 00

UNFRAMED MIRRORS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes glass mirrors for frameless installation at Dance Instruction and other locations as indicated.

B. Related Sections:
   1. Section 08 80 00 - Glazing: Glass and glazing.
   2. Section 10 28 00 - Toilet and Bath Accessories: Metal framed mirrors.

1.02 REFERENCES

A. American National Standards Institute:
   1. ANSI Z97.1 - Safety Glazing Materials Used in Buildings Safety.

B. ASTM International:
   1. ASTM C1048 - Standard Specification for Heat-Treated Flat Glass-Kind HS, Kind FT Coated and Uncoated Glass.

C. Consumer Product Safety Commission:
   1. CPSC 16 CFR 1201; Safety Standard for Architectural Glazing.

D. Glass Association of North America:
   1. GANA - Glazing Manual.

1.03 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data:
   1. Mirror Types: Submit structural, physical and environmental characteristics, size limitations, special handling or installation requirements.
   2. Glazing Materials: Submit chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors.

C. Manufacturer's Certificate: Certify mirrors meet or exceed specified requirements.

D. Preconstruction Mirror Mastic Glass Coating Compatibility Test: Submit mirror mastic products to organic protective coating manufacturer for testing to determine compatibility of adhesive with mirrored glass coating.

1.04 QUALITY ASSURANCE

A. Perform Work in accordance with GANA Glazing Manual for mirror installation methods.

B. Safety Glass: Category II materials complying with testing requirements in 16 CFR 1201 and ANSI Z97.1.

1.05 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Furnish five-year warranty to include coverage for reflective coating on mirrors and replacement of same.

PART 2 - PRODUCTS

2.01 MIRRORS

A. Tempered Safety Mirror Glass: ASTM C1048, Kind FT fully tempered, Type 1 transparent flat, Class 1 clear, Quality q1 mirror select; type with copper and silver coating, and organic overcoating.
   1. Edges: Polished.
   2. Thickness: 1/4 inch.
   3. Size: As noted on Drawings.

2.02 ACCESSORIES

A. Mirror Attachment Accessories: Extruded aluminum J-profile channels with concealed fasteners.

B. Setting Blocks: Neoprene, 70 to 90 Shore A hardness.

C. Edge Sealer: Coating compatible with glass coating and approved by mirrored glass manufacturer for use in protecting against silver deterioration at mirrored glass edges.

D. Mirror Adhesive: Chemically compatible with mirror coating and wall substrate.
   1. Interior Adhesives: Maximum volatile organic compound content in accordance with SCAQMD Rule 1168.

2.03 FABRICATION

A. Cut mirrored glass to final sizes and shapes to suit Project conditions.

B. Fabricate cutouts for notches and holes in mirrored glass without marring visible surfaces. Locate and size cutouts so they fit closely around penetrations in mirrored glass.

C. Seal edges of silvered mirrored glass after edge polishing to prevent chemical or atmospheric penetration of glass coating.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify wall surfaces are clean, free of obstructions, and ready to receive mirrors.

3.02 PREPARATION

A. Clean contact surfaces with solvent and wipe dry.

3.03 INSTALLATION

A. Perform installation in accordance with GANA Glazing Manual.
   1. Set mirrors plumb and level, free of optical distortion.
   2. Set mirrors with edge clearance free of surrounding construction including counter tops and backsplashes.
   3. Provide space for air circulation between back of mirrored glass units and face of mounting surface.

B. Frameless Mechanical Installation:
   1. Set mirrors with J-profile stainless steel continuous channel along top and bottom edges. Anchor rigidly to wall construction.
   2. Gap vertical joints uniformly 3/16”.
   3. Place plumb and level without visible distort.
   4. For continuous bottom supports, provide setting blocks 1/8 inch thick by 4 inches long at quarter points.

C. Frameless Adhesive Installation:
   1. Apply barrier coat to mirrored glass backing where approved in writing by manufacturers of mirrored glass and backing material.
   2. Set mirrors with adhesive.
   3. Place plumb and level without visible distortion.

3.04 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Inspect for quality of glazing.

C. Do not permit edges of silvered mirrored glass to be exposed to standing water.

D. Maintain environmental conditions that will prevent silvered mirrored glass from being exposed to moisture from condensation or other sources for continuous periods of time.

3.05 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Remove labels after Work is complete.

C. Clean mirrors and adjacent surfaces.

END OF SECTION

SECTION 08 87 23

IMPACT RESISTANT GLAZING FILM

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes installation of impact-resistant glazing film for all first floor exterior glazing assemblies and as indicated in the drawings.
   1. Not required at ballistic rated glazing assemblies incorporating laminated glass with factory-installed interlayer film.

B. Related Sections:
   1. Section 08 80 00 - Glazing.

1.02 REFERENCES

A. American Society of Civil Engineers
   1. ASCE 7 “Minimum Design Loads for Buildings and Other Structures": Section 6.0 "Wind Loads."

B. American National Standards Institute:
   1. ANSI Z97.1 - Safety Glazing Materials Used in Buildings Safety.

C. CPSC 16 CFR 1201 CAT I and II Test

D. General Services Administration
   1. GSA “Standard Testing Method for Windows and and Glazing systems Subject to Dynamic Overpressure Loadings”.

E. ASTM International:
   1. ASTM F-1642-04 “Standard Test Method for Glazing and Glazing systems Subjected to Airblast Loadings.”

1.03 PERFORMANCE REQUIREMENTS

A. Glass Thickness: The Project glass pane thickness for glazing film application is 1/4” unless indicated otherwise. Exterior glazing panels are comprised of (2) 1/4” thick tempered panes separated by 1/2” gasketed seals for an overall insulated glazing unit thickness of 1”.

B. Provide impact-resistant glazing film for single-pane and dual-pane insulated glass units as required to meet or exceed the following criteria:
   1. Wind Loads for Exterior Glazing:
      a. As may be indicated, but not less than wind loads required by ASCE 7.
      b. Probability of Breakage for Vertical Glazing: 8 lites per 1000 for lites set vertically or not more than 15 degrees off vertical and under wind action with a load duration of 3-seconds.

c. Maximum Lateral Deflection: For exterior glass supported on all 4 edges, provide thickness required that limits center deflection at design wind pressure to 1/50 times the short side length or 1 inch (25.4 mm), whichever is less.

1.04 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data:
1. Glazing Films: Provide structural, physical, and thermal and solar optical performance characteristics, size limitations, special handling or installation requirements.
2. Perimeter Sealants, Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors where exposed.

C. Samples:
1. Glass Panels: Submit two samples 12x12 inch in size, for each type of glazing film required, and each type of glass to receive glazing film, including spandrel and wire glass.
2. Perimeter Sealant: Submit 12-inch long bead of proposed perimeter sealant.
3. Sealant Cover: Submit 12-inch long strip of proposed vinyl cover and preformed corner.

D. Film Manufacturer's Certificate: Certify specified glass products including sealed insulating units, spandrel glass, tinted glass, low-E coated glass, and any fire-rated glass are appropriate products to receive glazing film and will not negatively affect glazing panel performance.

1.05 QUALIFICATIONS

A. Installer: Company specializing in performing Work of this section with minimum three years' experience.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

B. Do not install glazing films or liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 40 deg F.

1.07 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Furnish ten-year warranty to include coverage for glazing films from delamination, color change, optical transparency change, failure to provide impact protection within limitations as specified herein.

PART 2 - PRODUCTS

2.01 SYSTEM MANUFACTURERS

A. 3MTM, www.3m.com

B. Eastman Chemical Company, Llumar, www.llumar.com

C. Madico SafetyShield, Inc., St. Petersburg, FL, 526-277-8775, www.safetyshield.com

D. Solar Gard (Saint-Gobain) www.solargard.com

E. Substitutions: Section 01 60 00 - Product Requirements.

2.02 MATERIALS

A. Glazing Film: High strength Mylar polyester, optically clear and without waviness or other distortion. Colorless or tinted as selected.
   1. Basis of Design: SafetyShield 1500 clear film as manufactured by Madico, Inc. or approved equivalent by specified manufacturer.
   2. Film thickness:
      a. Minimum 15-mil at interior entry and transaction window systems and as indicated in the drawings.
      b. Minimum 8-mil at exterior glazing systems and as indicated in the drawings.

B. Application Solution/Bonding Agent: Film manufacturer’s recommended and approved application solution for use with security and safety films as tested to meet performance criteria.

C. Perimeter Sealant: Dow 995 Structural Silicone Sealant, black color.

D. Sealant Cover: Black vinyl bonding cap with preformed corners; BondKap system or approved equivalent.

E. Glass Cleaner: As recommended by glazing film manufacturer.

F. Applied system shall be odor-free and non-toxic after 72-hour cure time.
   1. Flame Spread: 0.
   2. Smoke Developed: 0.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify surfaces of glazing panels are clean, free of haze or visual distortion, dry, and ready to receive glazing.

C. Verify that frames are securely anchored and free of defects.

D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Remove any glazing labels or protective tape or other markings on film application side of glazing panel. Replace any removed safety labels or tape on non-application side of glass.

B. Clean contact surfaces with mild water-based solution, rinse thoroughly with clear potable water, and wipe dry.

C. Ensure surfaces of glazing panels are clean, free of haze or visual distortion, dry, and ready to receive glazing film.

3.03 INSTALLATION

A. Do not apply glazing film when surface temperature is less than 40 degrees Fahrenheit (4.44 degrees Celsius) or if precipitation is imminent.

B. Install in accordance with manufacturer's instructions, without air bubbles, wrinkles, streaks, bands, thin spots, pinholes, or gaps, as required to achieve specified performance.

C. Accurately cut film with straight edges to required sizes allowing 1/16 inch (1.59 mm) to 1/8 inch (3.18 mm) gap at perimeter of glazed panel unless otherwise required by anchorage method.

D. Seams: Seam film only as required to accommodate material sizes; form seams vertically without overlaps and gaps; do not install with horizontal seams.

E. Uniformly spray apply bonding agent to interior face of exterior glazing and to secure side of interior glazing.

F. Exterior Glazing:
   1. Exterior Windows:
      a. Apply film on interior face of glass.
      b. Anchor film to frame with structural sealant with BondKap over sealant.
         1) Must achieve minimum 1/2” contact between structural sealant bead to frame and minimum 1/2” contact between structural sealant bead to window film.
   2. Exterior doors with glass.
      a. Apply film on edge to edge of glass on interior face of glass.
      b. Apply structural sealant under caps/stops to adhere film to frame to cap/stop.
   3. Ballistic rated glass: Not required.

G. Interior Glazing:
   1. Interior Windows:
      a. Apply film on secure side of glass. Confirm with Architect.
      b. Anchor film to frame with structural sealant with BondKap over sealant.
         1) Must achieve minimum ½” contact between structural sealant bead to frame and minimum ½” contact between structural sealant bead to window film.
   2. Interior doors with glass.
      a. Apply film on edge to edge of glass on interior of glass.

b. Apply structural sealant under caps/stops to adhere film to frame to cap/stop.

3. Ballistic rated glass: Not required.

H. Clean glass and anchoring accessories following installation. Remove excess sealants and other glazing materials from adjacent finished surfaces.

3.04 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

3.05 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Provide final cleaning and polishing of applied film.

C. Do not remove any safety labels or tape from non-application side until removal is approved by General Contractor.

D. Clean adjacent surfaces.

END OF SECTION

SECTION 08 91 00

LOUVERS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Fixed louvers, frames and accessories.

B. Related Sections:
   1. Section 07 90 00 - Joint Protection: Sealant at louver perimeter.
   2. Division 23 Sections - HVAC ducting with direct connections to louvers.

1.02 REFERENCES

A. ASTM International:
   1. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
   2. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

1.03 PERFORMANCE REQUIREMENTS

A. As follows, determined by testing per AMCA Standard 500:
   1. Louver Free Area: Not less than 45%.
   2. Static Pressure Loss: Not more than 0.14 inch (3.56 mm) water gage at an airflow of 810 fpm free area intake velocity.
   3. Water Penetration: Not more than 0.02 oz. per sq. ft. of free area at an airflow of 855 fpm free area velocity when tested for 15 minutes.

B. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

1.04 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate louver layout plan and elevations, opening and clearance dimensions, tolerances; head, jamb and sill details; blade configuration, screens, blankout areas required, and frames.

C. Product Data: Submit data describing design characteristics, maximum recommended air velocity, design free area, materials and finishes.

D. Samples: Submit two samples illustrating finish and color of exterior surfaces.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.05 QUALITY ASSURANCE

A. Perform Work in accordance with AMCA Certification for Water Penetration, Air Performance, and Wind Driven Rain, in compliance with AMCA 500-L. Attach AMCA seal to louvers.

1.06 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.07 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Coordinate Work with installation of metal siding and masonry flashings.

C. Coordinate Work with installation of mechanical ductwork.

1.08 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Furnish twenty-year manufacturer warranty for louvers.

C. Warranty: Include coverage for degradation of fluoropolymer finish.

PART 2 PRODUCTS

2.01 LOUVERS

A. Manufacturers:
   1. Airline Products Co.
   2. Airolite Co. www.airolite.com
   3. Airstream Products www.pennvent.com
   4. Construction Specialties, Inc. www.c-sgroup.com
   5. Greenheck Fan Corporation www.greenheck.com
   6. Reliable Metal Products. www.reliablelouvers.com
   7. Ruskin Mfg. www.ruskin.com
   8. Substitutions: Section 01 60 00 - Product Requirements.

2.02 MATERIALS

A. Basis of Design: Series HZ700 as manufactured by Ruskin, or approved equivalent by specified manufacturer.

B. Aluminum Sheet: ASTM B209, alloy 3003 or 5005, temper as required to produce required finish.

C. Aluminum Extrusions: ASTM B221, alloy 6063-T5 or T52. Not less than 22,000 pounds per square inch ultimate tensile strength; not less than 16,000 pounds per square inch minimum yield strength; and not less than 0.090-inch thickness at any location for the main frame.

D. Flashings: Of same material and finish as louver frame.

E. Sealants: As specified in Section 07 90 00.

2.03 COMPONENTS

A. Wall Louvers: Non-Drainable Style
   1. Louver Construction: Aluminum.
   2. Louver Depth: 4 inches (101.6 mm), unless otherwise indicated.
   3. Frame Type: Channel flange.
   4. Frame Thickness: 0.081 inch (2.06 mm).
   5. Louver Blade Thickness: 0.081 inch (2.06 mm).
   6. Louver Blade Profile: Horizontal storm-resistant.
   7. Louver Blade Angle: 37 1/2 degrees.
   8. Louver Blade Spacing: 3".

2.04 ACCESSORIES

A. Bird Screen: Interwoven 1/2 inch (12.7 mm) mesh of 0.04 inch (1.02 mm) diameter galvanized steel wire.

B. Fasteners and Anchors: Stainless steel type.

C. Blank-Out Sheeting on Interior of Louver: Same material and finish as louver and frame:
   1. Configuration: Single sheet.

2.05 FABRICATION

A. Louver Frame: Mechanically fastened corner joints. Form perimeter of frames with recessed channel to retain backer rod for sealant application.

B. Intermediate Mullions: Concealed, of extruded aluminum, profiled to suit louver frame.
   1. Space at 72 inches (1828.8 mm) o.c. or as recommended by manufacturer.

C. Sill Extensions: Provide sill extensions and loose sills made of same material as louvers where required for drainage to exterior.

D. Screens: Install screen mesh in channel-shaped frame; reinforce corner construction.

2.06 FACTORY FINISHING

A. Aluminum - Painted Finish: Manufacturer's 2 coat fluoropolymer finish with minimum 50 percent polyvinylidene fluoride resin; complying with AAMA 2605.

PART 3 EXECUTION

3.01 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify prepared openings and flashings are ready to receive Work and opening dimensions are as indicated on shop drawings.

3.02 INSTALLATION

A. Install louvers level and plumb.

B. Align louver assembly to ensure moisture shed from flashings and diversion of moisture to exterior.

C. Secure louvers in opening framing with concealed fasteners.

D. Install bird screen and frame to interior of louver. Attach to frame with stainless steel machine screws.

E. Attach blank-off sheet to back of frame with stainless steel sheet metal screws.

F. Install perimeter sealant and backing rod in accordance with Section 07 90 00.

3.03 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements - Final cleaning.

B. Strip protective finish coverings.

C. Clean surfaces and components.

END OF SECTION

SECTION 09 21 16

GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal stud wall framing.

B. Metal channel ceiling framing.

C. Resilient sound isolation channels.

D. Acoustic insulation and sealant.

E. Gypsum sheathing.

F. Fire-rated gypsum sheathing.

G. Cementitious backing board.

H. Tile backing board for non-wet areas.

I. Gypsum wallboard.

J. Rated shaft wall assemblies.

K. Abuse-resistant gypsum board.

L. Joint treatment and accessories.

M. Plenum space sound control.

N. Partial height wall framing support.

O. Preformed aluminum reveals.

P. End wall trim.

1.02 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry: Wood blocking product and execution requirements.

B. Section 07 25 00 - Weather Barriers: Water-resistive barrier over sheathing.

1.03 REFERENCE STANDARDS

A. AISI S220 - North American Standard for Cold-Formed Steel Nonstructural Framing; 2020.

B. AISI S240 - North American Standard for Cold-Formed Steel Structural Framing; 2015, with Errata (2020).

C. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2018.

D. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 2019.

E. ASHRAE Std 62.1 - Ventilation for Acceptable Indoor Air Quality; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

G. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2015.

H. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2017 (Reapproved 2022).

I. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2017.

J. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.

K. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2020.

L. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2022.

M. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2022.

N. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base; 2019.

O. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2017.

P. ASTM C1280 - Standard Specification for Application of Exterior Gypsum Panel Products for Use as Sheathing; 2018.

Q. ASTM C1325 - Standard Specification for Fiber-Mat Reinforced Cementitious Backer Units; 2022.

R. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.

S. ASTM C1629/C1629M - Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels; 2019.

T. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.

U. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2022.

V. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.

W. ASTM E413 - Classification for Rating Sound Insulation; 2022.

X. GA-216 - Application and Finishing of Gypsum Panel Products; 2021.

Y. GA-226 - Application of Gypsum Board to Form Curved Surfaces; 2025.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the installation of gypsum board assemblies with size, location, and installation of service utilities.

B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data:
   1. Provide data on all products specified in Part 2 of this section. metal framing, gypsum board, glass mat faced gypsum board, accessories, and joint finishing system
   2. Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

C. Shop Drawings: Indicate special details associated with fireproofing and acoustic seals.

D. Test Reports: For stud framing products that do not comply with AISI S220 or ASTM C754, provide independent laboratory reports showing maximum stud heights at required spacings and deflections.

1.06 QUALITY ASSURANCE

A. Perform Work in accordance with ASTM C840.

B. Fire Rated Wall and Ceiling Construction: Rating as indicated on Drawings, tested in accordance with ASTM E119.
   1. Fire Rated Ceilings and Partitions: Listed assembly by UL, WH, or GA.
   2. Fire Rated Shaft Wall Requirements: Listed assembly by UL, WH, or GA.

C. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

D. Company specializing in manufacturing gypsum based products with minimum five years of documented experience.

E. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store gypsum products and accessories indoors and keep above freezing. Elevate boards above floor, on nonwicking supports, in accordance with manufacturer's recommendations.

B. Store metal products to prevent corrosion.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

A. Provide completed assemblies complying with ASTM C840 and GA-216.

B. Interior Partitions, Indicated as Acoustic: Provide completed assemblies with the following characteristics:
   1. Acoustic Attenuation: STC as indicated calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

C. Shaft Walls: Provide completed assemblies with the following characteristics:
   1. Air Pressure Within Shaft: Sustained loads of 5 lbf/sq ft (0.24 kPa) with maximum mid-span deflection of L/240.
      a. Provide gypsum board shaft-wall assemblies capable of withstanding the full air-pressure loads indicated for maximum heights of partitions without failing and while maintaining an airtight and smoke-tight seal.
      b. Evidence of failure includes deflections exceeding limits indicated, bending stresses causing studs to break or to distort, and end-reaction shear causing track (runners) to bend or to shear and studs to become crippled.
      c. Fire-Resistance-Rated Assemblies: Provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction
      d. Cavity Insulation: Sound attenuation blankets.
   2. Acoustic Attenuation: STC of 35-39 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

D. Fire-Resistance-Rated Assemblies: Provide completed assemblies with the following characteristics:
   1. Fire Rated Assemblies are indicated on drawings.
   2. Furnish one of the Type X panels specified above that meet the requirements for the specified fire rated assembly as well as the respective use and location requirements for Typical or Moisture-Resistant panels.
   3. Furnish Type C gypsum board panels only where specifically indicated or where otherwise required for the indicated fire rated assembly.
      a. Basis of Design: FireBloc Type C as manufactured by American Gypsum or approved equivalent by specified manufacturer.
      b. 5/8” Type X gypsum core with enhanced fire-resistant properties.

2.02 METAL FRAMING MATERIALS

A. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S240.

B. Manufacturers - Metal Framing, Connectors, and Accessories:

1. ClarkDietrich: www.clarkdietrich.com/
2. MarinoWARE: www.marinoware.com/
3. Phillips Manufacturing Co: www.phillipsmfg.com/
4. Substitutions: See Section 01 60 00 - Product Requirements.

C. Nonstructural Framing System Components: AISI S220; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf (L/120 at 240 Pa).
   1. Studs: C-shaped, 25 gauge thick, depth as indicated..
      a. Furnish 20 gauge studs at the following locations:
         1) Studs framing doors.
         2) Walls finished with tile.
         3) Walls finished with abuse resistant gypsum board.
         4) Studs supporting wall-mounted accessories and TV brackets
      b. Section Modulus Requirements
         1) 3-5/8" Studs: S=0.135
         2) 2-1/2" Studs: S-0.082
   2. Standard Runners: U shaped, sized to match studs.
   3. Deflection Tracks:
      a. Non-Rated Walls: 2-inch deep flanges, gauge to match studs.
      b. Rated Walls:
         1) Combination deflection track and fire stop system consisting of mineral fiber, fire caulk, zee clips and accessories as required to achieve the design rating.
         2) Basis of Design: *Shadowline* as manufactured by Firetrack Corp.
      c. Installed deflection tracks shall allow 3/4” or more of vertical movement up or vertical movement down.
   4. Ceiling Channels: C-shaped.
   5. Grid Suspension System for Interior Ceilings: direct-hung system composed of galvanized cold-formed main beams and interlocking cross-furring members.
      a. Manufacturers:
         1) Armstrong World Industries, Inc.; Furring Systems/Drywall.
         2) USG Interiors, Inc.; Drywall Suspension System.
   6. Furring Members: As indicated in Drawings, hat-shaped sections, minimum depth of 7/8 inch (22 mm).
   7. Furring Members: As indicated in Drawings, U-shaped sections, minimum depth of 3/4 inch (19 mm).
   8. Furring Members: As indicated in Drawings, Zee-shaped sections, minimum depth of 1 inch (25 mm).
   9. Resilient Furring Channels: Single or double leg configuration; 1/2 inch (13 mm) channel depth.
      a. Products:
         1) ClarkDietrich; RC Deluxe Resilient Channel: www.clarkdietrich.com/#sle.
         2) Phillips Manufacturing Co; RC-2 Resilient Sound Channel: www.phillipsmfg.com/
         3) Substitutions: See Section 01 60 00 - Product Requirements.

D. Shaft Wall Studs and Accessories: AISI S220; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 and specified performance requirements.
   1. Manufacturer's standard profile for repetitive members and corner and end members and for fire-resistance-rated assembly indicated.
      a. Depth: As indicated.
      b. Minimum Base Metal Thickness: Manufacturer's standard thicknesses that comply with structural performance requirements for stud depth indicated.
   2. Track (Runner): Manufacturer's standard J-profile track with long-leg length as standard with manufacturer, but at least 2 inches (51 mm), in depth matching studs.
      a. Minimum Base Metal Thickness: Manufacturer's standard thicknesses that comply with structural performance requirements for stud depth indicated.
   3. Jamb Struts: Manufacturer's standard J-profile strut with long-leg length of 3 inches (76.2 mm), in depth matching studs, and not less than 0.0329 (0.84 mm) thick.

E. Non-structural Framing Accessories:
   1. Fasteners: ASTM C1002; Type S; length to suit application.
   2. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
   3. Partial Height Wall Framing Support: Provides stud reinforcement and anchored connection to floor.
      a. Materials: ASTM A36/A36M formed sheet steel support member with factory-welded ASTM A1003/A1003M steel plate base.
      b. Height: 35-3/4 inches (908 mm).
         1) Fabricate or job-cut height of brace tube to be no lower than 2" below knee-wall height.
      c. Products:
         1) ClarkDietrich; Pony Wall (PW): www.clarkdietrich.com/#sle.
         2) Softforms; *SKB Knee Brace Kit*; www.kneewall.com.
         3) Substitutions: See Section 01 60 00 - Product Requirements.

F. Grid Suspension Systems: Steel grid system of main tees and support bars connected to structure using hanging wire.
   1. Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.
   2. Suspension Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.0625 inch diameter wire, or double strand of 0.0475 inch diameter wire.
   3. Products:
      a. CertainTeed Corporation: www.certainteed.com/ceilings-and-walls/#sle.
      b. USG Corporation; Drywall Suspension System: www.usg.com/#sle.
      c. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 BOARD MATERIALS

A. Manufacturers - Gypsum-Based Board:
   1. American Gypsum Company: www.americangypsum.com/
   2. CertainTeed Corporation: www.certainteed.com/
   3. Georgia-Pacific Gypsum: www.gpgypsum.com/
   4. Gold Bond Building Products, LLC provided by National Gypsum Company; ____: www.goldbondbuilding.com/#sle.

5. USG Corporation: www.usg.com/#
6. Substitutions: See Section 01 60 00 - Product Requirements.

B. General: Meet the following requiremnets unless otherwise noted:
   1. Conform to ASTM C1396 section 5 (C 36) and Federal Specification SS-L-30D Type lll, Grade X fire- resistant.
   2. Ends square cut, tapered long edges wrapped.
   3. 5/8” gypsum core faced and edge-wrapped with mold and moisture resistant 100% recycled paper.
   4. Surface Burning Characteristics per ASTM E 84:
      a. Flame Spread = 0
      b. Smoke Developed = 0.
   5. Intended for interior applications only.

C. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. Typical Gypsum Board Panels:
      a. Basis of Design: *FireBloc Type X Gypsum Wallboard*; American Gypsum Company or approved equivalent by specified manufacturer.
      b. Use throughout the interior of the Project except for specialized uses and locations requiring other panel types as indicated below.
   2. Thickness:
      a. Vertical Surfaces: 5/8 inch (16 mm).
      b. Ceilings: 5/8 inch (16 mm).
   3. Mold-Resistant, Paper-Faced Products:
      a. Basis of Design: American Gypsum Company; *M-Bloc Type X* or approved equlvalent by specified manufacturer.
         1) 5/8" water-resistant gypsum core faced with mold and moisture resistant 100% green-colored paper.
         2) Water absorption: Less than 5% per ASTM 1396.
         3) Meet requirements of Federal Specification SS-L-30D Type VII, Grade X.
         4) Use at restrooms, shower rooms, custodial rooms and othe rareas subject to high moisture. Where board is not surfaced with tile, prepare for finish painting.
            (a) Behind wall tile.
            (b) Toilet room walls not receiving cementitous backer board.

D. Abuse Resistant Wallboard:
   1. Application: Interior, High-traffic areas indicated.
   2. Indentation: Level 1, minimum, when tested in accordance with ASTM C1629/C1629M.
   3. Soft Body Impact: Level 2, minimum, when tested in accordance with ASTM C1629/C1629M.
   4. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   5. Paper-Faced Type: Gypsum wallboard, as defined in ASTM C1396/C1396M.
      a. Basis of Design: M-Bloc® Abuse-Resistant Type X as manufactured by American Gypsum or approved equivalent by specified manufacturer.
   6. Type: Fire-resistance-rated Type X, UL or WH listed.
   7. Thickness: 5/8 inch (16 mm).
   8. Edges: Tapered.

9. Water Absorption: Less than 5% per ASTM 1396.
10. Meet requirements of Federal Specification SS-L-30D Type lll, Grade X.
11. Use at locations indicated in the Drawings.

E. Backing Board For Wet Areas: One of the following products:
   1. Application:
      a. All shower walls and shower ceilings.
      b. All wet walls, including behind lavatories, toilets, and urinals, and side walls adjacent to these fixtures.
   2. ANSI Cement-Based Board: Non-gypsum-based; aggregated Portland cement panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9 or ASTM C1325.
      a. Thickness: 1/2 inch (13 mm).
      b. Products:
         1) Custom Building Products; Wonderboard Cement Backerboard: www.custombuildingproducts.com/#sle.
         2) PermaBASE Building Products, LLC provided by National Gypsum Company; PermaBase Cement Board: www.goldbondbuilding.com/#
         3) USG Corporation; Fiberock Brand Aqua-Tough AR Interior Panels Regular 1/2 in. (12.7 mm): www.usg.com/
         4) Substitutions: See Section 01 60 00 - Product Requirements.
   3. Membrane: Per TCA W244 install waterproof membrane direclty behind cementitious backer board, overlapping joints 4 inches - 6 inches.
      a. #15 asphalt saturated felt meeting requirements of ASTM D226, Type 1.
      b. Minimum 6 mil polyethylene film meeting requiremnts of ASTM D4397.

F. Backing Board For Non-Wet Areas: Water-resistant gypsum backing board as defined in ASTM C1396/C1396M; sizes to minimum joints in place; ends square cut.
   1. Application: Vertical surfaces behind thinset tile, except in wet areas.
   2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   3. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
   4. Type: Regular and Type X, in locations indicated.
   5. Type X Thickness: 5/8 inch (16 mm).
   6. Edges: Tapered.
   7. Products:
      a. American Gypsum Company; M-Bloc Type X: www.americangypsum.com/
      b. Georgia-Pacific Gypsum; DensArmor Plus: www.gpgypsum.com/
      c. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond XP Fire-Shield Gypsum Board: www.goldbondbuilding.com/
      d. Substitutions: See Section 01 60 00 - Product Requirements.

G. Exterior Sheathing Board: Sizes to minimize joints in place; ends square cut.
   1. Application: Exterior sheathing, unless otherwise indicated.
   2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   3. Glass Mat Faced Sheathing: Glass mat faced gypsum substrate as defined in ASTM C1177/C1177M.

4. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
5. Core Type: Regular and Type X, as indicated.
6. Type X Thickness: 5/8 inch (16 mm).
7. Regular Board Thickness: 1/2 inch (13 mm).
8. Edges: Square.
9. Flame Spread Rating: 0.0.
10. Smoke Developed: 0.0.
11. Fasteners: ASTM C954; steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing board to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B117
12. Glass Mat Faced Products:
    a. American Gypsum Company; M-Glass Exterior Sheathing Type X: www.americangypsum.com/
    b. American Gypsum Company; M-Glass 1/2" Exterior Sheathing: www.americangypsum.com/
    c. CertainTeed Corporation; GlasRoc 1/2" Exterior Sheathing: www.certainteed.com/
    d. CertainTeed Corporation; GlasRoc Type X Exterior Sheathing: www.certainteed.com/
    e. Georgia-Pacific Gypsum; DensGlass Sheathing: www.gpgypsum.com/
    f. Georgia-Pacific Gypsum; DensGlass Fireguard Sheathing: www.gpgypsum.com/
    g. USG Corporation; Securock Brand UltraLight Glass-Mat Sheathing 1/2 in. (12.7 mm): www.usg.com/
    h. USG Corporation; Securock Brand UltraLight Glass-Mat Sheathing Firecode X 5/8 in. (15.9 mm): www.usg.com/
    i. Substitutions: See Section 01 60 00 - Product Requirements.

H. Shaftwall and Coreboard: Type X; 1 inch (25 mm) thick by 24 inches (600 mm) wide, beveled long edges, ends square cut.

2.04 PLENUM SPACE SOUND CONTROL

A. Description: Acoustical extension wall board for noise control within ceiling plenums above wall partitions.

B. General Requirements:
1. Airstream surfaces installed in return air plenum to comply with requirements in ASHRAE Std 62.1.

2.05 GYPSUM BOARD ACCESSORIES

A. Acoustic Insulation: ASTM C665; preformed mineral-fiber, friction fit type, unfaced; thickness 3 inch (75 mm) minimum and as required for indicated, required STC rating.
1. If required by fire-resistance requirements for fire rated walls, furnish mineral fiber insulation complying with ASTM C665, Type I.

B. Sound Isolation Tape: Elastomeric foam tape for sound decoupling.

1. Surface Burning Characteristics: Provide assemblies with flame spread index of 75 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
2. Tape Thickness: 1/4 inch (6 mm).

C. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.
1. Non-hardening, non-skinning, for use in conjunction with gypsum board.
2. Products:

D. Water-Resistive Barrier: See Section 07 25 00.

E. Finishing Accessories: ASTM C1047, extruded aluminum alloy (6063 T5) or galvanized steel sheet ASTM A924/A924M G90, unless noted otherwise.
1. Types: As detailed or required for finished appearance.
2. Special Shapes: In addition to conventional corner bead and control joints, provide LC-bead at exposed panel edges.
3. Furnish rolled-zinc material at exterior locations.

F. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
1. Reinforcing tape, joint compound, and water.

G. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

H. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inches (0.84 mm) in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion-resistant.

I. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch (0.84 to 2.84 mm) in Thickness: ASTM C954; steel drill screws, corrosion-resistant.

J. Use screws recommended by manufacturer for fastening cementitious backer board to metal framing.

K. Aluminum Reveal Molding
1. Type: 6063 T5 alloy extruded aluminum open reveal.
2. Size(s): 5/8” deep x continuous x widths as indicated in the drawings.
3. Finish: Clear anodized aluminum.
4. Fabricate with wings and edge beads for taping and floating.
5. Mill finish or clear anodized.
6. Locate as indicated in the drawings over continuous drywall framing support.
7. Basis of Design: “F” reveal as manufactured by Fry Reglet Corp. or approved equivalent by Schluter.

L. End-Wall Trim
1. Where indicated provide prefinished aluminum end-wall trim at walls terminating on window mullions.
2. Type: Cased Jamb as manufactured by Raco Interior or approved equivalent.
3. Finish: Anodized to match window system mullions.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

B. Ensure that all exterior air-barrier work and roofing is completed, roof-top equipment fully installed and flashed, exterior wall openings including windows and doors are installed, and building is environmentally controlled prior to beginning any gypsum wallboard or ceiling board installation.

3.02 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
   1. Suspend overhead framing from structural members or floor slabs only; do not suspend members from steel roof decks.

B. Coordination with Sprayed Fire-Resistive Materials:
   1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling tracks to surfaces indicated to receive sprayed-on fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches o.c.
   2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of gypsum board assemblies and without reducing the fire-resistive material thickness below that which is required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

3.03 SHAFT WALL INSTALLATION

A. Shaft Wall Framing: Install in accordance with manufacturer's installation instructions.
   1. Fasten runners to structure with short leg to finished side, using appropriate power-driven fasteners at not more than 24 inches (600 mm) on center.
   2. Install studs at spacing required to meet performance requirements.

B. Shaft Wall Liner: Cut panels to accurate dimensions and install sequentially between special friction studs.
   1. On walls over sixteen feet high, screw-attach studs to runners top and bottom.
   2. Seal perimeter of shaft wall and penetrations.

C. Install gypsum board shaft-wall assemblies to comply with requirements of fire-resistance rated assemblies indicated, manufacturer's written installation instructions, and ASTM C 754 for installing steel framing.

D. Install supplementary framing in gypsum board shaft-wall assemblies 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 shaft-wall assembly framing.

E. Where handrails directly attach to gypsum board shaft-wall assemblies, provide galvanized steel reinforcing strip with 0.0312 inch (0.79 mm) minimum thickness of base (uncoated) metal, accurately positioned and secured behind at least 1 face-layer panel.

F. At penetrations in shaft wall, maintain fire-resistance rating of shaft-wall 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.

G. Isolate gypsum finish panels from building structure to prevent cracking of finish panels while maintaining continuity of fire-rated construction.
   1. Seal gypsum board shaft walls with acoustical sealant at perimeter of each assembly where it abuts other work and at joints and penetrations within each assembly. Install acoustical sealant to withstand dislocation by air-pressure differential between shaft and external spaces; maintain an airtight and smoke-tight seal; and comply with manufacturer's written instructions or ASTM C 919, whichever is more stringent.

H. In elevator shafts where gypsum board shaft-wall assemblies cannot be positioned within 2 inches (51 mm) of the shaft face of structural beams, floor edges, and similar projections into shaft, install 1/2 or 5/8 inch (12.7 or 15.9 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 inches (610 mm) o.c. with screws fastened to shaft-wall framing.

I. Where steel framing is required to support gypsum board cants, install framing at 24 inches (610 mm) o.c. and extend studs from the projection to the shaft-wall framing.

3.04 FRAMING INSTALLATION

A. Metal Framing: Install in accordance with AISI S220 and manufacturer's instructions.

B. Ceiling Framing:
   1. Space framing and furring members as indicated.
   2. Install framing after work above ceiling or soffit is complete. Coordinate the location of hangers with other work.
   3. Install framing independent of walls, columns, and above-ceiling work.
   4. Install suspension system components in sizes and spacings indicated on Drawings, but not less than those required by referenced installation standards for assembly types and other assembly components indicated.
   5. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
   6. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
   7. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, 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.
   8. Do not attach hangers or suspend members from steel roof deck.
   9. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
   10. Do not connect or suspend steel framing from ducts, pipes, or conduit.
   11. Grid Suspension Systems:

a. Install grid suspension system in accordance with manufacturer's instructions
b. Attach perimeter edge angle where ceiling system meets vertical surfaces.
c. Mechanically join main beam and cross furring members to each other and butt-cut to fit into wall track.

12. Level ceiling system to a tolerance of 1/360.
13. Laterally brace entire suspension system.
14. Install acoustical sealant between tops of partitions and bottom of ceiling board.

C. Soffit Framing Installation:
1. Install in accordance with ASTM C754.
2. Coordinate location of hangers with other work.

D. Install soffit framing independent of walls, columns, and above soffit work.
1. Reinforce openings in suspension system which interrupt main carrying channels or furring channels, with lateral channel bracing. Extend bracing minimum 24 inches past each end of openings.
2. Do not attach hangers to steel deck tabs.
3. Do not attach hangers to steel roof deck. Attach hangers to structural members.
4. Do not connect or suspend steel framing from ducts, pipes, or conduit.
5. Brace system to resist lateral loads and wind uplift at exterior locations. Provide cross-bracing and additional framing required to resist wind uplift for design loads of 20 psf inward and outward.

E. Studs: Space studs at 16 inches on center (at 406 mm on center) maximum.
1. Walls to receive tile may require 12-inches on center spacing.
2. Extend partition framing to structure where indicated..
3. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
4. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.
5. Fasten stud ends to floor and ceiling tracks (except at deflection tracks). Do not rely solely on gypsum board panels for stud-to-track connections.
6. Refer to Drawings for indication of partitions extending stud framing through ceiling to structure above. Maintain clearance under structural building members to avoid deflection transfer to studs. Install deflection track at tops of walls to avoid axial loading.
7. For fire-resistance-rated and STC-rated partitions that extend to the underside of floor/roof slabs and decks or other continuous solid-structure surfaces to obtain ratings, install framing around structural and other members extending below floor/roof slabs and decks as needed to support gypsum board closures and to make partitions continuous from floor to underside of solid structure.
8. Do not bridge building expansion joints with framing or furring members. Frame both sides of joints independently.

F. Openings: Reinforce openings for weight of doors or operable panels, using not less than double studs at jambs.

G. Acoustic Furring: Install resilient channels at maximum 24 inches (600 mm) on center. Locate joints over framing members.

H. Curved Partitions:
   1. Frame curved partitions to comply with GA-226 and with gypsum board manufacturer's applicable written recommendations, unless otherwise indicated.
   2. Cut top and bottom tracks through leg and web at 2-inch intervals for arc length. In cutting lengths of track, allow for uncut straight lengths of not less than 12 inches at ends of arcs.
   3. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
   4. Support outside (cut) leg of track by clinching steel sheet strip, 1-inch high-by-thickness of track metal, to inside of cut legs using metal lock fasteners.
   5. Begin and end each arc with a stud, and space intermediate studs equally along arcs at stud spacing recommended in writing by gypsum board manufacturer for radii indicated. On straight lengths of not less than 2 studs at ends of arcs, place studs 6 inches o.c.

I. Blocking: Install wood blocking support for, but not limited to the following:
   1. Framed openings.
   2. Wall-mounted cabinets.
   3. Plumbing fixtures.
   4. Toilet partitions.
   5. Toilet accessories.
   6. Wall-mounted door hardware.
   7. Architectural woodwork.
   8. Light fixtures.
   9. Equipment.
   10. Wall protection.

3.05 ACOUSTIC ACCESSORIES INSTALLATION

A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.

B. Sound Isolation Tape: Apply to vertical studs and top and bottom tracks/runners in accordance with manufacturer's instructions.

C. Acoustic Seal Tape: Use to close voids where finished end of gypsum board partition abuts a dissimilar material such as a metal mullion or frame. Apply continuous to the abutting surface and install the gypsum board tight against it to provide compression along its entire length. Tapte to form an acoustic, vision and light barrier.

D. Acoustic Sealant: Install in accordance with manufacturer's instructions.
   1. Apply at partition conditions indicated as Sound-Rated. Use Fire-Rated Acoustic Sealant at fire-rated partition assemblies only.
   2. Place one bead continuously on substrate before installation of perimeter framing members. Including the following locations:
      a. Partition ends abutting other materials.
      b. Partition tops abutting structure.
      c. Partition bottom abutting floor.
      d. Opening frame perimeter joint to abutting materials.
   3. Place continuous bead at perimeter of each layer of gypsum board.
   4. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.

3.06 BOARD INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

B. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.

C. Single-Layer Nonrated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
   1. Use maximum practical lengths to eliminate end joints. Fit ends and edges closely together. Stagger joints between panels to avoid 4-way joint intersections.
   2. Lift and maintain bottom of panels 1/2" above finish floor level prior to fastening.
   3. For single-layer vertical application of gypsum panels, space screws 12" o.c. maximum in field of panels and 8" o.c. staggered along vertical abutting edges. For horizontal panel application, space screws 12" o.c. maximum in field and along abutting end joints.
   4. For ceiling and soffit panel application, space screws 12" o.c. maximum in field and 8” o.c. maximum along abutting end joints.
   5. At fire-rated partitions, erect single layer gypsum board vertically, with edges and ends occurring over firm bearing.

D. Double Layer Applications: Place second layer parallel with first layer. Offset joints of second layer from joints of first layer. Stagger joints on opposite sides of partition.

E. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.

F. Exterior Sheathing: Comply with ASTM C1280. Install sheathing vertically, with edges butted tight and ends occurring over firm bearing.
   1. Seal joints, cut edges, and holes with water-resistant sealant.
   2. Paper-Faced Sheathing: Immediately after installation, protect from weather by application of water-resistive barrier.

G. STC-Rated Assemblies: Seal construction at perimeters, behind control and expansion joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 and manufacturer's instructions for locating edge trim and closing off sound-flanking paths around or through gypsum board assemblies, including sealing partitions above acoustical ceilings.

H. Place acoustic insulation in partitions tight within spaces, around cut openings, behind and around electrical and mechanical items within or behind partitions, and tight to items passing through partitions.

I. Install acoustic sealant where indicated.

J. Cover both faces of stud framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

K. Erect ceiling board panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

L. Seal penetrations of partitions by conduit, pipe, duct work, and rough-in boxes.

M. Exterior Soffits: Install exterior soffit board perpendicular to framing, with staggered end joints over framing members or other solid backing.
   1. Seal joints, cut edges, and holes with water-resistant sealant.

N. Cementitious Backing Board: Install over steel framing members where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.
   1. Install at wet walls receiving tile.

O. Coated Glass Mat Backer Board:
   1. Install at locations other than wet walls indicated to receive tile, and at custodial closets behind FRP panel material.

P. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of nonrated double-layer assemblies, which may be installed by means of adhesive lamination.

Q. Place corner beads at external corners as indicated on Drawings. Use longest practical length. Place edge trim where gypsum board abuts dissimilar materials

R. Curved Surfaces: Apply gypsum board to curved substrates in accordance with GA-226.

S. Install cementitious backer board in the following locations:
   1. Shower walls.
   2. Rear and side walls (wet walls) adjacent to lavatories, toilets, and urinals.

T. Install moisture resistant gypsum board in the following locations:
   1. Behind wall tile.
   2. Toilet room walls not receiving cementitious backer board.

U. Install abuse-resistant gypsum board at areas indicated in the drawings.

3.07 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.

B. Corner Beads: Install at external corners, using longest practical lengths.

C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

D. Decorative Trim: Install at locations shown on drawings and in accordance with manufacturer's instructions.

E. Moisture Guard Trim: Install on bottom edge of gypsum board according to manufacturer's instructions and in locations indicated on drawings.

3.08 JOINT TREATMENT

A. Glass Mat Faced Gypsum Board and Exterior Glass Mat Faced Sheathing: Use fiberglass joint tape, embed and finish with setting type joint compound.

B. Paper Faced Gypsum Board: Use paper joint tape, embed with drying type joint compound and finish with drying type joint compound.

C. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 5: Walls and ceilings to receive semi-gloss or gloss paint finish and other areas specifically indicated.
   2. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
   3. Level 3: Walls to receive textured wall finish.
   4. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
   5. Level 1: Fire-resistance-rated wall areas above finished ceilings, whether or not accessible in the completed construction.

D. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
   1. Feather coats of joint compound so that camber is maximum 1/32 inch (0.8 mm).
   2. Taping, filling, and sanding are not required at base layer of double-layer applications.

E. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.

F. Float solid between any corner beads or J-molds less than 36” apart to eliminate tapered or concave appearance.

G. Float control joints flush with wall surface so that ceiling trim will run straight without gaps or deformation.

H. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.09 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet (3 mm in 3 m) in any direction.

3.10 FIELD QUALITY CONTROL

A. Above-Ceiling Observation: Before Contractor installs gypsum board ceilings, Architect shall conduct an above-ceiling observation and report deficiencies in the Work observed. Do not proceed with installation of gypsum board to ceiling support framing until deficiencies have been corrected.

B. Notify Architect seven days in advance of date and time when Project, or part of Project, is to be ready for above-ceiling observation.

C. Before notifying Architect, complete the following in areas to receive gypsum board ceilings:
   1. Installation of 80 percent of lighting fixtures, powered for operation.
   2. Installation, insulation, and leak and pressure testing of water piping systems.
   3. Installation of air-duct systems.
   4. Installation of air devices.
   5. Installation of mechanical system control-air tubing.
   6. Installation of ceiling support framing.

3.11 PARTITION MARKINGS

A. Mark fire-rated partitions and smoke barriers with 3-inch-high upper case letters with 3/8 inch stroke stenciled in red paint.

B. Place markings 6-inches above ceilings both sides of partitions as follows:
   1. Centered over doors.
   2. Maximum 30 feet on center inverval and not less than 15 feet from end of partition.
   3. Lettering Copy (as applicable):
      a. "1-HOUR FIRE RATED-PROTECT ALL OPENINGS"
      b. "2-HOUR FIRE RATED-PROTECT ALL OPENINGS"
      c. "4-HOUR FIRE RATED-PROTECT ALL OPENINGS"
      d. "SMOKE BARRIER, PROTECT ALL OPENINGS" (with appropriate fire rating).

C. Mark point of partition type demarcation with 1 inch wide painted vertical line from ceiling line to bottom of structure at the following conditions:
   1. From rated partition type to non-rated partition type;
   2. From change in partition type rating.

3.12 PROTECTION

A. Protect installed gypsum board assemblies from subsequent construction operations.

3.13 SCHEDULES

A. Finishes in accordance with GA-214 Level:
   1. **Level 1:** Embed tape at joints in ceiling plenum areas, concealed areas, on portions of walls above ceilings between the ceilings and the tops of walls and where indicated, unless a higher level of finish is required for fire-resistance-rated assemblies and sound-rated assemblies.
   2. **Level 2:** Embed tape and apply first coat of joint compound to tape, fasteners, and trim flanges where panels are substrate for tile.
   3. **Level 3:** Embed tape and apply separate first and fill coats of joint compound to tape, fasteners, and trim flanges where panels are substrate for medium or heavy textures or heavy-grade wallcoverings. Verify with wallcovering installer that gypsum board finish is acceptable for wallcovering application.
   4. **Level 4** (Standard Finish): Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges where panels are substrate for light textures, flat paints, or standard vinyl wallcoverings.
   5. **Level 5:** 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 over entire surface where panels are substrate for gloss or semi-gloss paints.
      a. Provide at drywall panels in high-level natural or artificial lighting areas such as near glazed entries, clerestory windows, or down-lighting mounted on or near walls.
   6. Provide at drywall scheduled to receive dry-erase coatings or wall coverings to be used as dry-erase marker surfaces.
      a. Level 5 finish at specialty backdrop painted walls.

END OF SECTION

SECTION 09 30 00

TILING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Tile for floor applications.

B. Tile for wall applications.

C. Miscellaneous Trim.

D. Thinset mortar installation method.

E. Mortar Bed installation method.

1.02 REFERENCE STANDARDS

A. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; 2023.

B. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2018.

C. ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar; 2019.

D. ANSI A118.4e - ANSI for Modified Dry-Set Cement Mortar - Extended Open Time; 2024.

E. ANSI A118.6 - American National Standard Specifications for Standard Cement Grouts for Tile Installation; 2019.

F. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2022.

G. ASTM C373 - Standard Test Methods for Determination of Water Absorption and Associated Properties by Vacuum Method for Pressed Ceramic Tiles and Glass Tiles and Boil Method for Extruded Ceramic Tiles and Non-tile Fired Ceramic Whiteware Products; 2018 (Reapproved 2023).

H. ASTM C627 - Standard Test Method for Evaluating Ceramic Floor Tile Installation Systems Using the Robinson-Type Floor Tester; 2018.

I. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2023.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by affected installers.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.

C. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and setting details.
   1. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

D. Samples for Initial Selection: For each type of tile and grout indicated. Include Samples of accessories involving color selection.

E. Samples for Verification:
   1. Full-size units of each type and composition of tile and for each color and finish required.
   2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required. Make samples at least 12 inches square, but not fewer than 4 tiles. Use grout of type and in color or colors approved for completed Work.
   3. Submit two full-size units of each type of trim and accessory for each color and finish required.
   4. Stone thresholds in 6-inch lengths.
   5. Metal edge strips in 6-inch lengths.

F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

G. Master Grade Certificate: Submit for each type of tile, signed by the tile manufacturer and tile installer.

H. Material Test Reports: For each tile-setting and -grouting product.

I. Installer's Qualification Statement:

J. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.

1.05 QUALITY ASSURANCE

A. Source Limitations for Tile: Obtain tile of each type from one source or producer.
   1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from one manufacturer and each aggregate from one source or producer.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer for each product:
   1. Stone thresholds.
   2. Waterproof membrane.

3. Crack isolation membrane.
4. Joint sealants.
5. Metal edge strips.

D. Perform Work in accordance with TCNA Handbook and ANSI A108 Series/A118 Series.

E. To ensure warranty requirements and compatibility of products provide all tile grout, setting materials, additives, accessories, and factory-prepared dry-set mortars from the same manufacturer.

F. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum threeyears of documented experience.

G. Installer Qualifications:
1. Company specializing in performing tile installation, with minimum of three years of documented experience.

1.06 MOCK-UPS

A. See Section 01 40 00 - Quality Requirements for general requirements for mock-up.

B. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Build integrated mockup of floor tile installation per Division 01 Section “Quality Requirements”.
2. Build integrated mockup of wall tile installation per Division 01 Section “Quality Requirements”.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.08 FIELD CONDITIONS

A. Do not install solvent-based products in an unventilated environment.

B. Maintain ambient and substrate temperature above 50 degrees F (10 degrees C) and below 100 degrees F (38 degrees C) during installation and curing of setting materials.

1.09 EXTRA MATERIALS

A. Furnish one unopened box of each type and color of ceramic tile installed, including accent colors, to the Owner. Obtain receipt.

B. Furnish four unopened boxes of each type and color of porcelain tile installed, including accent colors, to the Owner. Obtain receipt.

C. Furnish one unopened box of each type and color of quarry tile installed, including accent colors, to the Owner. Obtain receipt.

PART 2 - PRODUCTS

2.01 GENERAL

A. ANSI Ceramic Tile Standards:
   1. Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
      a. Provide tile complying with Standard grade requirements unless otherwise indicated.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCA installation methods specified in tile installation schedules, and other requirements specified.

C. FloorScore Compliance: Tile for floors shall comply with requirements of FloorScore Standard.

D. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

E. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.
   1. Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.

2.02 PERFORMANCE REQUIREMENTS

A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:
   1. Level Surfaces: Minimum 0.6.

B. Dynamic Coefficient of Friction of Hard Surface Flooring Materials: For tile installed on walkway surfaces, provide products Tile to conform to requirements of ANSI A326.3.

C. Load Bearing Performance: for ceramic tile installed on walkway surfaces, provide installations rated for the following load-bearing performance level based on testing assemblies according to ASTM C627 that are representative of those indicated for this Project:
   1. Heavy: Passes cycles 1 through 12.

2.03 TILE

A. Tile Manufacturers: Refer to specific manufacturers and products indicated in the Drawings to determine the Project requirements. Subject to compliance with requirements, provide products indicated or equal product by one of the following manufacturers, unless a specific product is referenced as “No Substitutions”.
   1. Acceptance of products other than those indicated is contingent upon submittal of proposed alternate products to the Architect. Submittal of proposed alternate products must occur prior to bidding as described in Division One specification section “Product Substitutions”.
   2. Submittals must demonstrate to the Architect that the proposed alternate product line has colors that match the basis-of-design indicated. The Architect may reject the proposed

product for technical non-compliance or, at his discretion, on the basis of lack of color match alone.

B. Manufacturers:
   1. Manzarri; https://www.marazziusa.com/
   2. Concept Surfaces; https://www.conceptsurfaces.com/
   3. Crossville, Inc.; https://www.crossville.com/
   4. Summitville Tile, Inc.; https://summitville.com/
   5. Trinity Tile; https://www.trinitytile.com/
   6. American Olean Corporation: www.americanolean.com/
   7. Dal-Tile Corporation: www.daltile.com/
   8. Additional manufacturers as may be listed in the Finish/Color Schedule.

C. Types: Tile Types correspond to Types indicated on the Finish/Color Schedule:
   1. Porcelain Mosaic Floor Tile
      a. Basis of Design: As scheduled.
      b. Moisture Absorption: 0 to 0.5 percent.
      c. Size(s): As scheduled.
      d. Edge: Square, rectified.
      e. Surface Finish: Unglazed.
      f. Joint Size: 1/8”.
      g. Type: Through-color.
      h. Use sanded acid-resistant Portland cement grout, sealed at restroom floors.
      i. Use epoxy emulsion grout at shower floors.
   2. Quarry Tile: ANSI A137.1 standard grade.
      a. Size: 6 by 6 inch (152 by 152 mm), nominal.
      b. Thickness: 1/2 inch (12.7 mm), nominal.
      c. Edges: Square.
      d. Surface Finish: Non-slip.
      e. Joint Size: 3/8"
      f. Base:
         1) Size: 5" high x 6" long.
         2) Top Edge: Bullnose.
         3) Toe: Cove flush with floor tile.
      g. Use eposy emulsion grout.
   3. Porcelain Tile: ANSI A137.1 standard grade.
      a. Moisture Absorption: 0 to 0.5 percent as tested in accordance with ASTM C373.
      b. Size: As scheduled, rectified.
      c. Edges: Square.
      d. Surface Finish: Unglazed.
      e. Type: Through-color.
      f. Joint Size: 1/8"
      g. Color(s): As indicated on drawings.
      h. Use sanded acid-resistant Portland cement grout, sealed at restroom walls.

2.04 TRIM AND ACCESSORIES

A. Miscellaneous Trim: Satin natural anodized extruded aluminum or as otherwise noted below and on drawings, style and dimensions to suit application, for setting using tile mortar or adhesive.
   1. Applications:
      a. Porcelain floor tile to porcelain floor tile transition.
      b. Continuous cove strip between restroom wall tile and floor tile where no base is indicated: Schluter Dilex-HKS stainless steel.
      c. Tile to concrete floor, hard-surface floor, and resilient flooring: Schluter-RENO-U, aluminum.
      d. Tile to Carpet: Schluter SCHIENE same-height, aluminum
      e. Top of Wainscot Edge Strip: Schluter-JOLLY, extruded clear satin anodized aluminum.
      f. Corridor Wainscot Tile to Floor Tile: No base, not trim. Provide sealant joint.
      g. Floor Transition at Restrooms: prefabricated marble threshold.
      h. Floor Transition from Curbless Shower to Adjacent Floor: Schluter ShowerProfile WSK + WSC set on clear silicone bead.
   2. Manufacturers:
      a. Schluter-Systems: www.schluter.com/#sle.
      b. Genesis APS International: www.genesis-aps.com/#sle.

B. Thresholds: 2 inches (51 mm) wide by full width of wall or frame opening; beveled edge on both long edges; without holes, cracks, or open seams. Provide at each entry door or framed opening to restrooms or restroom vestibules.
   1. Material: Carrara white marble, Grade A.
   2. Configuration: One-piece material, 2-in. wide x full width of door. ADA compliant with long edges beveled and top surface of threshold 3/8” – 1/2” higher than finish flooring on either side.
   3. Finish: Sealed with clear non-yellowing penetrating sealer.
   4. Location:
      a. Door: Center threshold on door.
      b. Opening without door: Center on wall opening or frame.

C. Steel Reinforcing Mesh: 2 x 2 inch size weave of 16/16 wire size, galvanized welded fabric for mortar beds. Optional as recommended by the mortar manufacturer for the particular conditions.

2.05 SETTING MATERIALS

A. Provide setting and grout materials from same manufacturer.

B. Manufacturers:
   1. ARDEX Engineered Cements: www.ardexamericas.com/
   2. Bostik Inc: www.bostik-us.com/
   3. Mapei Corporation; www.mapei.com
   4. TEC Specialty Products, Inc.; www.tecspecialty.com/products/
   5. LATICRETE International, Inc: www.laticrete.com/
   6. Substitutions: See Section 01 60 00 - Product Requirements.

C. Mortar Bed Materials at Recessed Slabs: ANSI A108.1A; Portland cement, sand, latex additive, and water; proportioned in accordance with TCNA specifications.

D. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02.
   1. Cleavage Membrane: Asphalt felt, ASTM D 226, Type I (No. 15); or polyethylene sheeting, ASTM D 4397, 4.0 mils (0.1 mm) thick.
   2. Reinforced Wire Fabric: Galvanized, welded wire fabric, 2 by 2 inches by 0.062-inch diameter; comply with ASTM A 185 and ASTM A 82 except for minimum wire size.
   3. Latex Additive: Manufacturer's standard water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement and aggregate mortar bed.

E. Large-Format Floor and Wall Tile Mortar (Medium Set): ANSI A118.4HTE & A118.11.
   1. Provide prepackaged, dry-mortar mix combined with required additives at Project site.
   2. See Evaluations for discussion on difference between normal and nonsagging mortar.
   3. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.

F. Latex-Portland Cement Mortar Bond Coat, single-component type polymer-modified thin-set or medium bed mortar.: ANSI A118.4e
   1. Provide prepackaged, dry-mortar mix combined with acrylic resin or styrene-butadiene-rubber liquid-latex additive at Project site.
   2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4e.
   3. Basis of Design:
      a. Small Format Floor or Wall Tile (all dimensions less than 15”): *Ultraflex-2* thin-set as manufactured by Mapei or approved equivalent by specified manufacturer; meets or exceeds requirements of ANSI A118.4E, ANSI A118.11, and ISO C2TE.
      b. Large Format Floor Tile (any dimension 15” or greater): *Ultraflex-LFT* medium bed as manufactured by Mapei or approved equivalent by specified manufacturer; meets or exceeds requirements of ANSI A118.4, ISO 13007 C2TES1P1, and TE and ANSI A118.11.
      c. Large Format Wall Tile (any dimension 12” or greater): *Ultralite Pro* non-sag type as manufactured by Mapei or approved equivalent by specified manufacturer; meets or exceeds requirements of ANSI A118.4TE, ANSI A118.4TE, and ISO 13007 C2TE.

2.06 GROUTS

A. Provide setting and grout materials from same manufacturer.

B. Manufacturers:
   1. ARDEX Engineered Cements: www.ardexamericas.com/
   2. Bostik Inc: www.bostik-us.com/
   3. Mapei Corporation; www.mapei.com
   4. TEC Specialty Products, Inc.; www.tecspecialty.com/products/
   5. LATICRETE International, Inc; LATICRETE PERMACOLOR Grout: www.laticrete.com/
   6. Substitutions: See Section 01 60 00 - Product Requirements.

C. Standard Grout: ANSI A118.6 standard cement grout.

1. Applications: Use this type of grout where indicated and where no other type of grout is indicated.
2. Use sanded grout for joints 1/8 inch (3.2 mm) wide and larger; use unsanded grout for joints less than 1/16 inch (3.2 mm) wide.
    a. Sanded Grout: Calcium Aluminate Cement type that meets or exceeds requirements of ANSI A118.6.
        1) Color: As selected.
        2) Basis of Design: *Ultracolor Plus FA* as manufactured by Mapei or approved equivalent by specified manufacturer.
    b. Non-Sanded Grout: Latex-Portland cement polymer-modified type that meets or exceeds requirements of ANSI A118.6.
        1) Color: As selected.
        2) Basis of Design: *Keracolor-U* as manufactured by Mapei or approved equivalent by specified manufacturer.
3. Color(s): As selected by Architect from manufacturer's full line.

2.07 MAINTENANCE MATERIALS

A. Grout Sealer: Liquid-applied, moisture and stain protection for existing or new Portland cement grout. Manufacturer's standard silicone product for sealing grout joints and that does not change color or appearance of grout.
    1. Composition: Water-based colorless silicone.
    2. Products: Subject to compliance with requirements, provide one of the following:
        a. Bonsal American; an Oldcastle company; Grout Sealer.
        b. Bostik, Inc.; CeramaSeal Grout & Tile Sealer.
        c. C-Cure; Penetrating Sealer 978.
        d. Custom Building Products; Grout Sealer.
        e. MAPEI Corporation; KER 003, Silicone Spray Sealer for Cementitious Tile Grout
        f. Southern Grouts & Mortars, Inc.; Silicone Grout Sealer.
        g. Summitville Tiles, Inc.; SL-15, Invisible Seal Penetrating Grout and Tile Sealer.
        h. TEC; a subsidiary of H. B. Fuller Company; TA-256 Penetrating Silicone or TA-257 Silicone Grout Sealer.
        i. Substitutions: See Section 01 60 00 - Product Requirements.

B. Tile Sealer: Stain protection for ceramic tile and natural stone tile.

C. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.
    1. MAPEI *Ultracare Stone, Tile & Grout Care* Solutions or approved equivalent.

2.08 ACCESSORY MATERIALS

A. Concrete Floor Slab Crack Isolation Membrane: Manufacturer's standard product,complying with ANSI A118.12; not intended as waterproofing, and is recommended by the manufactuer for the application intended. Include reinforcement and accessories recommended by manufacturer.
    1. For Covering Shrinkage Cracking and Non-Structural Cracks to less than 1/8” - Use one of the following:

a. Mapelastic C1 as manufactured by MAPEI: Liquid-applied.
b. Blue 92 as manufactured by Laticrete: Liquid-applied.
c. Mapeguard 2 with SM Primer as manufactured by MAPEI: Sheet
d. NobleSeal CIS as manufactured by Noble Corp: Sheet.

2. For Bridging Construction Joints and Any Cracks 1/8" or greater– Use one of the following membrane sheets meeting or exceeding requirements of ASTM C627-*Extra Heavy*:
   a. Mapeguard 2 with SM Primer as manufactured by MAPEI.
   b. Crack Isolation Mat as manufactured by Laticrete.
   c. NobleSeal CIS as manufactured by Noble Corp.
3. In addition install sealant-filled control joint at or within 12" of construction joints or any joints exceeding 1/4" in width.

B. Cleavage Membrane Under Thick Mortar Bed:
   1. Material: No. 15 (6.9 kg) asphalt saturated felt.

C. Underlayment at Floors: Specifically designed for bonding to thin-set setting mortar; not primarily a waterproofing material and having the following characteristics:
   1. Type: Fluid or Trowel Applied.
      a. Products:
         1) Planiprep SC by Mapei: www.mapei.com
         2) LATICRETE International, Inc; LATICRETE 125 Sound and Crack Adhesive: www.laticrete.com/
         3) Merkrete, by Parex USA, Inc; Merkrete Fracture Guard: www.merkrete.com/
         4) Proflex Products, Inc; Hydra-Seal: www.proflex.us/

D. Cementitious Backer Board: As specified in Section 09 21 16 for use at shower walls and wet walls behind lavatories, toilets, and urinals, and side walls adjacent to these fixtures.

E. Sealants
   1. Interior Non-Traffic Joints: Vertical expansion joints up to 1/4" wide and less than 25% movement; for filling joints where tile abuts dissimilar surfaces such as countertops; at inside corners of wall tile; for dry or occasionally wet surfaces.
      a. Single-component siliconized acrylic in color(s) to match adjacent grout(s).
      b. Mold and mildew resistant.
      c. Paintable.
      d. Non-structural.
      e. Meets ASTM C834 for low-movement sealant.
      f. *Keracaulk* sanded or unsanded as manufactured by Mapei, or approved equivalent by Laticrete. Match tile joint colors.
   2. Interior Tile Floors: Floor expansion joints; joints exceeding 25% movement; perimeter floor joints at wall Interface or other vertical interruptions; for all vertical or horizontal sealant joints in showers, pool decks, dressing rooms, and other areas continually wet.
      a. High performance, single-component, neutral cure, 100% silicone formulated for ceramic tile and stone applications. In color(s) matching adjacent grout(s).
      b. Low Sheen to match finish of grout joints.
      c. Mold and mildew resistant.
      d. Non-structural.

e. *Mapesil-T* as manufactured by Mapei or approved equivalent by Laticrete. Match tile joint colors.

3. Exterior Tile Walls, Floors, Expansion Joints, and Other Surfaces: *Mapesil-T* as manufactured by Mapei or approved equivalent by Laticrete. Match tile joint colors.

4. Backer Rods and Strips: Closed-cell compressible foam polyurethane as recommended by sealant manufacturer and sized to:
   a. Fit snugly within the joint without compressing.
   b. Provide a sealant depth of 1/2 the dimensional width of the joint.
   c. Prevent adhesion to the backup surface.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.

B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.

C. Verify that subfloor surfaces are dust free and free of substances that could impair bonding of setting materials to subfloor surfaces.

D. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

A. Protect surrounding work from damage.

B. Vacuum clean surfaces and damp clean.

C. Seal substrate surface cracks, holes, depressions and inconsistancies with filler. Level existing substrate surfaces to acceptable flatness tolerances.
   1. Use trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

D. Install crack control membrane at substrate cracking and construction/expansion joints in accordance with membrane manufacturer’s printed recommendations.

E. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1a and is sloped 1/4 inch per foot (1:50) toward drains.

F. Install specified liquid-applied membrane over walls and mortar bed at showers, and over entire concrete substrate at upper-floor restrooms prior to installing tile.
   1. Apply two-coats over entire concrete floor area. Allowing recommended drying time between coats.
   2. Where floor interfaces with masonry walls turn membrane up wall 3”.
   3. Where floor interfaces with stud walls, apply membrane manufacturer’s recommended sealant between concrete floor and bottom of drywall, allow to cure and turn membrane up wall 3”.

4. Allow membrane to cure thoroughly in accordance with membrane manufacturer's recommendations prior to beginning tile work.

G. Blending of Ceramic Tile: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

H. Install backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of setting material to a feather edge.

3.03 INSTALLATION - GENERAL

A. Install tile, thresholds, and stair treads and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.20, manufacturer's instructions, and TCNA (HB) recommendations.

B. Apply sealant to junction of tile and dissimilar materials and junction of dissimilar planes.

C. For the following installations, follow procedures in the ANSI A108 Series of tile installation standards for providing 95 percent mortar coverage:
1. Tile floors in wet areas.
2. Tile floors composed of tiles 8 by 8 inches (200 by 200 mm) or larger.
3. Tile floors composed of rib-backed tiles.

D. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.

E. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.

F. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.

G. Place metal edge strips at exposed tile edges.

H. Form internal angles square and external angles bullnosed.

I. Install non-ceramic trim in accordance with manufacturer's instructions.

J. Install thresholds where indicated.

K. Sound tile after setting. Replace hollow sounding units.

L. Keep control and expansion joints free of mortar, grout, and adhesive.

M. Prior to grouting, allow installation to completely cure; minimum of 48 hours.

N. Grout tile joints unless otherwise indicated. Use standard grout unless otherwise indicated.

O. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

P. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

Q. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

R. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.

S. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
   1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
   2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
   3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

T. Joints: Place tile with joints uniform in width, subject to variance in tolerance allowed in tile size. Make joints watertight, without voids, cracks, excess mortar, or excess grout.
   1. Ceramic or Porcelain Floor or Wall Tile:
      a. 1” x 1” to 4” x 4” Tile: 1/16-inch.
      b. 6” x 6” to 12” x 12” Tile: 1/8-inch
      c. Large Format Tile, Rectified: 1/8 inch.
      d. Large Format Tile, Non-Rectified: 1/4 inch.
   2. Glass Wall Tile: 1/16 inch.
   3. Quarry Tile: 1/4 inch - 3/8 inch.

U. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

V. Match tiles within each space by selecting tiles to achieve uiformaity of color and pattern, consistant with design intent shown on drawings and reviewed tile samples. Reject or relocate tiles that do not match color and pattern of adjacent tiles.

W. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
   1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
   2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

X. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.
   1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in latex-portland cement mortar (thin set).
   2. Do not extend cleavage membrane, waterproofing, or crack isolation membrane under thresholds set in latex-portland cement mortar. Fill joints between such thresholds and

adjoining tile set on cleavage membrane, waterproofing, or crack isolation membrane with elastomeric sealant.

Y. Metal Edge Strips: Where exposed edge of tile flooring meets carpet, or other flooring that finishes flush with or below top of tile; at joints between wall bases and floor; and where indicated. Provide and install all profiles, setting and accessory materials as required by manufacturer for complete, durable, and water-resistant assembly.

Z. Door Transitions/Thresholds: Reference Door Schedule for type:
   1. Metal Edge Strips:
      a. Install floor transition strips at all floor tile terminations where stone or solid surfacing thresholds are not scheduled.
      b. Install wall edge strips at exposed edges of tile where wall tile terminates away from inside corners.

AA. 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.

BB. When bonding large-format tiles, install in accordance with TCNA and tile manufacturer’s recommendations to achieve full coverage of mortar bed under tile surface. Back-butter tiles as necessary to ensure full coverage.

3.04 WATERPROOFING INSTALLATION

A. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness and bonded securely to substrate.

B. Do not install tile or setting materials over waterproofing until waterproofing has cured and been tested to determine that it is watertight.

3.05 CRACK ISOLATION MEMBRANE INSTALLATION

A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness and bonded securely to substrate.

B. Do not install tile or setting materials over crack isolation membrane until membrane has cured.

3.06 INSTALLATION - FLOORS - THIN-SET METHODS

A. Over interior concrete substrates, install in accordance with TCNA (HB) Method F113, dry-set or latex-Portland cement bond coat, with standard grout, unless otherwise indicated.
   1. Where waterproofing membrane is indicated, install in accordance with TCNA (HB) Method F122, with latex-Portland cement grout.
   2. Where epoxy bond coat and grout are indicated, install in accordance with TCNA (HB) Method F131.

B. At upper-floor restrooms apply specified liquid-applied membrane over concrete subfloor before installing tile. install in accordance with TCNA Handbook Method F122, using specified latex-Portland cement mortar compatible with the cured membrane.

C. Install tile-to-tile floor movement joints in accordance with TCNA (HB) Method EJ171F.

3.07 INSTALLATION - FLOORS - MORTAR BED METHODS

A. Over interior concrete substrates, install in accordance with TCNA (HB) Method F112, bonded with latex-Portland cement bonding mortar.
   1. Install over mortar bed at recessed slabs, align with adjacent floor level.
   2. Where waterproofing membrane is indicated, with standard grout or no mention of grout type, install in accordance with TCNA (HB) Method F121.
   3. At quarry tile installations, install in accordance with TCNA Handbook Method F112, with epoxy grout.

B. Cleavage Membrane: Lap edges and ends.

C. Mortar Bed Thickness: Minimum 5/8 inch (15.9 mm), unless otherwise indicated.

3.08 INSTALLATION - WALL TILE

A. On exterior walls install in accordance with TCNA (HB) Method W244, thin-set over cementitious backer units, with waterproofing membrane.

B. Over cementitious backer units on studs, install in accordance with TCNA (HB) Method W244, using membrane at toilet rooms.

C. Over coated glass mat backer board on studs, install in accordance with TCNA (HB) Method W245.

D. Over gypsum wallboard on wood or metal studs install in accordance with TCNA (HB) Method W243, thin-set with dry-set or latex-Portland cement bond coat, unless otherwise indicated.
   1. Where mortar bed is indicated, install in accordance with TCNA (HB) Method W222, one coat method.
   2. Where waterproofing membrane is indicated other than at showers and bathtub walls, install in accordance with TCNA (HB) Method W222, one coat method.

E. Over interior concrete and masonry install in accordance with TCNA (HB) Method W202, thin-set with dry-set or latex-Portland cement bond coat.

F. Over metal studs without backer install in accordance with TCNA (HB) Method W241, mortar bed, with membrane where indicated.

3.09 CLEANING

A. Clean tile and grout surfaces.
   1. Broom clean and cover tiled floors with heavy non-staining, non-asphaltic building paper taped in place until just prior to final clean and polish for Owner acceptance.

3.10 PROTECTION

A. Do not permit traffic over finished floor surface for 4 days after installation.
   1. Where temporary access across tiled floors cannot be avoided, cover traffic path with 3/4” plywood or lumber.

B. Keep epoxy grout free of construction and drywall dust until fully cured, as determined by the epoxy grout manufacturer.

END OF SECTION

SECTION 09 51 00

ACOUSTICAL PANEL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Suspended metal grid ceiling system.

B. Acoustical units.

1.02 REFERENCE STANDARDS

1.03 ADMINISTRATIVE REQUIREMENTS

A. Section 01 31 19 – Project Meetings: Schedule and coordinate pre-installation meeting that includes the trade(s) for the work of this Section and other trades that whose work is related to the work of this Section.

B. Convene minimum one week prior to commencing work of this Section.

C. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.

D. Do not install acoustical units until after interior wet work is dry.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Shop Drawings: Indicate grid layout and related dimensioning. Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items. Show the following:
   1. Ceiling suspension system members.
   2. Method of attaching suspension system hangers to building structure.
   3. Ceiling-mounted items including light fixtures; air outlets and inlets; speakers; sprinklers; and special moldings at walls, column penetrations, and other junctures of acoustical ceilings with adjoining construction.
   4. Minimum Drawing Scale: 1/8 inch = 1 foot (1:96).

C. Product Data: Provide data on suspension system components and acoustical units.

D. Samples: Submit two samples 6 by 6 inch in size illustrating material and finish of acoustical units.

E. Samples: Submit two samples each, 12 inches long, of suspension system main runner, cross runner, and perimeter molding.

F. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

G. Certification: Provide certification from manufacturer of products that all materials used in food preparation and food serving areas have USDA approval for use in food preparation and food serving areas.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Acoustical Units: Quantity equal to 2 percent of total installed.
   2. Furnish 1 box of suspension system material to Owner.

1.05 QUALITY ASSURANCE

A. Conform to CISCA requirements.

B. Surface Burning Characteristics: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

C. Certify all materials used in food preparation and food serving areas have USDA approval for use in food serving and food preparation areas.

D. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

E. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.06 FIELD CONDITIONS

A. Maintain uniform temperature of minimum 60 degrees F (16 degrees C), and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acoustic Tiles/Panels:
   1. Armstrong World Industries, Inc: www.armstrongceilings.com
   2. CertainTeed Corporation: www.certainteed.com/ceilings-and-walls
   3. Rockfon: www.rockfon.com
   4. USG Corporation: www.usg.com/ceilings
   5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Suspension Systems:
   1. Basis of Design: Armstrong, Prelude XL 15/16" or 9/16" Exposed Tee.
   2. Armstrong World Industries, Inc: www.armstrongceilings.com
   3. CertainTeed Corporation: www.certainteed.com/ceilings-and-walls
   4. Rockfon: www.rockfon.com
   5. USG Corporation: www.usg.com/ceilings
   6. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 ACOUSTICAL UNITS

A. General:
1. 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 reflectances, unless otherwise indicated.
   a. Mounting Method for Measuring Noise Reduction Coefficient: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from test surface per ASTM E 795.
2. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
   a. Where appearance characteristics of acoustical panels are indicated by referencing ASTM E 1264 pattern designations and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range of products that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.
3. Products: Subject to compliance with requirements, provide one of the named products that follow, in each designation:

B. **APC-1**: ASTM E1264, Type IV conforming to the following:
1. Basis of Design: *School Zone Fine Fissured #1713* as manufactured by Armstrong or approved equivalent by specified manufacturer.
2. Typical locations: Primary learning areas and classrooms, or as noted in drawings.
3. Size: 24 x 24 inches.
4. Thickness: 3/4 inches.
5. Composition: Mineral fiber, wet-formed.
6. NRC: 0.70.
7. CAC: 35.
8. Edge: Square lay-in.
9. Surface Color: White, typical.
10. Surface Finish: Medium texture.
11. Special Treatment: HumiGuard Plus and BioBlock.
12. Grid: 15/16” wide, factory powder coat white, Prelude XL.

C. **APC-2:** ASTM E1264, Type IV, Form 2, Pattern G, conforming to the following:
1. Basis of Design: *Ultima Health Zone #1920* as manufactured by Armstrong or approved equivalent by specified manufacturer.
2. Locations: As noted on drawings.
3. Size: 24 x 24 inches.
4. Thickness: 3/4 inches.
5. Composition: Mineral fiber, wet-formed.
6. Light Reflectance Coefficient: 0.90.
7. CAC: 35.
8. Edge: Square edge.
9. Surface Color: White.
10. Surface Finish: Factory-applied acrylic latex paint, smooth texture.
11. Special Treatment: Bioblock.
12. Grid: 15/16” wide, factory powder coat white, Prelude XL.

D. **APC-3**: ASTM E1264, Type IV conforming to the following:
   1. Basis of Design: *School Zone Fine Fissured #1713BL* as manufactured by Armstrong or approved equivalent by specified manufacturer.
   2. Typical locations: Primary learning areas and classrooms, or as noted in drawings.
   3. Size: 24 x 24 inches.
   4. Thickness: 3/4 inches.
   5. Composition: Mineral fiber, wet-formed.
   6. NRC: 0.70.
   7. CAC: 35.
   8. Edge: Square lay-in.
   9. Surface Color: Black.
   10. Surface Finish: Factory-applied acrylic latex paint, smooth texture.
   11. Special Treatment: HumiGuard Plus and BioBlock Plus.
   12. Grid: 15/16” wide, factory powder coat black, Prelude XL.

2.03 SUSPENSION SYSTEM(S)

A. Metal Suspension Systems, General:
   1. Metal Suspension System Standard: Provide 1) manufacturer's standard direct-hung metal suspension systems of types, 2) all accessories available and designed for the installation of the particular system being installed, 3) in appropriate structural classifications, and 4) finishes indicated that comply with applicable ASTM C 635 requirements.
   2. 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.
   3. Grid Members:
      a. Minimum 0.015 inch bare metal thickness.
      b. Minimum 300 lb. tension/ compression connection value.
      c. UL-certified for load compliance as required by ASTM C635.
   4. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung, unless otherwise indicated.
      a. Postinstalled 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.
   5. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
      a. Zinc-Coated Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
      b. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635, Table 1, Direct Hung) will be less than yield stress of wire, but provide not less than 0.106 inch (2.69 mm) diameter wire.
   6. Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that fit acoustical panel edge details and

suspension systems indicated; formed from extruded aluminum, or sheet metal of same material and finish as that used for exposed flanges of suspension system runners.

a. 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.

b. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

c. For narrow-face suspension systems, provide suspension system and manufacturer's standard edge moldings that match width and configuration of exposed runners.

B. Non-fire Rated Grid: ASTM C635, intermediate duty; exposed T; components die cut and interlocking.

1. Grid Materials: Commercial quality cold rolled steel with galvanized coating.
2. Basis of design, Prelude XL as manufactured by Armstrong or approved equivalent by specified manufacturer.
3. Grid Finish:
   a. Factory painted white or black steel face as scheduled.
   b. 15/16” face typical. 9/16” face for tegular edged tile.

C. Accessories: Stabilizer bars, clips, splices, perimeter moldings, hold down clips, and other items required for suspended grid system.

1. For circular penetrations of ceiling, provide perimeter moldings fabricated to diameter required to fit penetration exactly.

D. Support Channels and Hangers: Galvanized steel; size and type to suit application and ceiling system flatness requirement specified.

1. Post-installed 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.
2. Zinc-Coated Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper. Select wire diameter so its stress at three times hanger design load will be less than yield stress of wire but provide not less than 0.106 inch diameter wire.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage, and other conditions affecting performance of acoustical panel ceilings.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Verify that layout of hangers will not interfere with other work.

3.02 PREPARATION

A. Install after major above-ceiling work is complete.

B. Coordinate the location of hangers with other work, verify layout of hangers will not interfere with 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

3.03 INSTALLATION - SUSPENSION SYSTEM

A. Install after major above ceiling work is complete. Coordinate location of hangers with other work.

B. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.

C. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.

D. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.

E. Install system capable of supporting imposed loads to deflection of 1/360 maximum.

F. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

G. 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 referenced standards and publications.

H. 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; that are appropriate for substrate; and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.

I. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, powder-actuated fasteners, or drilled-in anchors that extend through forms into concrete.

J. Do not attach hangers to steel deck tabs.

K. Do not attach hangers to steel roof deck. Attach hangers to structural members.

L. Do not support components on main runners or cross runners when weight causes total dead load to exceed deflection capability. Support fixture loads by supplementary hangers located within 6 inches of each corner; or support components independently.

M. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers, unless otherwise indicated; and provide hangers not more than 8 inches (200 mm) from ends of each member.

N. Lay out system to a balanced grid design with edge units no less than 50 percent of acoustical unit size. Confirm in writing any divergence from Architect's ceiling layout shown on drawings.

O. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.

P. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.

Q. Do not eccentrically load system or induce rotation of runners.

R. At all lighting systems installed in ceiling suspension systems, and particularly at linear light systems, coordinate requirements of Lighting and Ceiling Manufacturers for a complete integrated installation where all parts of the lighting system will stay in place and function properly. Linear light systems will require additional accessory structure and possibly additional accessories.

S. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
   1. Use longest practical lengths.
   2. Overlap corners.
   3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
   4. Install at junctions with other interruptions.
   5. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

T. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3 mm in 3.6 m). Miter corners accurately and connect securely.
   1. Delete subparagraph below or qualify if exposed fasteners are allowed.

U. Do not use exposed fasteners, including pop rivets, on moldings and trim.

3.04 INSTALLATION - ACOUSTICAL UNITS

A. Install acoustical units in accordance with manufacturer's instructions.

B. Install units after above-ceiling work is complete.

C. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.

D. Lay directional patterned units with pattern parallel to longest room axis.

E. Fit border trim neatly against abutting surfaces.

F. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.

G. Cutting Acoustical Units:
   1. Cut to fit irregular grid and perimeter edge trim.
   2. Make field cut edges of same profile as factory edges.
   3. Double cut and field paint exposed reveal edges.

H. Where round obstructions occur, provide preformed closures to match perimeter molding.

I. Install hold-down clips on panels within 20 ft (6 m) of an exterior door.

J. 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. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.
   2. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
   3. 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.
   4. 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.
   5. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions, unless otherwise indicated or required.
   6. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.

K. Reveal edge panels (Tegular Panels):
   1. Provide factory cut, custom panels.

3.05 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet (3 mm in 3 m).

B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

3.06 CLEANING

A. See Section 01 70 00 - Execution and Closeout Requirements for additional requirements.

B. Clean surfaces. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.

C. Replace damaged or abraded components.

END OF SECTION

SECTION 09 54 23

LINEAR METAL CEILING SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes suspended decorative metal ceilings as a manufactured system.

B. Related Sections include the following:
1. Section 09 51 13 - Acoustical Panel Ceilings: For ceilings consisting of mineral-base and glass-fiber-base acoustical panels and suspended grid systems.
2. Division 23 Sections for grilles, registers, and diffusers.
3. Division 26 Sections for light fixtures.

1.02 REFERENCES

A. ASTM International:
1. ASTM C635 - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
2. ASTM C636 - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.

B. Ceilings and Interior Systems Construction Association:
1. CISCA - Acoustical Ceilings: Use and Practice.

1.03 1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items. Show the following:
1. Ceiling pattern.
2. Ceiling suspension members.
3. Method of attaching suspension system hangers to building structure.
4. Indicate all required end joints in panel lengths.
5. Ceiling-mounted or above-ceiling items including lighting fixtures, air outlets and inlets; speakers; sprinklers; access panels, column penetrations, and any other junctures, penetrations, or interfaces with specialty metal ceilings.
6. Submit details indicating special conditions.

C. 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.

D. Physical Samples: Submit (2) 12” lengths of factory-finished panel sections, (2) 12” lengths of factory-finished support grid, and (2) 12” lengths of each type of matching trim.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed specialty metal ceilings similar in material, design, and extent to those indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Source Limitations for Specialty Metal Ceilings: Obtain specialty metal ceilings from one source with resources to provide products of consistent quality in appearance and physical properties.

C. Fire-Test-Response Characteristics: Provide specialty metal ceiling components with the following surface-burning characteristics as determined by testing identical assemblies per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify ceiling units with appropriate markings of applicable testing and inspecting agency.
   1. Flame Spread: 25 or less.
   2. Smoke Developed: 50 or less.

D. Mockups: Prior to installing specialty metal ceilings, construct mockups 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. Mockups shall be built by the Subcontractor responsible for the Project Work. Build mockups to comply with the following requirements, using all conditions and materials indicated for the completed Work:
   1. Build mockups on-site in the location and of the size indicated or, if not indicated, as directed by Architect.
   2. Erect mockups 10’ by 10’ (3 m by 3 m) using materials indicated for final Work.
   3. Notify Architect 7 days in advance of dates and times when mockups will be constructed.
   4. Demonstrate the proposed range of aesthetic effects and workmanship.
   5. Obtain Architect's approval of mockups before beginning final installation of specialty metal ceilings.
   6. Retain and maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work. Approved mockups may be incorporated into the final installation.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings."

1.05 DELIVERY, STORAGE, AND HANDLING

A. All materials shall be delivered to the Project site in the original, labeled, unopened packages.

B. Materials shall be stored off of the floor level, flat and level, in a fully enclosed space.

C. Exercise care in handling to avoid damage.

1.06 PROJECT CONDITIONS

A. Do not install specialty metal 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.

1.07 COORDINATION

A. Coordinate layout and installation of specialty metal panels and suspension system components with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

1.08 WARRANTY

A. Installed suspension system and ceiling panels shall be warranted by Contractor to be free from rusting, sagging, warping, shrinking, buckling, or delaminating for a minimum of one year from date of Substantial Completion of the Project.

B. For sag-resistant panels, provide ceiling panel manufacturer's written warranty against sagging, warping, shrinking, buckling or delaminating as a result of manufacturing defects for a period of ten years from date of Substantial Completion of the Project.

C. Provide suspension manufacturer's written warranty against material defects for a period of fifteen years from date of Substantial Completion.
   1. Where suspension manufacturer and non-sag ceiling panel manufacturer are the same, provide combination warranty including protection from sagging, warping, shrinking, buckling or delaminating of ceiling panels as a result of manufacturing defects.

D. Provide suspension manufacturer's written warranty against the occurrence of 50% red rust on grid face for a period of thirty years from date of Substantial Completion.

1.09 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
   1. Specialty Metal Ceiling Units: Full-length units equal to 2.0 percent of quantity installed.
   2. Suspension System Components: Quantity of each exposed component equal to 2.0 percent of quantity installed.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers:
   1. CertainTeed Architectural, www.certainteed.com
   2. Hunter-Douglas Ceilings & Walls, www.hunterdouglasarchitectural.eu
   3. Reference Section 01 25 13-Product Substitutions.

2.02 LINEAR METAL BOX CEILING SYSTEM

A. Type: *Box Series Metal Ceiling System*, as manufactured by CertainTeed or approved equivalent by specified manufacturer.

B. Panels:
   1. Profile: Roll formed nominal 5-1/4" wide x 5/8" deep with x 3/4" reveal joints to form 6" module of one panel and one joint.

2. Length: One-piece lengths as indicated in the drawings.
3. Material:
   a. 0.025” formed aluminum with non-perforated face.
4. Joints: Open.
5. Finish: Factory finished.

C. Trim and Accessories:
1. Panel End Caps: Formed, stamped, or milled end caps in matching finish.
2. Splicing System: Manufacturer’s formed aluminum back-mounted inserts designed to snap-fit between ends of two ceiling panels.
   a. Provide cross joints only where length of installed panels exceeds manufacturer’s standard maximum panel lengths.
   b. Stagger cross joints uniformly a minimum of 12” between adjacent panels.
   c. Perimeter Edges: Where floating perimeters are indicated, provide 6” high clip on metal edge in finish matching ceiling panels.
   d. Acoustical Material: Not applicable.

D. System Performance:
1. Recycled Content: 75% - 100% content with 100% locally recyclable.

E. Linear Suspension System: Non-fire rated system.
1. Carrier: Universal hat-shaped 0.038" roll-formed aluminum section with hook-shaped tabs spaced to receive ceiling panels at 2" on-center and 27/32" apart. Support holes spaced 4" on-center. Factory-applied black enamel finish.
2. Wire-suspended at nominal 4 ft. intervals with not less than 12-ga. inch diameter zinc-coated steel wire screw-fastened or powder-actuated fastening system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for system with capability to sustain a load equal to 10 times that imposed by ceiling construction per ASTM E 1190.

2.03 PANEL FINISH

A. Factory powder coat in scheduled faux wood color/finish. Finish protected with strippable temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in appearance of abutting or adjacent pieces are not acceptable.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine overhead construction prior to beginning installation of specialty metal ceilings to ensure that all overhead work including finish painting of deck, structure, ducting, conduits, piping, etc. is completed.

B. Proceed with installation only after unsatisfactory conditions have been corrected. Beginning of specialty ceiling installation indicates acceptance of overhead work.

C. Verify layout of hangers will not interfere with other work.

3.02 INSTALLATION

A. General: Install linear metal ceilings in accordance with manufacturer's recommendations and requirements and to comply with the following:
   1. Standard for Ceiling Suspension System Installations: Comply with ASTM C 636.
   2. CISCA Recommendations for Acoustical Ceilings: Comply with CISCA's "Recommendations for Direct-Hung Acoustical Tile and Lay-in Panel Ceilings--Seismic Zones 0-2."

B. Install system capable of supporting imposed loads to deflection of 1/360 maximum.

C. Suspend ceiling hangers from building's structural members and as follows:
   1. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
   2. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system.
   3. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
   4. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the 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 referenced standards and publications.
   5. Secure hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for structure to which hangers are attached and for type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
   6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, powder-actuated fasteners, or drilled-in anchors that extend through forms into concrete.
   7. Do not attach hangers to steel deck tabs.
   8. Do not attach hangers to steel roof deck. Attach hangers to structural members.

D. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs.
   1. Fasten bracing wires into concrete with cast-in-place or post-installed anchors.
   2. Bracing wires shall be located as to not be visible from below ceiling.

E. Install suspension system carriers so they are aligned and securely interlocked with stabilzers and face panels. Remove and replace dented, deformed, or kinked members

F. Neatly cut finished panels for accurate fit at interruptions and penetrations through ceilings. Stiffen edges of cut units as required to eliminate evidence of buckling or variations in flatness exceeding referenced standards for stretcher-leveled metal sheet.

G. Install finished panels in coordination with suspension system and exposed moldings and trim.

1. Where finished length exceeds manufacturer’s maximum standard lengths, fit adjoining units to form flush, tight joints. Finished lengths less than manufacturer’s maximum lengths shall be one-piece without joints.
2. Install panels requiring butt joints using internal panel splices and in aligned configuration.
3. Install directionally patterned panels in directions indicated.
4. Install matching end caps at open ends of finished units.
5. Do not use exposed fasteners, including pop rivets, on moldings and trim.

3.03 CLEANING

A. Clean exposed surfaces of specialty metal ceilings, including visible support framing. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.

B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage, including dented and deformed units.

END OF SECTION

SECTION 09 61 50

CONCRETE FLOOR CLEAR FINISH

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Water-based clear finish for interior concrete floors to remain exposed.

B. Related Sections:
   1. Section 03 30 00 - Cast-In-Place Concrete: Concrete slab-on-grade surfaces and curing agents.
   2. Section 07 90 00 - Joint Protection: Sealants

1.02 REFERENCE STANDARDS

A. UL 410 - Standard for Slip Resistance of Floor Surface Materials; 2020.

1.03 SYSTEM DESCRIPTION

A. Applied Finish: Material to restrict moisture absorption and provide slip-resistant and abrasion-resistant finished appearance for interior concrete flooring indicated to remain exposed.

1.04 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit details of product description, tests performed, limitations to coating, and chemical properties including percentage of solids.

C. Samples: Of each substrate indicated to receive water repellent, 12 inches (304.8 mm) square, with specified repellent treatment applied to half of each sample.

D. Manufacturer's Installation Instructions: Submit special procedures and conditions requiring special attention, and cautionary procedures required during application.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements, including local requirements controlling the emission of VOCs.

1.05 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section for a minimum of three years.

B. Applicator: Company specializing in performing Work of this section with minimum three years' experience and approved by manufacturer for this application.

1.06 PRE-INSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Protect product from freezing.

1.08 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

B. Do not apply coating when ambient or surface temperature is lower than 40 degrees Fahrenheit (4.44 degrees Celsius) or higher than 100 degrees Fahrenheit (37.78 degrees Celsius).

1.09 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Furnish manufacturer's written warranty for sealer/finish for a minimum of two-years after Substantial Completion of Project.

PART 2 PRODUCTS

2.01 MANUFACTURERS:

A. Euclid Chemical Company; www.euclidchemical.com

B. Sika; sika.com

C. W.R. Meadows; www.wrmeadows.com

D. Substitutions: Section 01 60 00 - Product Requirements.

2.02 MATERIALS

A. Concrete Finish: Water-based clear and colorless high solids type sealer and finish that is VOC-compliant. Provides high slip-resistance dry or wet. Low odor.
   1. Basis-of-Design: *Selectseal Plus* as manufactured by Scofield.
   2. VOC Content: less than 100 g/L.
   3. Semi-Gloss or Gloss finish.
   4. High solids content; low odor.
   5. Certified wet-slip resistant per UL 410.
   6. Abrasion-resistant.
   7. Apply at interior concrete floors scheduled to remain exposed.

PART 3 EXECUTION

3.01 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify joint sealants are installed and cured.

C. Verify surfaces to be coated are dry, clean, and free of efflorescence, oil, or other matter detrimental to application of coating.

D. Obtain product information from Contractor for curing agent that was used on floors scheduled to receive a clear finish coat to ensure that the proposed finish coat is compatible.

3.02 PREPARATION

A. Test the surface of previously sealed concrete before applying finish to ensure it absorbs drops of water within 20-30 seconds.
   1. Surfaces not readily absorbing moisture will require mild acid-etching prior to finish application. AND
   2. Remove curing agents remaining on surface of affected slabs. Ensure compatibility of curing agent and any installed joint sealants with proposed clear finish product.

B. Delay Work until concrete substrate is cured minimum of 60 days, and all other trades have completed work in the affected areas.

C. Remove loose particles and foreign matter. Remove oil or foreign substances that may interfere with appearance or performance of sealer/finish. Remove drywall compound and paint drips by scraping.

D. Remove curing agents remaining on surface of affected slabs. Ensure compatibility of curing agent and any installed joint sealants with proposed clear finish product.

E. Scrub and rinse surfaces with water and let dry while restricting foot traffic. Vacuum dry surface just prior to application of sealer/finish.

F. Test for pH level of substrate before applying. Do not apply to substrates with pH level outside of manufacturer’s recommended limits.

G. Protect adjoining work, including sealant bond surfaces at joints. Mask-off wall bases and adjoining surfaces of aluminum and glass if there is the possibility of water repellent being deposited on surfaces.

H. Coordination with Sealants:
   1. Coordinate with finish manufacturer to determine whether sealer/finish should be applied prior to or after installation of any joint sealants in concrete slab. Sealant joints installed prior to application of sealer/finish shall be fully cured.
   2. Sealer/finish application may precede joint sealant installation only if sealant adhesion and compatibility have been tested and verified.

3.03 APPLICATION

A. Apply in accordance with manufacturer’s instructions.

B. Apply a saturation coating of clear sealer/finish on indicated surfaces using foam, microfiber, or lamb's wood applicators. Cover all surfaces to remain exposed.

C. Apply second coat in accordance with manufacturer's directions for drying and scuffing of first coat. Final coat shall be free of lap or brush marks.

3.04 PROTECTION OF INSTALLED CONSTRUCTION

A. Section 01 70 00 - Execution and Closeout Requirements: Protecting installed construction.

B. Immediately remove sealer/finish from adjacent surfaces by methods as instructed by coating manufacturer. Repair damage to surfaces not indicated to receive sealer/finish.

END OF SECTION

SECTION 09 65 00

RESILIENT FLOORING AND BASE

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
1. Solid vinyl tile flooring (luxury vinyl tile).
2. Rubber base: Provide and install rubber base where scheduled throughout the project, regardless of floor finish.
3. Rubber stair covering.

B. Related Sections
1. Section 05 51 00: Metal Stairs and nosings.
2. Section 09 65 69: Modular Resilient Athletic Flooring.

1.02 REFERENCES

A. ASTM International:
1. ASTM F1700 - Standard Specification for Solid Vinyl Floor Tile.
2. ASTM F1861 - Standard Specification for Resilient Wall Base.
3. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.

1.03 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit data describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.

C. Samples:
1. Submit manufacturer's complete set of color samples for initial selection.
2. Submit two full size samples of each tile and base item specified.

1.04 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

B. Operation and Maintenance Data: Submit maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

1.05 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years’ experience.

B. Installer: Company specializing in performing Work of this section with minimum three years' experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Store tiles on flat surfaces.

1.07 MANUFACTURER'S WARRANTY

A. Provide manufacturer's written warranty against defects in materials or workmanship for a period of 5-years after date of Substantial Completion of the Project. Warranted defects shall include but not necessarily be limited to:
   1. Shrinking, cracking, crazing, or delaminating of plies of material.
   2. Color fading.
   3. Off-gassing of material.
   4. Loss of resiliency.
   5. Delaminating of flooring from substrate.

1.08 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

B. Maintain temperature in storage area between 55 degrees Fahrenheit (12.78 degrees Celsius) and 90 degrees Fahrenheit (32.22 degrees Celsius).

C. Store materials for not less than 48 hours prior to installation in area of installation at temperature of 70 degrees Fahrenheit (21.11 degrees Celsius) to achieve temperature stability. Thereafter, maintain conditions above 55 degrees Fahrenheit (12.78 degrees Celsius).

1.09 EXTRA MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

B. Furnish one additional sealed carton of matching material for Owner's future use for each type, color, and pattern of flooring installed.

C. Furnish one gallon of each type of adhesive used to Owner.

PART 2 PRODUCTS

2.01 SOLID VINYL TILE FLOORING

A. Manufacturers:
   1. Armstrong Commercial Flooring; www.armstrong.com
   2. Mohawk Industries; www.mohawkflooring.com
   3. Mannington Commercial; www.mannington.com

4. Roppe Corporation; www.roppe.com
5. Shaw Contract; www.shawcontract.com
6. Tarkett; www.commercial.tarkett.com
7. Substitutions: Section 01 60 00 - Product Requirements.

B. Type: ASTM F1700, Class 3, Type B
1. Basis of Design: Solid luxury vinyl tile by as scheduled or approved equivalent by a specified manufacturer.
2. Size(s): As indicated.
3. Overall Thickness: Minimum 0.12 inch (3 mm).
4. Wear Layer: 28-mil thick with manufacturers protective coating.
5. Warranty: Minimum 20-years.
6. Colors/Patterns: As indicated.

2.02 RESILIENT BASE

A. Manufacturers:
1. Armstrong World Industries; www.armstrong.com
2. Mannington Commercial; www.mannington.com
3. Johnsonite; www.johnsonite.com
4. Marley Flexco; www.flexcofloors.com
5. Roppe Corporation; www.roppe.com
6. Substitutions: Section 01 60 00 - Product Requirements.

B. Rubber Base: ASTM F1861, rubber, Type TP:
1. Height: 4-inch.
2. Thickness: 1/8 inch (3.18 mm).
3. Finish: Smooth.
4. Length: Continuous rolls.
5. Style: Coved with top-set toe.

2.03 ACCESSORIES

A. Subfloor Filler: Self-leveling latex-modified cementitious type, ARDEX SD-F “Feather Finish” as manufactured by Ardex Engineered Cements.

B. Adhesives:
1. Flooring Adhesive: Waterproof type recommended by the flooring manufacturer. Maximum volatile organic compound content in accordance with SCAQMD Rule 1168.
2. Base Adhesive: Latex type as recommended by the rubber base manufacturer.
3. Use clear adhesive.

C. Moldings and Edge Strips: Extruded aluminum, one edge tapered, of height necessary to flush with tile thickness.

2.04 RUBBER STAIR COVERING

A. A. Manufacturers:

1. Armstrong; www.armstrong.com
2. Mannington Commercial (Burke Collection); www.burkeflooring.com
3. Flexco; www.flexcofloors.com
4. Johnsonite (Tarkett); commercial.tarkett.com
5. Roppe Corporation; www.roppe.com
6. VPI Flooring; www.vpicorp.com
7. Substitutions: Section 01 60 00 - Product Requirements.

B. Stair Treads: ASTM F2169 Type TS; full width and depth of stair tread in one piece; tapered thickness.
   1. Composition: Compression molded, high grade rubber with color throughout.
   2. Thickness: 0.20” inch.
   3. Nosing Style: Metal nosing provided under Section 05 51 00.
   4. Basis of Design: *Vantage* raised pattern as manufactured by Roppe or approved equivalent by specified manufacturer.
   5. Color: As selected.

C. Landings: Material, color and finish to match treads.

D. Stair Risers: Maintain height and length in one piece, matching treads in material and color with non-patterned surface:
   1. Thickness: 1/8 inch.

PART 3 EXECUTION

3.01 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify concrete floors are dry to maximum moisture content as recommended by manufacturer, and exhibit negative alkalinity, carbonization, and dusting. Maximum allowable amount of moisture emission from substrate is 3.0 pounds per 1,000 sq feet (1.07643 sq cm) in 24-hour period and shall not exceed 85% or the maximum allowable moisture content as recommended or allowed by flooring manufacturer.
   1. Perform deep-probe moisture meter testing per ASTM F2170 for each area receiving the specified floor finish.
   2. Perform number of tests recommended by the flooring system manufacturer per each floor area, but no less than one test per each 1,000 sq. ft.
   3. Provide written test results to the Architect, along with flooring manufacturer’s recommended maximum moisture values.

C. Verify floor surfaces are free of substances capable of impairing adhesion of new adhesive and finish materials.

D. Starting installation of flooring indicates installer’s acceptance of flooring substrate conditions.

E. Verify new concrete substrates are dry to maximum moisture content as recommended by manufacturer, and exhibit negative alkalinity, carbonization, and dusting. Maximum allowable amount of moisture emission from substrate is 3.0 pounds per 1,000 sq feet (1.07643 sq cm) in

24-hour period and shall not exceed maximum allowable moisture content as recommended or allowed by flooring manufacturer.

F. Verify floor and lower wall surfaces are free of substances capable of impairing adhesion of new adhesive and finish materials.

G. Starting installation of flooring indicates installer’s acceptance of flooring substrate conditions.

3.02 PREPARATION

A. At existing floors, remove flooring and shot-blast exposed concrete slab to clean white finish with slight texture for proper adhesion.

B. Remove sub-floor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with sub-floor filler to achieve smooth, flat, hard surface.

C. Prohibit traffic until filler is cured.

D. Clean substrate.

E. Apply flooring manufacturer’s recommended primer as required to prevent "bleed-thru" or interference with adhesion by substances that cannot be removed.

3.03 INSTALLATION - TILE FLOORING

A. Mix tile from container to ensure shade variations are consistent when tile is placed.

B. Lay flooring with joints and seams butted tight and parallel to building lines to produce symmetrical tile pattern.

C. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

D. Where floor finishes are different on opposite sides of door, terminate flooring under centerline of door.

E. Install edge strips at unprotected or exposed edges, where flooring terminates, and where flooring materials change.

F. Install flooring in recessed floor access covers designed for finish material installation. Maintain floor pattern.

G. At movable partitions, install flooring under partitions without interrupting floor pattern.

H. Extend flooring into knee recesses under casework and other recesses.

I. Install under all permanently installed casework.

3.04 INSTALLATION - BASE

A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches (457.2 mm) between joints.

B. Use factory-preformed exterior corners, and factory preformed or job-mitered interior corners. Do not wrap exterior corners without express approval of the Architect.

C. Install base on solid backing. Bond tightly to wall and floor surfaces.

D. Scribe and fit to door frames and other interruptions.

E. Install base at cabinets, shelving, and other fixed equipment and permanently installed casework.

3.05 INSTALLATION - RUBBER STAIR COVERING

A. Install stair coverings in accordance with manufacturer's written instructions using recommended adhesives, primers, and sealers.

B. Use flooring manufacturer's recommended stair nosing adhesive (typically epoxy) for all tread nosings. Use recommended contact or pressure-sensitive adhesive for treads, risers, and landings as appropriate for the substrate.

C. Install landing tile first, running parallel to the top stair nosing. Center tile on landings to ensure cut tiles at walls are of equal and maximum possible size.

D. Install risers before treads. Install risers in one-piece lengths. Apply adhesive and fit riser tight against the underside of the tread or nosing above.

E. Install treads after risers. Install treads in one-piece, full-width lengths. Apply adhesive and press tread firmly onto the substrate and against the riser.

F. At treads specified with a separate metal nosing, scribe and fit rubber tread to butt tight, level, and flush against the back edge of the metal nosing.

G. Roll all treads, risers, and landings with a 100 lb. roller, followed by hand-rolling all nosings, joints, and coves to ensure full adhesion.

3.06 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Remove excess adhesive from floor, base, and wall surfaces without damage.

C. Clean, seal, and maintain resilient flooring products.

3.07 PROTECTION OF INSTALLED CONSTRUCTION

A. Section 01 70 00 - Execution and Closeout Requirements: Protecting installed construction.

B. Prohibit traffic on resilient flooring for 48 hours after installation.

C. Do not slide furnishings, equipment, or other 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. Remove and replace damaged tiles.

END OF SECTION

SECTION 09 65 66

RESILIENT ATHLETIC FLOORING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Resilient exercise sheet flooring, adhesively applied with heat-welded seams. Installed at Gym and Dance as scheduled.
   2. Field applied game court layout lines as indicated.

B. Related Sections:
   1. Section 03 30 00 - Cast-In-Place Concrete: Concrete leveling infill.
   2. Section 09 65 00 - Resilient Flooring and Base: 4-inch rubber coved base.

1.02 REFERENCES

A. ASTM International:
   1. ASTM-F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.

1.03 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit data describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.

C. Samples:
   1. Submit manufacturer's complete set of color samples for initial selection.
   2. Submit two 12-in x 12-in samples of each color/pattern specified.

1.04 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

B. Operation and Maintenance Data: Submit maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

1.05 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years’ experience.

B. Installer: Company specializing in performing Work of this section with minimum three years’ experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Unroll sheet material and allow to relax in environmentally controlled room for 24 hours prior to installation.

C. Maintain temperature in storage area between 55 degrees F and 90 degrees F.

D. Store materials for not less than 48 hours prior to installation in area of installation at temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

1.07 WARRANTY

A. Provide manufacturer's written material warranty against material defects and failures due to surface wear-through and moisture vapor intolerance.
   1. Warranty Period: Minimum 15-years after Project Substantial Completion.

B. Provide installer's written warranty against defects in installation and workmanship.
   1. Warranty Period: Minimum 2-years after Project Substantial Completion.

1.08 EXTRA MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

B. Furnish additional 5% of packaged material for Owner's future use for each type, color, and pattern of flooring installed.

PART 2 PRODUCTS

2.01 RUBBER FLOORING

A. Manufacturers:
   1. Tarkett Sports; www.tarkettsportsindoor.com
   2. Substitutions: Section 01 60 00 - Product Requirements.

B. Rubber Athletic Sheet Flooring: 100-percent recycled high-density rubber flooring.
   1. Basis of Design: *Tarkett Ominisports.*
   2. Color/texture as scheduled.
   3. Construction: Embossed, homogeneous product of vulcanized natural and synthetic rubbers with mineral aggregates, stabilizing agents, and pigmentation.
      a. Surface: Printed faux wood design coated with clear PVC and UV cured urethane treatment.
      b. Foam force reduction layer: High density closed cell PVC foam with honeycomb embossing.
      c. Intermediate Layers: Reinforced with a non-woven fiberglass grid for dimensional stability.
      d. Total Thickness: Layers vulcanized to form 0.27" (7.1 mm) overall thick sheet.

e. Antimicrobial treatment.

4. Recyclability:
   a. Made from 30% recycled content and 100% manufacturing waste recycled.
   b. FloorScore certified.
5. Wear Layer: Type 1 – Grade 1 per ASTM F1303/F410.
6. Impact Resistance: Passes EN 1717.
7. Ball Rebound: >90% per ASTM F2772.
8. Fire Rating: Class I per ASTM E648.
9. Roll Width: 6’-6”.

2.02 ACCESSORIES

A. Primers and Adhesives: Waterproof; types approved by flooring manufacturer.

B. Seam Welding Rods: Matching color and compatible material provided by flooring manufacturer.

C. Game-Line and Marker Paint: Enamel or other approved product, compatible with flooring and recommended by flooring and paint manufacturers for use indicated.
   1. Colors: As indicated, or if not indicated, as selected by Architect from manufacturer’s full range of line colors

D. Transition Strips: Beveled strips that transition smoothly from the surface of rubber athletic flooring to the adjacent flooring.

E. Rubber Base: Coved, 4-inch high as specified in Section 09 65 00.

PART 3 EXECUTION

3.01 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Perform in-situ relative humidity testing (ASTM F2170) to determine moisture condition of concrete subfloor.

C. Verify concrete subfloors are dry to maximum moisture content as recommended by manufacturer, and exhibit negative alkalinity, carbonization, and dusting. Maximum allowable amount of moisture emission from substrate is 3.0 pounds per 1,000 square feet in 24-hour period and shall not exceed 85% or the maximum allowable moisture content as recommended or allowed by flooring manufacturer.
   1. Perform deep-probe moisture meter testing per ASTM-F2170 for each area receiving the specified floor finish.
   2. Perform number of tests recommended by the flooring system manufacturer per each floor area, but no less than one test per each 1,000 sq. ft.
   3. Provide written test results to the Architect, along with flooring manufacturer’s recommended maximum moisture values.

D. Verify substrate surfaces are free of substances capable of impairing adhesion of new adhesive and finish materials.

E. Ambient temperature of installation area shall be maintained at 65-degrees F or greater.

F. Starting installation of flooring indicates installer’s acceptance of flooring substrate conditions.

3.02 PREPARATION

A. Remove coatings, including curing compounds and other substances that are incompatible with flooring adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.

B. Remove sub-floor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with sub-floor filler to achieve smooth, flat, hard surface.

C. Prohibit traffic until filler is cured.

D. Clean and vacuum substrate thoroughly.

E. Apply primer as required to prevent "bleed-thru" or interference with adhesion by substances that cannot be removed.

3.03 INSTALLATION

A. Lay flooring with joints and seams parallel to building lines. Provide wall-to-wall lengths where possible to avoid end seams. Gap seams uniformly for flush application of matching filler using heat-welded rods. Stagger end seams nominal 24”.

B. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints

C. Where floor finishes are different on opposite sides of door, terminate flooring under centerline of door.

D. Adhere products to substrates using a full spread of adhesive applied to substrate to comply with adhesive and flooring manufacturers' written instructions, including those for trowel notching, adhesive mixing, and adhesive open and working times.
   1. Roll flooring for maximum adhesion and flatness using minimum 50 lb. roller.
   2. Provide completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

E. Install manufacturer’s pre-formed transition strips at exposed edges where flooring does not abut vertical surfaces.

F. Mask flooring at game lines and markers and apply paint to produce sharp edges and opaque coverage.

G. At movable partitions, install flooring under partitions without interrupting floor pattern.

H. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

I. Reference Section 09 65 00 for installation requirements of rubber base.

J. Remove excess adhesive from floor, base, and wall surfaces without damage.

K. Clean and maintain resilient flooring products.

3.04 PROTECTION OF INSTALLED CONSTRUCTION

A. Section 01 70 00 - Execution and Closeout Requirements: Protecting installed construction.

B. Protect flooring against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods indicated or recommended in writing by flooring manufacturer.

C. Do not move heavy or 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.

D. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION

SECTION 09 68 13

TILE CARPETING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Carpet tile, fully adhered.

B. Fully-adhered modular carpet as scheduled and specified.

1.02 REFERENCE STANDARDS

A. Consumer Products Safety Commission: CPSC 16 CFR 1630 - Standard for the Surface Flammability of Carpets and Rugs.

B. NFPA 253 - Standard Method of Test for Critical Radiant Flux for Floor Covering Systems Using a Radiant Heat Energy Source.

C. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.

D. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.

C. Shop Drawings: Indicate layout of joints, direction of carpet pile, and location of edge moldings, type of subfloor, type of installation, pattern of installation, patterns and colors, location, and direction..

D. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected. Label each sample with manufacturer's name, material description, color, pattern, and designation indicated on the Drawings and in schedules.

E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

F. Operation and Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, and Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products, for additional provisions.
   2. Extra Carpet Tiles: Quantity equal to 2 percent of total installed of each color and pattern installed. Confirm quantity with Architect and Owner during construction.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet tile with minimum three years documented experience.

B. Installer Qualifications: Company specializing in installing carpet tile with minimum three years documented experience and approved by carpet tile manufacturer.
   1. FCIB or IFCI certified carpet installers or demonstrate compliance with certification program requirements.

C. Surface Burning Characteristics:
   1. Floor Finishes: Comply with one of the following:
      a. Class I, minimum 0.45 watts/sq cm when tested in accordance with NFPA 253.
      b. CPSC 16 CFR 1630.

1.05 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience.

B. Installer: Company specializing in performing work of this section and is approved by manufacturer.
   1. FCIB or IFCI certified carpet installers or demonstrate compliance with certifiction program requirements.

1.06 PRE-INSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.07 ENVIRONMENTAL REQUIREME

A. Section 01 60 00 - Product Requirements.

B. Store materials in area of installation for 48 hours prior to installati

C. Do not install carpet until wet work in spaces is complete and dry, and ambient temperatire and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

D. Do not install carpet over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet manufacturer.

1.08 MOCKUPS

A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
   1. Build mockups at locations and in sizes shown on Drawings, or, if not shown, as directed by the Architect.

1.09 FIELD CONDITIONS

A. Section 01 60 00 - Product Requirements.

B. Store materials in area of installation for minimum period of 48 hours prior to installation.

C. Do not install carpet until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project.

D. Do not install carpet over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Tile Carpeting:
   1. Tarkett; https://www.tarkettna.com/
   2. Substitutions: None.

2.02 MATERIALS

A. Tile Carpeting: Tufted, manufactured in one color dye lot.
   1. Selection: Selected pattern(s) and color(s) as indicated on Material/Finish Schedule.
   2. Format type: Modular, size(s) as indicated on Material/Finish Schedule.
   3. Pile Construction: Patterned loop pile
   4. Dye Method: Solution Dyed.
   5. Stain Repel and Soil Release: Manuifactrer's Eco-Ensure (Fluorine-Free Soil Protection) treatment.
   6. Backing: Manufacturer's synthetic non-woven, Flex-Aire Modular Cushion backing with Manufacture's RS Adhesive "peel and stick" self-adhesion.

B. Manufacturer's Warranties:
   1. Lifetime antimicrobial protection.
   2. Lifetime anti-stain protection.
   3. Lifetime edge ravel protection.
   4. Lifetime face fiber wear.
   5. Lifetime antistatic.
   6. Lifetime cushion delamination and resiliency.

C. ADA Compliance: Less than 0.6 static coefficient of friction.

2.03 ACCESSORIES

A. Subfloor Filler: White premix latex; type recommended by flooring material manufacturer.

B. Subfloor Primer: Compatible with carpet material and recommended by carpet manufacturer.

C. Edge Strips: Embossed aluminum, color as selected by Architect.

1. Extruded aluminum with mill finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

D. Adhesives:

E. Carpet Tile Adhesive: Recommended by carpet tile manufacturer; Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requiremnets for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive carpet tile.

B. Cementitious Subfloor Surfaces: Verify that substrates are ready for flooring installation by testing for moisture and alkalinity (pH).
   1. Test as Follows:
      a. Alkalinity (pH): ASTM F710.
         1) Verify that concrete slabs comply with ASTM F710 and the following
            (a) Slab 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 bond and moisture tests recommended by the carpet manufacturer.
            (b) Arrange for the Owner's independent testing laboratory to perform calcium-chloride testing or deep-probe moisture meter testing per ASTM-F2170 for new and existing substrates for each area receiving the specified floor finish. Provide written test results to the Architect.
            (c) Subfloor finishes comply with requiremnets specified in Section 03 30 00 for slabs receiving carpet
            (d) Subfloors are free of cracks, ridges, depressions, scale and foreign deposits.
      b. Internal Relative Humidity: ASTM F2170.
   2. Verify subfloor finishes comply with requirements specified in Section 03 30 00 for slabs receiving carpet.
   3. Verify subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
   4. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.

C. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

A. Remove existing carpet tile.

B. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

C. Remove subfloor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with subfloor filler.

D. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider, and protrusions more than 1/32 inch (0.8 mm) unless more stringent requirements are required by manufacturer's written instructions.

E. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.

F. Metal Substrates: Clean grease, oil, soil and rust, and prime if recommended in writing by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.

G. Broom and vacuum clean substrate immeditaly before installing carpet tile. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.03 INSTALLATION

A. Comply with the Carpet and Rug Institute's CRI 104, Section 10, "Carpet Tile," and with carpet tile manufacturer's written installation instructions.

B. Starting installation constitutes acceptance of subfloor conditions.

C. Apply primer as recommended by manufacturer.

D. Install carpet tile in accordance with manufacturer's instructions.

E. Maintain dye-lot integrity. Do not mix dye lots in same area.

F. Blend carpet from different cartons to ensure minimal variation in color match.
   1. Do not mix carpet from different cartons unless from same dye lot.

G. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.

H. Lay carpet tile in square pattern, with pile direction parallel to next unit, set parallel to building lines.

I. Locate change of color or pattern between rooms under door centerline.

J. Adhere carpet tiles using manufacturer’s trowel-applied waterborne adhesive.

K. Trim carpet tile neatly at walls and around interruptions.

L. Complete installation of edge strips, concealing exposed edges.

M. Roll tiles with 100 lb. roller for complete contact of carpet backing to floor.

N. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

O. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

3.04 CLEANING

A. See Section 01 70 00 - Execution and Closeout Requirements for additional requirements.

B. Remove excess adhesive without damage, from floor, base, and wall surfaces.

C. Replace any damaged or stained carpet that cannot be cleaned.

D. Thoroughly clean and vacuum carpet surfaces.

E. Arrange for carpet manufacturer’s local area representative to inspect the completed installation and provide written report to Architect indicating any deviations from the project specifications.

END OF SECTION

SECTION 09 68 16

SHEET CARPETING

GENERAL

1.01 SUMMARY

A. Section includes fully-adhered broadloom and walk-off carpet as scheduled and specified.

B. Related Sections:
1. Section 03 30 00 - Cast-In-Place Concrete: Subfloor at carpeted areas.
2. Section 09 65 00 - Resilient Flooring and Base: Rubber base at carpeted areas.
3. Section 09 68 16 – Tile Carpeting.

1.02 REFERENCES

A. Consumer Products Safety Commission:
1. CPSC 16 CFR 1630 - Standard for the Surface Flammability of Carpets and Rugs.

B. National Fire Protection Association:
1. NFPA 253 - Standard Method of Test for Critical Radiant Flux for Floor Covering Systems Using a Radiant Heat Energy Source.

1.03 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate layout of joints, direction of carpet pile, patterns and colors, and location of edge moldings.

C. Product Data: Submit data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.

D. Samples:
1. Submit two carpet tiles illustrating color and pattern design for each type and color of carpet selected.
2. Submit two 12 inch long samples of transition edge strip and accessories.

E. Manufacturer's Installation Instructions: Submit special procedures and perimeter conditions requiring special attention.

1.04 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

B. Operation and Maintenance Data: Submit maintenance procedures, including:
1. Methods for maintaining carpet, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet.

1.05 QUALITY ASSURANCE

A. Surface Burning Characteristics:
   1. Floor Finishes: Comply with one of the following:
      a. Class I, minimum 0.45 watts/sq cm when tested in accordance with NFPA 253.
      b. CPSC 16 CFR 1630.

1.06 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience.

B. Installer: Company specializing in performing work of this section and is approved by manufacturer.
   1. FCIB or IFCI certified carpet installers or demonstrate compliance with certification program requirements.

1.07 PRE-INSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.08 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

B. Store materials in area of installation for 48 hours prior to installation.

C. Do not install carpet until 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.

D. Do not install carpet over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet manufacturer.

1.09 EXTRA MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

B. Furnish additional 10% of each installed material type/color installed to Owner. Obtain receipt.

PRODUCTS

2.01 MANUFACTURERS

A. Tarkett Johnsonite Floor Covering, www.commerical.tarkett.com

B. Substitutions: None.

2.02 COMPONENTS

A. Roll Carpet: 100 percent nylon, tufted textured loop on synthetic cushion backing.
   1. Basis of design: Patterns and colors as scheduled; manufactured by Tarkett.
   2. Construction: Tufted.
   3. Primary Backing: Synthetic Non-Woven.
   4. Secondary Backing: Powerbond Cushion RS cushion backing with manufacture's Peel & Stick installation.
   5. Face Weight: 20 oz. per S.Y
   6. Finished Pile Height: 0.080".
   7. Fiber System: Dynex® Nylon.
   8. Dye Method: Solution dyed/yarn dyed.
   9. Stain Repel and Soil Release: Manufacturer's Eco-Ensure (Fluorine-Free Soil Protection) treatment.
   10. Flammability: Class I per ASTM E662.

B. Entry Mat Carpet (walk-off carpet): 100% TDX® Nylon.
   1. Basis of Design: Assertive Action 100% recyclable as manufactured by Tandus.
   2. Roll Width: 6 feet or wider.
   3. Primary Backing: Non-woven synthetic fiber.
   4. Construction Type: Symtex®.
   5. Dye Method: 100% Solution Dyed.
   6. Soil/Stain Protection: Eco-Ensure.
   7. Gauge: 1/10.
   8. Color(s) as indicated in the Color/Finish Schedule.
   9. Warranty: Lifetime stain-resistance and 20-year wear warranty.
      a. Manufacturer's Warranties:
   10. Lifetime antimicrobial protection.
   11. Lifetime anti-stain protection.
   12. Lifetime edge ravel protection.
   13. Lifetime face fiber wear.
   14. Lifetime antistatic.
   15. Lifetime cushion delamination and resiliency.

2.03 ACCESSORIES

A. Subfloor Filler: Self-leveling latex-modified cementitious type, ARDEX SD-F "Feather Finish" as manufactured by Ardex Engineered Cements.

B. Subfloor Primer: Compatible with carpet material and recommended by carpet manufacturer.

C. Moldings and Edge Strips: Extruded aluminum, clear anodized; height as required to protect carpet edge.

EXECUTION

3.01 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify floor surfaces are smooth and flat within tolerances specified in Section 03 30 00 and are ready to receive work.

C. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
   1. Slab 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 bond and moisture tests recommended by the carpet manufacturer.
   2. Arrange for the Owner's independent testing laboratory to perform calcium-chloride testing or deep-probe moisture meter testing per ASTM-F2170 for new and existing substrates for each area receiving the specified floor finish. Provide written test results to the Architect.
   3. Subfloor finishes comply with requirements specified in Section 03 30 00 for slabs receiving carpet.
   4. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

3.02 PREPARATION

A. Remove coatings, including curing compounds and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by the carpet manufacturer.

B. Remove sub-floor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with trowel-applied sub-floor filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured

C. Clean subfloor and apply flooring manufacturer's recommended primer as required to prevent "bleed-thru" or interference with adhesion by substances that cannot be removed.

D. Broom and vacuum clean primed subfloor immediately prior to installing carpet. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.03 SHEET CARPET INSTALLATION

A. Primer: Apply primer to concrete substrate as recommended by manufacturer.

B. Carpet:
   1. Verify carpet match before cutting to ensure minimal variation between dye lots.
   2. Adhere carpet using manufacturer's peel and stick self-adhesive backing.
   3. Lay out carpet and locate seams in accordance with CRI 104 section 7.2:
      a. Locate seams in area of least traffic, out of areas of pivoting traffic, and parallel to main traffic.
      b. Do not locate seams perpendicular through door openings.
      c. Align run of pile in same direction as anticipated traffic and in same direction on adjacent pieces.

d. Locate change of color or pattern between rooms under door centerline.
e. Provide monolithic color, pattern, and texture match within each contiguous area.

4. Install carpet tight and flat on subfloor. Trim carpet neatly at walls and around interruptions.
5. Double cut carpet seams.
   a. Make cuts straight, true, and unfrayed.
      1) Apply a bead of carpet manufacturer's seam sealer to carpet edges at proper height to seal all edges. Thoroughly clean all seams. Ensure that seams are seam straight, not overlapped or peaked, and free of gaps.
      2) Roll with 100 lb. roller for complete contact of carpet backing to floor and with uniform appearance.
6. Complete installation of edge strips, concealing exposed edges.

3.04 WALKOFF CARPET INSTALLATION

A. Primer: Apply primer to concrete substrate as recommended by manufacturer.

B. Carpet:
1. Do not mix carpet from different cartons unless from same dye lot.
2. Cut carpet cleanly, fitting tight to intersection with vertical surfaces without gaps.
3. Adhere carpet using cold-applied latex adhesive, applied with manjrecommended notched trowel.
4. Trim carpet tile neatly at walls and around interruptions.
5. Roll installed carpet with 100 lb. roller for complete contact of carpet backing to floor.
6. Complete installation of edge strips, concealing exposed edges.

3.05 CLEANING AND MANUFACTURER'S INSPECTION

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Remove excess adhesive or seam sealant from floor, base, and wall surfaces without damage.

C. Replace any damaged or stained carpet that cannot be cleaned to the satisfaction of the Architect.

D. Thoroughly clean and vacuum all carpet surfaces.

E. Arrange for carpet manufacturer's local area representative to inspect the completed installation and provide written report to Architect indicating any deviations from the project specifications.

END OF SECTION

SECTION 09 72 00

WALL COVERINGS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Synthetic fabric wall covering as scheduled.

B. Related Sections:
   1. Section 09 21 16 - Gypsum Board Assemblies: Wall substrate.

1.02 REFERENCES

A. ASTM International:
   1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

B. National Fire Protection Association:
   1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.
   2. NFPA 265 - Standard Methods of Fire Tests for Evaluating Room Fire Growth Contribution of Textile Coverings on Full Height Panels and Walls.

C. Underwriters Laboratories Inc.:
   1. UL 723 - Tests for Surface Burning Characteristics of Building Materials.

1.03 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit data on covering and adhesive.

C. Shop Drawings: Indicate wall elevations with seaming layout.

D. Samples: Submit two samples of each selected wall covering, 12x12 inch in size illustrating color, finish, and texture.

E. Manufacturer's Installation Instructions: Submit special installation procedures and perimeter conditions requiring special attention.

1.04 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

B. Operation and Maintenance Data: Submit data on cleaning, touch-up, and repair of covered surfaces.

1.05 QUALITY ASSURANCE

A. Surface Burning Characteristics:
   1. Comply with one or both of the following:
      a. Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.
      b. Comply with requirements of applicable code when tested in accordance with NFPA 265 Method A or Method B test protocols.
         1) City of Houston: Approved for vertical wall applications per the City of Houston.

1.06 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience.

B. Installer: Company specializing in performing work of this section and approved by manufacturer.

1.07 MOCK-UP

A. Section 01 40 00 - Quality Requirements: Mock-up requirements.

B. Install full-size mock-up of each type of wall covering specified in location designated by Architect; include substrate preparation, trim and accessories, and seaming.
   1. Approved mock-up will be used as standard of quality to evaluate remainder of work.

C. Approved mock-up may be incorporated into the work.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Deliver materials to site in unbroken and undamaged original factory wrappings, clearly labeled with the manufacturer's identification label, quality or grade, and lot number.

C. Inspect roll materials on site to verify acceptance.

D. Protect packaged adhesive from temperature cycling and cold temperatures.

E. Store material in a flat position; do not store roll goods on end; do not cross stack material; support material off the floor in a manner to prevent sagging and warping.

1.09 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

B. Do not apply materials when surface and ambient temperatures are outside temperature ranges required by adhesive or wall covering product manufacturer.

C. Maintain these conditions 24 hours before, during, and after installation of adhesive and covering.

D. Provide lighting level of 80 ft candles measured mid-height at substrate surfaces.

PART 2 PRODUCTS

2.01 WALL COVERINGS

A. Vinyl Sheet.
   1. Basis of Design: Color/Pattern as scheduled, and as manufactured by MDC, www.mdcwall.com
   2. Type: Type ll commercial grade white color, smooth, matte-faced vinyl on poly-cotton osnaburg backing.
   3. Color/Pattern: As indicated on the Material Schedule.
   4. Product Weight: 20-oz. per square yard.
   5. Width: 52/54”
   6. Additives:
      a. Mildew inhibitors to pass ASTM G21
      b. Factory-applied Teflon film.
   7. Fire Rating: Class A with Flame Spread of 10 and Smoke Developed 40.

2.02 ACCESSORIES

A. Adhesive: Use only type recommended by wall covering manufacturer. Adhesive shall be rated mildew resistant by the manufacturer.

B. Release Coat: Provide sealer or undercoat for new gypsum wallboard substrates as recommended by wallcovering manufacturer.

C. Substrate Filler: As recommended by adhesive and wall covering manufacturers; compatible with substrate.

D. Substrate Primer and Sealer: Type recommended by wall covering manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify substrate surfaces are ready to receive work and conform to requirements of covering manufacturer.
   1. Gypsum board shall be finished to Standard Level 4 finish or better in accordance with Section 09 21 16.

C. Measure moisture content of surfaces using electronic moisture meter. Do not apply coverings unless moisture content of surfaces is below the following maximums:
   1. Plaster and Gypsum Wallboard: 5-percent.
   2. Masonry, Concrete, and Concrete Unit Masonry: 12-percent.
   3. Wood Surfaces: 15-percent, measured in accordance with ASTM D4442.

D. Verify flatness tolerance of surfaces does not vary more than 1/8 inch (3.18 mm) in 10 feet (304.8 cm) nor vary at rate greater than 1/16 inch (1.59 mm)/ft.

E. Verify substrate surfaces are clean, dry, smooth, structurally sound and free from surface defects and imperfections that would show through the finished surface.

F. Evaluate all marked, stained, or painted surfaces for the possibility of pigment bleed-through.

G. Beginning wall covering installation indicates acceptance of substrates and conditions.

3.02 PREPARATION

A. Prepare surfaces in accordance with manufacturer's instructions.

B. Fill cracks in substrate and smooth irregularities with filler; sand smooth.

C. Wash impervious surfaces with tetra-sodium phosphate, rinse and neutralize; wipe dry.

D. Surface Appurtenances: Remove electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.

E. Surfaces: Correct defects and clean surfaces which affect work of this section. Remove existing coatings that exhibit loose surface defects.

F. Marks: Seal with shellac those which may bleed through surface finishes.

G. Apply primer sealer to substrate surfaces as required, in accordance with manufacturer's instructions. Allow to dry. Lightly sand smooth.

H. Vacuum clean surfaces free of loose particles.

I. Store unpackaged wall covering in environmentally controlled areas of installation a minimum of 24 hours before applying to finish surfaces.

J. Inspect and confirm product for uniform color, texture and quality.

3.03 INSTALLATION

A. Install wallcovering with long dimension vertical. Lay out accurately between corners, jambs, walls, or other interruptions to equalize spacing of joints.
   1. Do not locate joints at or within 2" of inside corners or within 6" of outside corners.
   2. Install seams vertically and plumb. Horizontal seams are not acceptable.

B. Use covering in roll number sequence. Change run numbers at partition breaks and corners only.

C. Razor trim edges on flat worktable, changing blade often to prevent rough cut edges. Do not razor cut on gypsum board surfaces.

D. Wall coverings shall be fully adhered to substrates using manufacturer's recommended adhesive capable of permanently supporting the weight of the wallcovering material to the particular substrate. Apply adhesive uniformly to back of wallcovering. Install wallcovering with full substrate bond, smooth, clean without wrinkles, gaps, or overlaps. Eliminate air pockets and ensure full bond to substrate surface.

E. Place wallcovering panels consecutively in the same order as cut from rolls. Install rolls in consecutive order as numbered by the manufacturer.
   1. Trim selvages as required to assure color uniformity and pattern match at seams.
   2. Patterns shall come from same lot.
      a. Overlap and double-cut seams through overlapped edges, lifting and removing underlayer after cutting. Lay down seams butted tightly together smoothly and apply hand roller to flatten and smooth. Cut wallcovering neatly to all penetrations.

F. Remove excess adhesive while wet from seam before proceeding to next covering panel. Wipe clean with dry cloth.

G. Trim wall covering 3/4” below top of resilient base.

3.04 CLEANING

A. Reference Section 01 70 00 - Execution and Closeout Requirements: Final cleaning

B. Clean wallcovering of all adhesive, dirt, stains, or marks. Reinstall wall plates and any other removed accessories.

C. Clean coverings of excess adhesive, dust, dirt, and other contaminants.

D. Reinstall wall plates and accessories removed prior to work of this section.

E. Package and deliver to the Owner any partial or full rolls or usable scrap material.

END OF SECTION

SECTION 09 77 00

FRP WALL PANELS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2022.

1.02 SUMMARY

A. Section Includes: FRP pre-laminated wall panels.

1.03 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Include physical characteristics, installation methods for each different type of substrate, and maximum permissible moisture content of substrates.

C. Shop Drawings: Show location and extent of wall panels, panel terminations, installation details, and elevations showing nonstandard conditions.

D. Samples for Initial Selection: For initial selection of color, pattern and surface texture, provide the manufacturer's standard color chips consisting of actual sections of each FRP wall panel and vinyl plastic material required showing the full range of materials, colors, and textures available.

E. Samples for Verification: Provide the following samples for verification of compliance with requirements indicated. Prepare samples from the same material to be used in the Work.
   1. 6 inch (152.4 mm) by 6 inch square samples of each wall panel material required for verification of color, pattern, and texture selected.
   2. 12 inch (304.8 mm) long sample of each molding accessory.

F. Product Test Reports: From a qualified independent testing laboratory showing compliance of FRP wall panel materials with requirements indicated based on tests performed by the laboratory within the past five years.

G. Maintenance data for FRP wall panel material components for inclusion in the operating and maintenance manuals specified in Division 1.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has previously installed FRP wall panel materials similar in design and extent to the materials required on this Project.

B. Fire Performance Characteristics: Provide FRP wall panels that are identical to those tested in accordance with ASTM E84 for the fire performance characteristics indicated below. Identify wall panel materials with appropriate markings from the testing and inspection organization.

1. Flame Spread: 25 or less.
2. Smoke Developed: 450 or less.

C. Single Source Responsibility: Obtain each color, texture, grade, finish, and type of FRP wall panel material from a single source with resources to provided products of consistent quality in appearance and physical properties without delaying progress of the Work.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to Project site in original factory wrappings, clearly labeled with identification of manufacturer, brand name, lot number, quality or grade, and fire hazard classification.

B. Store materials inside in original undamaged packages in a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity. Do not store rolled goods upright; lay flat, blocked off the ground to prevent sagging and warping.
1. Maintain room temperature within the storage area at not less than 70 degrees Fahrenheit (21.11 degrees Celsius) during the period FRP wall panel and accessory materials are stored. Keep material out of direct sunlight to avoid surface distortion.

1.06 PROJECT CONDITIONS

A. Environmental Conditions: Do not install FRP wall panel material until the space to receive the wall panel material is enclosed and weatherproof. Do not install materials until the ambient temperature within the building is maintained and stabilized at not less than 70 degrees Fahrenheit (21.11 degrees Celsius) for not less than 72 hours prior to beginning of the installation.

1.07 SEQUENCING AND SCHEDULING

A. Schedule installation with other construction activities to minimize the possibility of damage and soiling during the remainder of the construction period.

1.08 MAINTENANCE

A. Maintenance Instructions: Provide the manufacturer's instructions for maintenance of installed work. Include recommended methods and frequency for maintaining materials in optimum condition under anticipated traffic and use conditions. Include precautions against cleaning materials and methods that may be detrimental to finishes and performance.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Products:
1. Fire-X Glasbord, Kemlite Company, www.kemlite.com.
2. Substitutions: 01 16 00 - Product Requirements.

2.02 FRP WALL PANELS

A. Wall Panels: Provide manufacturer's standard FRP wall panels. Panels shall consist of 0.09 inch (2.29 mm) thick, textured, USDA approved panel.

B. Sheet Size: Typically 4 X 9 feet (274.32 cm).

C. Colors and Textures of Plastic Material: Provide plastic material that matches color and texture indicated by reference to the manufacturer's standard color and texture designation.

D. Adhesive: Provide the type of adhesive recommended by the manufacturer for use with the wall panel material on the substrate indicated.

E. Trim: Provide extruded, impact-resistant, vinyl plastic trim members matching color of wall panel materials.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates scheduled to receive FRP wall panel materials for compliance with manufacturer's requirements and conditions affecting performance.
   1. Wall surfaces to receive FRP wall panel materials shall be dry and free from dirt, grease, loose paint, and scale.
   2. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. General: Prior to installation, clean substrate to remove dust, debris, and loose particles. Provide skim coat over rough walls to smooth surface.
   1. Complete all finishing operations, including painting, before beginning installation of FRP wall panel materials.
   2. Test masonry and plaster substrates to receive FRP wall panel with an electronic moisture meter. Moisture content shall be within manufacturer's recommended limits.
   3. Prime and seal substrates, if required, in accordance with the FRP wall panel material manufacturer's recommendations for the type of substrate.

3.03 INSTALLATION

A. General: Install FRP wall panel materials in accordance with manufacturer's recommendations using adhesive recommended for use over the substrate.
   1. Moldings: Furnish moldings for perimeter edging where indicated. Install moldings in the longest practical lengths. Tightly butt end joints and miter corners.
   2. Installation Type: full wall height, from top of wall base to 8 inches (203.2 mm) above ceiling.

3.04 CLEANING

A. General: Immediately upon completion of installation, clean FRP wall panels and accessories using a manufacturer's recommended cleaning agent. Clean moldings in accordance with the manufacturer's recommendations.

B. Remove excess adhesive, using methods and materials recommended by manufacturer.

C. Remove surplus materials, rubbish, and debris resulting from installation upon completion of work, and leave areas of installation in neat, clean condition.

END OF SECTION

SECTION 09 77 23

FABRIC WRAPPED ACOUSTICAL WALL PANELS

GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Fabric-wrapped acoustical wall panels, absorptive type for acoustical panels mounted below above 9 ft. from finish floor level.
   2. Fabric-wrapped impact resistant wall panels for acoustical panels mounted below 9 ft. from finish floor level.

1.02 SUBMITTALS

A. Shop Drawings: Submit shop drawings showing layout and components, including details of hanging method for wall panels and suspension method for baffles, accessories. Identify each panel and baffle as to size, type, and fabric.

B. Product Data: Submit manufacturer's technical data for each type of acoustical panel and baffle required.

C. Submit manufacturer's standard size swatches of scheduled fabric for each type of panel and facing material required.

D. Certified Test Reports: Submit test data from an independent testing agency, acceptable to authorities having jurisdiction, evidencing that panel assemblies comply with requirements indicated for fire performance characteristics.

E. Certificates: Submit certificates from manufacturers of acoustical panels attesting that their products comply with specified requirements including those for fire performance characteristics.

1.03 QUALITY ASSURANCE:

A. Fire Performance Characteristics: Provide acoustical panels, with surface-burning characteristics as indicated below, which have been determined by testing assemblies of identical materials and construction according to ASTM E 84 by a testing organization acceptable to authorities having jurisdiction.
   1. Flame Spread: 25 or less.
   2. Smoke Developed: 450 or less.

1.04 PRODUCT HANDLING:

A. Protect acoustical wall panels from excessive moisture in shipment, storage, 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 have been completed and cured to a condition of equilibrium.

1.05 PROJECT CONDITIONS:

A. Do not begin installation until spaces to receive acoustical panels have been enclosed and maintained at approximately the same humidity and temperature conditions as planned for occupancy. Maintain temperature and humidity as recommended by panel manufacturer.

1.06 EXTRA MATERIALS:

A. Deliver extra materials to Owner. Furnish extra materials described below matching products installed, packaged with protective covering for storage and identified with appropriate labels:
   1. Fabrics: Furnish quantity of each fabric equal to 5.0 percent of each type of fabric installed.
   2. Fabric shall be provided in continuous rolls, packaged for storage.

PART 2 PRODUCTS

2.01 GENERAL

A. MANUFACTURERS: Subject to compliance with requirements, approved manufacturers include the following:
   1. Acoustical Surfaces, Inc. www.soundsilencer.com
   2. Conwed, Inc.
   3. Decoustics. www.decoustics.com
   4. Golterman & Sabo, www.golterman.com
   5. Lamvin http://www.lamvin.com
   6. MBI Products Company, www.mbiproducts.com
   7. Wall Technology. www.walltechnology.com

2.02 FABRICATION - GENERAL:

A. Fabricate panels to sizes and configurations indicated; attach facing materials to cores to produce installed panels with visible surfaces fully covered and free from wrinkles, sags, blisters, seams, adhesive or other foreign matter.
   1. Fabricate back-mounted panels in factory to sizes required to fit wall surfaces based on field measurements of completed substrates indicated to receive wall panels.
   2. Fabricate suspended baffles in factory to indicated sizes, complete with hanging system.
   3. Each panel shall be faced with approved fabric bonded directly to the panel face and edges. Provide panels with flat, wrinkle-free surface, and tailored corners.

B. Provide panel manufacturer's accessories for securely mounting panels of type and size indicated to substrates provided and complying with the following requirements:
   1. Provide manufacturer’s 2-part zee-clips with one part screw- fastened to back of panel and receiving part fastened to wall using appropriate anchoring. In addition provide heavy-duty Velcro anchoring to stabilize panel and provide resistance to removal.
   2. Unless indicated otherwise, anchoring system shall be designed to hold back of panel within 1/4” of wall surface.

2.03 ACOUSTICAL WALL PANELS:

A. Sound Absorption Performance: Provide acoustical panels with noise reduction coefficients (NRC) indicated as determined by testing per ASTM C 423 for mounting type specified under individual product requirements.

B. Octave Band Center Frequencies (Hz)/Nominal Absorption Coefficient: Panels tested at 2” thick shall have the following nominal octave band absorption coefficients within a tolerance of plus or minus 5% when mounted directly on a hard surface:
   a. 125/0.40
   b. 250/0.98
   c. 500/1.00
   d. 1000/1.00
   e. 2000/1.00
   f. 4000/1.00

C. Back-Mounted Edge-Reinforced Acoustical Wall Panels: Manufacturers standard panel construction consisting of scheduled fabric laminated to front, edges and back border of molded glass fiber board core, with edges chemically hardened to a minimum depth of 1/8" to reinforce panel perimeter against warping and edge damage. structural framing using wood, plastic, or metal will not be accepted:

D. Typical Panels:
   1. Core Density: 7 lbs. per cu. ft.
   2. Panel Face Size: As indicated, custom sizes.
   3. Panel Thickness: 2” thick unless otherwise indicated.
   4. Edge Detail: Square, fabric wrapped.
      a. Fabric:
         1) Custom Color(s) and pattern(s) as scheduled or selected during construction.
   5. Mounting: Provide 1” x 3” wood furring strips or metal furring channels.

E. Impact-Resistant Wall Panels:
   1. Use for panels mounted with any portion of panel installed at a height of less than 9'-0" above finish floor.
   2. Provide construction as specified above plus impact-resistant rigid fiberglass sheet laminated to front, edges, and back border of glass fiber board core.
   3. Color(s) and pattern(s) as scheduled or selected during construction.
   4. Mounting: Provide 1” x 3” wood furring strips or metal furring channels.

PART 3 EXECUTION

3.01 INSTALLATION:

A. Install acoustical wall panels in locations indicated with vertical surfaces and edges plumb, top edges level, and in alignment with other panels,
   1. Scribe to fit adjoining work accurately at borders and at penetrations.
   2. Comply with panel manufacturer's printed instructions for installation of panels using type of mounting accessories as specified above.

3. Remove and replace panels which are damaged and are unacceptable to Architect.

END OF SECTION

SECTION 09 77 33

CEMENTITIOUS WOOD FIBER ACOUSTIC PANELS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Cementitious wood fiber acoustical wall-mounted panels.

B. Related Sections:
   1. Section 09 90 00 – Painting and Coating: For field-painted finish of cementitious wood fiber panels.

1.02 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit manufacturer's technical data for each type of cementitious wood fiber wall panel required.

C. Maintenance Procedures: Submit recommended procedures for normal cleaning and removal of stains including precautions in use of cleaning materials that may be detrimental to surfaces.

D. Samples: Submit minimum 6” x 6” sample panel for each wall panel type and color selected, showing full range of exposed texture to be expected in completed work. Samples shall have 2 fabricated edges and corner as specified.

E. Test Reports and Certifications: Submit certified test reports from recognized test laboratories. Submit manufacture’s certificate that products meet or exceed specified requirements, including fire, smoke, and acoustical ratings.

1.03 QUALITY ASSURANCE

A. Fire Performance Characteristics: Provide cementitious wood fiber wall panels, with surface-burning characteristics as indicated below, which have been determined by testing assemblies of identical materials and construction according to ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials by a testing organization acceptable to authorities having jurisdiction.
   1. Flame Spread: 25 or less.
   2. Smoke Developed: 450 or less.

B. Acoustical Performance: Provide panels with acoustical ratings of minimum 0.75 per inch thickness.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Protect cementitious wood fiber wall panels from excessive moisture in shipment, storage, and handling.
   1. Deliver in unopened cartons and store in a dry place with adequate air circulation. Open cartons at each end during storage to stabilize moisture content and temperature.
   2. Do not deliver material to building until "wet work" such as concrete and plaster have been completed and cured to a condition of equilibrium.
   3. Protect panels from soiling and abrasion on surfaces that will be exposed to view in final construction. Discard damaged panels at time of installation

1.05 PROJECT CONDITIONS

A. Do not begin installation until spaces to receive cementitious wood fiber wall panels have been stored within the area of installation.
   1. Maintain installation area at approximately the same humidity and temperature conditions as planned for occupancy at least 48 hours before beginning installation of panels.
   2. During and after installation maintain temperature and humidity as recommended by panel manufacturer.

PART 2 PRODUCTS

2.01 CEMENTITIOUS WOOD FIBER WALL PANELS

A. Manufacturers:
   1. Armstrong www.armstrongceilings.com.
   2. Substitutions: Section 01 60 00 - Product Requirements.

2.02 MATERIALS

A. Basis of Design: Basis of Design: Tectum Finale direct-mount panels as manufactured by Armstrong.
   1. Cementitious Wood Fiber Panels: Manufacturer's standard precast panels composed of long, chemically-processed Aspen wood fibers bonded with inorganic hydraulic cement, pressure bonded with a uniform bottom face texture to provide shapes and sizes as required, with the following properties:
   2. Density: 30 to 45 lbs. per cu. ft. with maximum 10% moisture content; ASTM C 209.
   3. Fire Resistance: Tested and classified by UL for flame spread, fuel contribution and smoke classifications of not more than 25, 15 and 5, respectively; ASTM E 84.
   4. Cementitious wood fiber Absorption: NRC of 0.85 for 1-inch thickness; NRC of 0.70 for 2-inch thickness; ASTM C 423.

B. Fabrication
   1. General: Factory-fabricate the panels to sizes and configurations indicated and as follows:
      a. 1-1/2 inch thick cementitious panels in face sizes as indicated on the drawings.
      b. Edges: Factory-beveled or square as indicated.
   2. Finish: Manufacturer's factory white or off-white primer on exposed face and edges ready for field or shop painting.
   3. Perimeter Frame: None.

2.03 FINISHING

A. Panel Finishing: Field or shop painting provided under Section 09 90 00 Painting and Coating. Paint exposed face and edges minimum 2 coats using acrylic paint as recommended by the panel manufacturer.
   1. Provide custom paint color(s) as selected by the Architect.
   2. Provide number of coats necessary to provide complete hiding of raw wood fibers on all exposed surfaces.

B. Fastener Finishing: Paint heads of screws to match panels after installation.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install cementitious wood fiber wall panels in locations indicated with vertical surfaces and edges plumb, top edges level, and in alignment with adjacent panels.

B. Comply with panel manufacturer's printed instructions for installation of panels.

C. Panels direct to Drywall: Use flat-head self-drilling wall screws, spacing as recommended by the manufacturer, but no less than 12" o.c. along each stud. Set screw heads flush with panel face. Each panel must be fastened to at least two vertical studs.
   1. Where a panel width does not allow the panel to be fastened to at leas two studs, Install continuous horizontal bands of 16-ga. x 4” wide sheet metal across 3 or more metal studs prior to installation of gypsum board.
      a. Fasten sheet steel band using minimum of (2) bugle-head drywall screws at each stud. Dimple sheet metal at screw locations for flush heads to avoid interference with gypsum board installation.
      b. Provide continuous metal bands horizontally as required for mounting of panels with a minimum of two columns of fasteners, maximum 12” on center vertically.
   2. All screw heads to be field painted to match selected panel paint color.

D. Remove and replace panels which are damaged and are unacceptable to Architect.

3.02 CLEANING AND ADJUSTING

A. Clean exposed surfaces of panels and trim in accordance with manufacturer’s recommendations for cleaning.

B. Fill minor scratches or gouges and touch-up with matching paint.

END OF SECTION

SECTION 09 84 00

SUSPENDED ACOUSTICAL BAFFLES AND CLOUDS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Prefabricated modular acoustical baffle system in wave pattern suspended from overhead building structure.
   2. Prefabricated two-dimensional cloud circles suspended from overhead building structure.

B. Related Sections:
   1. 09 90 00 Painting and Coating: Finish painting of exposed and partially exposed floor or roof structure and decking prior to beginning work under this Section.

1.02 REFERENCES

A. ASTM International:
   1. ASTM C423 Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
   2. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
   3. ASTM E795 Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

1.03 PERFORMANCE DATA

A. Surface Burning Characteristics ASTM E84-15a:
   1. Rated Class A
   2. Flamespread: 0.
   3. Smoke Developed: 45.

B. Acoustics
   1. Noise Reduction Coefficient: Manufacture’s published NRC rating of minimum 0.50.

1.04 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures.

B. Product Data:
   1. Submit product data sheet for specified products. Include performance criteria.
   2. Submit certified test reports showing compliance with specified performance requirements

C. Shop Drawings: Submit shop drawings showing layout and components, including suspension method, accessories, finish colors and textures.

D. Samples: Submit selection and verification samples of finishes, colors and textures.

1.05 DELIVERY, STORAGE & HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Delivery: Deliver materials in manufacturer’s original, unopened, undamaged containers with identification labels intact.

C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.

1.06 PROJECT CONDITIONS

A. A. Environmental Requirements: Do not install baffles or clouds until overhead work, including finish painting, is complete.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Autex Acoustics, www.autexacoustics.com

B. Substitutions: Section 01 60 00 - Product Requirements.

2.02 COMPONENTS

A. Acoustical Baffles: Frontier Talus™ Acoustic Fins as manufactured by Autex.
   1. Thickness: 1/2 inches (12 mm) unless indicated otherwise.
   2. Length: As indicated.
   3. Depth: Varies with wave pattern.
   4. Construction: Formed from 100% polyester fiber (PET) using minimum 60% recycled material.
   5. Color and Pattern: As indicated.
   6. End Caps: At open ends of suspension channels, provide manufacturer’s color-matching PET end caps.

B. Acoustical Circles: Frontier Horizon™ prefabricated circles as manufactured by Autex.
   1. Thickness: 1- inch.
   2. Construction: Formed from 100% polyester fiber (PET) using minimum 80% recycled material.
   3. Color and Pattern: As indicated.

C. Mounting Accessories: All-threaded steel rods and manufacturer’s mounting clips, aluminum channels, and cross rails.

2.03 LAYOUT

A. Parallel continuous panels at 12” centers unless indicated otherwise.

PART 3 - EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

A. Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions and product carton instructions for installation.

3.02 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: coordination and project conditions.

B. Site Verification of Conditions: Verify that the supporting structure for suspension of acoustical baffles and clouds is acceptable for product installation in accordance with manufacturer's instructions.
   1. Do not install baffles or clouds until unsatisfactory conditions are corrected.
      a. Ensure that hangers are fastened as intended at each panel, are secured to panel core, and are fully capable of supporting at least 3 times the weight of the panel.

3.03 INSTALLATION

A. Suspend system manufacturer's 24 mm aluminum mounting channels from roof or floor structure using manufacturer's adjustable suspension set composed of fully-threaded steel rods or stainless steel aircraft cable as determined by the manufacturer for the particular installation. Utilize manufacturer's custom aluminum or stainless steel connectors. Mount channels perpendicular to planned run of acoustical baffles. For installations near exterior entries or HVAC vents, always use threaded rods to avoid wind movement of baffles or clouds.
   1. Space mounting channels at maximum 48". Provide suspension cables to each channel at maximum 48" spacing. Provide closer spacing of channels and or suspension cables where recommended by the system manufacturer for the specific substrate or system weight.
   2. Where floor or roof joist locations permit, suspend wires or threaded rods from bottom chord of joists. For cable installation, loop end of each wire around bottom chord of joists and secure loop with crimped sleeves. Use beam clamps where connecting wires or rods to "H"-shaped beam with flange.
   3. Where joist spacing does not allow for fastening to joists, use system manufacturer's recommended screws to fasten system mounting clips securely to metal floor or roof deck.

B. Anchor aluminum top cap of each baffle to suspended channels at 12" centers using manufacturer's removable twist-clips. as recommended by the manufacturer for the panel weight and length.

C. Suspend baffle panels at uniform height, with top edges of panels level and in-plane.

D. Suspend cloud panels at heigh(s) and locations as indicated.

3.04 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Follow manufacturer's instructions for cleaning materials soiled during installation. Replace baffles and clouds that cannot be cleaned and repaired to as-new condition.

END OF SECTION

SECTION 09 84 16

REFLECTIVE LAY-IN CEILING DIFFUSERS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Pyramidal-shaped ceiling diffusers for standard ceiling grid.
   2. Extent of diffusers is shown on drawings.

B. Related Sections:
   1. Section 09 51 13 – Acoustical Panel Ceilings: Ceiling grid for ceiling-mounted diffusers.

1.02 SUBMITTALS

A. Section 01 33 00 – Submittal Procedures: Submittal procedures.

B. Product Data: Submit manufacturer's technical data for each type of diffuser required.

C. Samples for Verification Purposes: Submit 12" square samples of each type of diffuser required. Include representative samples of installation devices and accessories.

D. Certificates: Submit certificates from manufacturers of diffusers attesting that their products comply with specified requirements including those for fire performance characteristics.

1.03 QUALITY ASSURANCE

A. Fire Performance Characteristics: Provide diffusers with surface-burning characteristics as indicated below, which have been determined by testing assemblies of identical materials and construction according to ASTM E 84 by a testing organization acceptable to authorities having jurisdiction.
   1. Flame Spread: 25 or less.
   2. Smoke Developed: 450 or less.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 – Product Requirements: Product storage and handling requirements.

B. Protect diffusers from excessive moisture in shipment, storage, 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 have been completed and cured to a condition of equilibrium.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Section 10 60 00 – Product Requirements: Product storage and handling requirements.

B. Do not begin installation until spaces to receive diffusers have been enclosed and maintained at approximately the same humidity and temperature conditions as planned for occupancy. Maintain temperature and humidity as recommended by diffuser manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers:
   1. Wenger Corp., www.wingercorp.com
   2. Kinetics Noise Control, www.kineticsnoise.com
   3. Wall Technology. www.walltechnology.com
   4. Conwed Designscape, www.conweddesignscape.com
   5. RPG Inc., www.rpginc.com
   6. Melhart Music, www.melhart.com
   7. Substitutions: Section 01 25 00 – Substitution Procedures

2.02 DIFFUSERS

A. Ceiling Suspended Pyramidal Diffusers: Pyramidal diffusers shall be constructed of 0.125-inch thick thermoformed plastic, molded into one-piece special offset pyramidal shape, nominal 4 x 4 foot size.
   1. Edges flanged for laying into standard ceiling grid as specified.

B. Acoustical Performance: Diffusers shall have a Noise Reduction Coefficient of 0.13 or below with an E-400 mounting according to ASTM E795.

C. Finish: Factory white color paint, lightly textured.

PART 3 EXECUTION

3.01 PREPARATION

A. Do not begin installation until all wet work, such as plastering, concrete, etc. is complete. The panels are designed for installation under standard occupancy conditions from 60 degrees F to 85 degrees F and at not more than 80 percent R.H. in an enclosed building.

3.02 INSTALLATION

A. Install diffusers in accordance with the manufacturer’s instructions.

B. Furnish all hardware and accessories necessary for complete installation.

C. Protection – Protect installed work from damage due to subsequent construction activity. Remove and replace diffusers which are damaged and are unacceptable to Architect.

END OF SECTION

SECTION 09 90 00

PAINTING AND COATING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints, interior.

C. Scope: Finish surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
   1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
   2. It is the intent of this Section that all exterior and interior materials normally requiring finish paint, coating, or stain/finishing as determined by the Architect, will be painted, coated, or stain/finished under this Section except for specialty coatings and finishes specifically covered under other Sections.
      a. Painting shall include but not be limited to the following:
         1) Unfinished Materials.
         2) Backpriming.
         3) Concrete.
         4) Masonry.
         5) Metals, including hidden surfaces and galvanized finishes.
         6) Woods and fabrications of wood.
         7) Sheet metal.
         8) Spray-fireproofed steel framing, metal deck.
         9) Gypsum board.
         10) Glass fiber reinforced gypsum plaster.
         11) Doors.
         12) Exposed piping, conduits, ducts, hangers, exposed steel and iron supports, panels, and surfaces of mechanical, electrical equipment and items that do not have a factory-applied final finish.
         13) Roof-top equipment.
         14) Miscellaneous items.
         15) Surfaces behind mirrors.
   3. Where the Bidder is uncertain of whether a specific item is intended to be painted,coated, or stain/finished, contact the Architect during the Bidding period for clarification.

D. 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 (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory-applied final finish.
   2. Exposed Roof Decks:

a. Paint galvanized roof deck and exposed structure.

E. Do Not Paint or Finish the Following Items:
1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished including but not limited to the following:
a. Plastic laminate faced casework and millwork.
b. Acoustical wall panels.
c. Toilet compartment doors and partitions.
d. Metal lockers.
e. Finished mechanical and electrical equipment, unless roof-top equipment visible from ground level.
f. Light fixtures.
2. Items indicated to receive other finishes.
3. Items indicated to remain unfinished.
4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
5. Floors, unless specifically indicated.
6. Glass.
7. Concealed pipes, ducts, and conduits.
8. Concealed surfaces including 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.
9. Finished metal surfaces including the following:
a. Anodized aluminum.
b. Stainless steel.
c. Chromium plate.
d. Copper and copper alloys.
e. Bronze and brass.
10. Operating parts include moving parts of operating equipment and the following:
a. Valve and damper operators.
b. Linkages.
c. Sensing devices.
d. Motor and fan shafts.

1.02 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.

B. ASTM D4258 - Standard Practice for Surface Cleaning Concrete for Coating; 2023.

C. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2020.

D. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.

E. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).

F. SSPC-SP 2 - Hand Tool Cleaning; 2018.

G. SSPC-SP 6 - Commercial Blast Cleaning; 2007.

H. SSPC-SP 13 - Surface Preparation of Concrete; 2018.

1.03 ADMINSTRATIVE REQUIREMENTS

A. Section 01 31 19 – Project Meetings: Schedule and coordinate pre-installation meeting that includes the trade(s) for the work of this Section and other trades that whose work is related to the work of this Section.

B. Convene minimum one week prior to commencing work of this Section.

1.04 DEFINITIONS

A. Conform to ASTM D16 for interpretation of terms used in this section.
   1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
   2. Eggshell refers to low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.
   3. Semigloss and satin refer to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.
   4. Full gloss refers to high-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g., "alkyd enamel").
   2. MPI product number (e.g., MPI #47).
   3. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference to specified paint system products to be used in project; include description of each system. Identify each material by manufacturer's catalog number and general classification.
   4. Manufacturer's installation instructions.
   5. Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.
   6. VOC content.

C. Samples: For each color and material to be applied, with texture to simulate actual conditions, on representative Samples of the actual substrate.
   1. Provide stepped Samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.
   2. Provide a list of materials and applications for each coat of each Sample. Label each Sample for location and application.

D. Submit two Samples on the following substrates for Architect's review of color and texture only:
   1. Concrete: 4 inch square Samples for each color and finish.
   2. Concrete Unit Masonry: 4 x 8 inch Samples of masonry, with mortar joint in the center, for each finish and color.
   3. Painted Wood: 12 inch square Samples for each color and material on hardboard.
   4. Stained or Natural Wood: 4 x 8 inch Samples of natural or stained wood finish on representative surfaces.

E. Paint Schedule: Submit schedule of proposed paint type and sheen for each room. Use room names and numbers as appearing in the Architect’s drawings.

F. Maintenance Data: See Section 01 70 00 - Execution and Closeout Requirements: *Closeout procedures.* Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, material safety data sheets (MSDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 70 00 - Execution and Closeout Requirements*: Spare parts and maintenance products* for additional provisions.
   2. Extra Paint and Finish Materials:
      a. 10-gallons of each type and color used for walls, ceilings, steel doors, and exposed structure.
      b. 3-gallons of each type and color used for door frames, trim, and accents.
   3. Label each container with color in addition to the manufacturer's label.

H. Qualification Data: For firms and persons specified in the “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.

1.06 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Furnish five year manufacturer warranty for paints and coatings.

1.07 QUALITY ASSURANCE

A. Obtain primers and block fillers from the same manufacturer as the finish coats.

B. Applicator: Company specializing in performing work of this section on projects similar in materials, design, and extent to those of this project, and whose work has resulted in applications with successful in-service performance.

C. Sequencing:
   1. Section 01 10 00 - Summary: Work sequence.
   2. Sequence application to the following:
   3. Do not apply finish coats until paintable sealant is applied at all joints and transitions of differing material.
   4. Back prime wood trim before installation of trim.

1.08 MOCK-UP

A. See Section 01 40 00 - Quality Requirements, for general requirements for mock-up.

B. Provide a full-coat mock-up for each type of coating and substrate required. Comply with procedures specified in PDCA P5. Duplicate finish of approved sample Submittals.
   1. Architect will select one room or surface to represent surfaces and conditions for application of each type of coating and substrate.
      a. Wall Surfaces: Provide mock-up on at least 100 sq. ft.
      b. Small Areas and Items: Architect will designate items or areas required.
   2. Apply mock-up 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.
      a. After finishes are accepted, Architect will use the room or surface to evaluate coating systems of a similar nature.

C. Final approval of colors will be from mock-ups.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

C. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

D. Paint Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

1.10 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Do not apply exterior coatings during rain or snow when relative humidity is outside humidity ranges, or moisture content of surfaces exceed those required by paint product manufacturer.

1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

C. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.

D. Minimum Application Temperature for Varnish Finishes: 65 degrees F for interior or exterior, unless required otherwise by manufacturer's instructions.

E. Provide lighting level of 80 ft candle measured mid-height at substrate surface.

F. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

G. Provide lighting level of 80 fc (860 lux) measured mid-height at substrate surface.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Paints:
1. Pittsburgh Paints: www.ppgpaints.com/
2. Sherwin-Williams Company: www.sherwin-williams.com/
3. Benjamin Moore & Co: www.benjaminmoore.com/
4. Substitutions: See Section 01 60 00 - Product Requirements

B. Applications Schedules:
1. Reference Schedules under Part 3 below for locations and applications of specific paint systems, coatings, stains, finishes, and sealers for this Project.
2. Certain of the paint and coating systems specified in Part 2 may not be required or scheduled for this particular Project.

2.02 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready-mixed, unless intended to be a field-catalyzed paint.
1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
2. Supply each paint material in quantity required to complete entire project's work from a single production run.
3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

B. Material Compatibility: Provide block fillers, primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

C. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.

1. 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

D. Alternate Manufacturers: Sherwin-Williams products are specified. Equivalent products by listed manufacturers are acceptable upon approval by Architect.
   1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

E. Colors: As indicated in the Color Schedule in the Drawings.
   1. Provide custom colors of the finished paint systems to match the Architect’s samples. If other manufacturer’s materials cannot match the color, finish, sheen or light reflectance or the Architect’s approval, the named manufacturer’s products shall be required. The Architect’s decision will be final.
   2. The Contractor is advised that certain special colors may be required for some of the Work. Such colors if required shall be furnished and installed at no additional cost.

F. Volatile Organic Compound (VOC) Content:
   1. Provide paints and finishes that comply with the most stringent requirements specified in the following:
      a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings (EPA Method 24).
         1) Flat Paints and Coatings: 50 g/L maximum.
         2) Nonflat Paints and Coatings: 150 g/L maximum.
         3) Dry-Fog Coatings: 400 g/L maximum.
         4) Primers, Sealers, and Undercoaters: 200 g/L maximum.
         5) Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L maximum.
         6) Zinc-Rich Industrial Maintenance Primers: 340 g/L maximum.
         7) Pretreatment Wash Primers: 420 g/L maximum.
         8) Floor Coatings: 100 g/L maximum.
         9) Shellacs, Clear: 730 g/L maximum.
         10) Shellacs, Pigmented: 550/L maximum.
   2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.

2.03 CONCRETE UNIT MASONRY BLOCK FILLERS

A. Concrete Unit Masonry Block Filler: Factory-formulated latex block fillers.

B. Sherwin-Williams; PrepRite Interior/Exterior Block Filler B25W25: Applied at a dry film thickness of not less than 8.0 mils per coat.

2.04 EXTERIOR PRIMERS

A. Exterior Metal Field Primers:
   1. Factory-formulated metal primer for galvanized or bare metal without shop primer.
      a. Sherwin-Williams; Pro-Cryl Universal Water Based Primer, B66 Series: Applied at a dry film thickness of 2.0 – 4.0 mils per coat.

2. Field Welds in Galvanized Metal:
   a. ZRC Worldwide “Galvilite” zinc-rich coating.

B. Shop Primers: Typically applied by steel or miscellaneous metals fabricator.
1. Verify compatibility of finish paint with shop-applied primers.
2. Reference Division 5 metals sections for special epoxy shop primers required at items specified or indicated to be shop primed and field painted with urethane alkyd enamel.

C. Exterior Concrete and Masonry Primer: Factory-formulated masonry primer for exterior application:
1. Sherwin-Williams; Loxon Masonry Primer A24W300: Applied at a dry film thickness of not less than 3.0 mils.

2.05 EXTERIOR FINISH COATS

A. Urethane Alkyd Enamel: Factory-formulated full-gloss urethane alkyd enamel for exterior application.
1. Sherwin-Williams; Industrial Urethane Alkyd Enamel, B54E51: Applied at a dry film thickness of 2.0 – 4.0 mils per coat.

B. Alkyd Enamel: Factory-formulated formulated full-gloss alkyd enamel for exterior application.
1. Sherwin-Williams; Industrial Enamel B-54WZ101: Applied at a dry film thickness of not less than 2.0 mils per coat.
2. Apply two (2) coats over specified primer.

C. Exterior Low-Luster Acrylic Paint: Factory-formulated low-sheen (eggshell) acrylic-latex paint for exterior application.
1. Sherwin-Williams; A-100 Exterior Latex Satin House & Trim Paint A82 Series: Applied at a dry film thickness of not less than 1.5 mils.
2. Apply two (2) coats over specified primer.

D. Concrete Curb Enamel:
1. Sherwin-Williams; H&C Concrete Sealer Solid Color solvent-based flat enamel (fire lane curbs).
2. Finish Coats: Two coats specified exterior full-gloss alkyd enamel.

2.06 INTERIOR PRIMERS

A. Interior Concrete and Concrete Masonry (CMU) Primer: Factory-formulated alkali-resistant acrylic-latex interior primer for interior application.
1. Sherwin-Williams; Loxon Concrete & Masonry Primer, A24W8300: Applied at a dry film thickness of not less than 3.0 mils per coat.
2. Use equivalent zero VOC primer when building will be occupied by students or staff within 5 days after application

B. Interior Gypsum Board Primer: Factory-formulated latex-based primer for interior application.
1. Sherwin-Williams; Pro Mar 200 Zero VOC Latex Primer B28W2600 Series: Applied at a dry film thickness of not less than 1.5 mils per coat.

C. High Performance Gypsum Board Primer: Factory-formulated acrylic primer for application under epoxy finish coats.

1. Sherwin-Williams; PrepRite 200 Latex Wall Primer B28W200 Series: Applied at a dry film thickness of not less than 1.0 mils per coat.

2.07 INTERIOR FERROUS METAL PRIMER: FACTORY-FORMULATED FOR GALVANIZED OR BARE METAL NOT SHOP PRIMED.

A. Sherwin-Williams; Pro Cryl Universal Water Based Primer B66 series: Applied at a dry film thickness of 2.0 – 4.0 mils per coat.

B. Reference Division 5 metals sections for special epoxy shop primers required at items specified or indicated to be shop primed and field painted with urethane alkyd enamel

2.08 INTERIOR DRYFALL UNDERCOAT: FACTORY-FORMULATED ACRYLIC UNDERCOAT FOR EXPOSED ROOF STRUCTURE, ROOF DECK, PIPING AND DUCTING THAT HAS NOT BEEN SHOP PRIMED.

A. Sherwin-Williams: Waterborne Acrylic Dry Fall, B42 Series.

2.09 INTERIOR FINISH COATS

A. Reference Schedule Information in Part 3 for specific usage of each paint system.

B. Interior Low-VOC Latex Enamel: Factory-formulated acrylic-latex interior enamel.
1. Sherwin-Williams; Pro Mar 200 Zero VOC Latex Enamel: Applied at a dry film thickness of not less than 1.7 mils per coat. Gloss, semigloss, and eggshell/satin as scheduled.
2. Sherwin-Williams; Pro Industrial Zero-VOC Acrylic Semigloss, B66W651 over shop primer: Applied at a dry film thickness of 2.5 – 4.0 mils per coat. Where specifically indicated for industrial finish.

C. Interior Dryfall Finish Coat: Factory-formulated acrylic finish coat for exposed roof structure, roof deck, piping, ducting, and cementitious wood fiber planks, both unprimed and primed.
1. Sherwin-Williams: Waterborne Acrylic Dryfall, B42 Series.

D. Urethane Alkyd Enamel: Factory-formulated full-gloss urethane alkyd enamel for interior application.
1. Sherwin-Williams; Industrial Urethane Alkyd Enamel, B54E51: Applied at a dry film thickness of 2.0 – 4.0 mils per coat.

E. Interior Semigloss Epoxy: Factory-formulated, two-component, waterbased, catalyzed epoxy resin for high performance applications.
1. Sherwin-Williams: Waterbased Catalyzed Epoxy B70-200 Series: Applied at a dry film thickness of not less than 2.5 mils per coat.

2.10 INTERIOR WOOD STAINS AND LACQUERS

A. 250 VOC Interior Wood Stain: Factory-formulated penetrating wood stain for interior application, 250 g/L VOC. Use where stain or color is specifically indicated, and verify with Architect:

B. Sherwin-Williams; Wood Classics Interior Oil Stain-250.

C. Interior Waterborne Polyurethane Varnish: Factory-formulated clear varnish, Gloss or Satin.

1. Sherwin-Williams; Wood Classics Waterborne Polyurethane Varnish, A68 Series: Applied at a dry film thickness of 0.8 - 1.0 mils per coat. Satin finish unless otherwise indicated

2.11 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces. Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve finishes specified; commercial quality.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Do not begin application of paints and finishes until substrates have been adequately prepared.

C. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

D. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

E. Test shop-applied primer for compatibility with subsequent cover materials.

F. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces is below the following maximums:
   1. Gypsum Wallboard: 12 percent.
   2. Plaster and Stucco: 12 percent.
   3. Masonry, Concrete, and Concrete Masonry Units: 12 percent.
   4. Interior Wood: 15 percent, measured in accordance with ASTM D4442.
   5. Concrete Floors and Traffic Surfaces: 8 percent.

3.02 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated.

B. Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting.
   1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved. Remove

C. Clean surfaces thoroughly and correct defects prior to application of paint, other surface treatments. Remove oil and grease before cleaning.
   1. Clean substrates of substances that could impair bond of paints,
   2. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
   3. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

D. Prepare surfaces using the methods according to manufacturer's written instructions for achieving the best result for each substrate under the project conditions.
   1. Provide barrier coats over incompatible primers or remove and re-prime.
   2. Cementitious Materials: Prepare concrete, concrete unit masonry, cement plaster, and mineral-fiber-reinforced cement panel surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
      a. Use abrasive blast-cleaning methods if recommended by paint manufacturer.
      b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces if moisture content exceeds that permitted in manufacturer's written instructions.
      c. Clean concrete floors to be painted with a 5 percent solution of muriatic acid or other etching cleaner. Flush the floor with clean water to remove acid, neutralize with ammonia, rinse, allow to dry, and vacuum before painting.

E. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

F. Seal surfaces that might cause bleed through or staining of topcoat.

G. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

H. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.

I. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
   1. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
   2. Use only thinners approved by paint manufacturer and only within recommended limits.

J. Painted Surfaces: When painting over surfaces that have been previously painted, prepare surfaces in accordance with paint manufacturer’s instructions, and verify with manufacturer that new coatings are compatible with the existing coatings.
   1. Provide adhesion testing of existing paint. Remove completely any loose, flaking, or non-adhering paint.
   2. Clean existing finishes of grease, oil, dust or other materials that may tend to adversely affect adhesion of new paint. Do not use cleaners that will leave a residue.

3. Remove by sanding any gloss or sheen on existing painted surfaces before application of paint. Remove all sanding dust.
4. Apply an alkyd bonding primer to all prepared existing painted surfaces prior to application of new paint. Use manufacturer's recommended epoxy primer for new epoxy painting. Verify proper primer for the specific application with the finish paint manufacturer and submit to the Architect.
5. Where encountering existing no-sheen finishes, primer may not be required if preparation of existing surfaces will produce sufficient bonding of new paint, as demonstrated to the Architect through industry standard pull testing.

K. If specified new coating is determined to be incompatible with exiting coatings, do not proceed, and notify Architect for direction.

L. Concrete:
1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
2. Clean concrete according to ASTM D4258. Allow to dry.
3. Prepare surface as recommended by top coat manufacturer and according to SSPC-SP 13.

M. Masonry:
1. Remove efflorescence and chalk. Do not coat surfaces if moisture content, alkalinity of surfaces, or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
2. Prepare surface as recommended by top coat manufacturer.
3. Clean surfaces with pressurized water. Use pressure range of 600 to 1,500 psi (4,140 to 10,350 kPa) at 6 to 12 inches (150 to 300 mm). Allow to dry.

N. Steel Substrates: Remove rust, oil, grease, dirt, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:.
1. SSPC-SP 3, "Power Tool Cleaning."
2. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
3. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."

O. Aluminum: Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.

P. Galvanized Surfaces:
1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
2. Remove all soluble and insoluble contaminants and corrosion from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints. Perform Sweep (Abrasive) Blasting per ASTM D 6386 to achieve a uniform anchor profile (1.0-2.0 mils).
3. Prepare surface according to SSPC-SP 2.

Q. Ferrous Metal:
1. Solvent clean according to SSPC-SP 1.

2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 Commercial Blast Cleaning. Protect from corrosion until coated.
4. 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.

R. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.
1. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer.
2. Sand surfaces that will be exposed to view, and dust off.
3. Prime, stain or seal wood to be painted immediately on delivery.
4. Prime edges, ends, faces, undersides, and backsides of wood.
5. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
6. Back-prime paneling on interior partitions where masonry, plaster, or other wet wall construction occurs on back side.
    a. If transparent finish is required, backprime with spar varnish.
7. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.

S. Material Preparation: Mix and prepare paint

3.03 APPLICATION

A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
1. Paint colors, surface treatments, and finishes are indicated in the paint schedules.
2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
3. Provide finish coats that are compatible with primers used.
4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convector covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
6. Paint interior surfaces of ducts with a flat, non-specular black paint where visible through registers or grilles.
7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
8. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
9. Finish interior of wall and base cabinets and similar field-finished casework to match exterior.
10. Sand lightly between each succeeding coat and clean with tack-cloth.

B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

C. Apply each coat to uniform appearance in thicknesses specified by manufacturer, to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
   1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
   2. Omit primer over metal surfaces that have been shop primed and touchup painted.
   3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
   4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.

D. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
   1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
   2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
   3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.

E. 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.

F. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.

G. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in occupied spaces.

H. Mechanical items to be painted include, but are not limited to, the following:
   1. Uninsulated metal piping.
   2. Uninsulated plastic piping.
   3. Pipe hangers and supports.
   4. Tanks that do not have factory-applied final finishes.
   5. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
   6. Duct, equipment, and pipe insulation having "all-service jacket" or other paintable jacket material.
   7. Mechanical equipment that is indicated to have a factory-primed finish for field painting.

I. Electrical items to be painted include, but are not limited to, the following:

1. Switchgear.
2. Panelboards.
3. Electrical equipment that is indicated to have a factory-primed finish for field painting.

J. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.

K. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.

L. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

M. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections.

N. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

O. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

P. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for general requirements for field inspection.

B. Owner reserves the right to test installed work at any time and as often as Owner deems necessary during the period when paint is being applied:
1. Owner will engage a qualified independent testing agency to sample paint material being used. Samples of material delivered to Project will be taken, identified, sealed, and certified in the presence of Contractor.
2. Owner may direct Contractor to stop painting if test results show material being used does not comply with specified requirements. Contractor shall remove noncomplying paint from Project site, pay for testing, and repaint surfaces previously coated with the noncomplying paint. If necessary, Contractor may be required to remove noncomplying paint from previously painted surfaces if, on repainting with specified paint, the two coatings are incompatible.

3.05 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.06 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

C. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.
   1. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.07 SCHEDULE - INTERIOR SURFACES (EXCEPT EPOXY)

A. Scheduling of paint types below is a general reference for the Project. Where specific paint types on the Color/Finish Schedule in the drawings vary from below, the Color/Finish Schedule shall govern.

B. Concrete (other than concrete masonry units): Provide the following paint systems over interior concrete:
   1. Primer: Specified interior concrete and masonry primer.
   2. Finish Coats: Interior low-VOC acrylic enamel.
      a. Semigloss finish in Classrooms and Laboratories.
      b. Eggshell/satin finish elsewhere unless otherwise scheduled.

C. Concrete Unit Masonry: Provide the following finish systems over interior concrete masonry units, except where scheduled for epoxy:
   1. Block Filler:
      a. Typical: 2 coats.
      b. Music and Theater: At Band, Practice Rooms, Shared Ensemble, orchestra, choir, stage, and auditorium provide 3-coats.
   2. Finish Coats: 2-coats specified interior low-VOC latex enamel, semigloss finish.

D. Gypsum Board Partitions: Provide the following finish systems over interior gypsum board partitions (unless otherwise scheduled):
   1. Primer: Specified interior gypsum board primer.
   2. Finish Coats: 2-coats specified interior low-VOC latex enamel.
      a. Semigloss finish in laboratory and prep.rooms, restrooms, custodial closets, wet areas and corridors.
      b. Satin finish in classrooms.
      c. Flat finish (black) at “Black Box” theater room.
      d. Light orange peel texture at all interior walls.

E. Gypsum Board Ceilings and Furrings: Provide the following finish systems over interior gypsum board ceilings and furrings in dry or normal humidity areas:
   1. Eggshell/Satin: Zero-VOC Latex Enamel Finish: Two finish coats over specified primer.
   2. Primer: Interior gypsum board primer.
   3. Finish Coats at typical dry or low humidity areas: 2-coats specified interior Eggshell/Satin low-VOC latex enamel.
   4. Finish Coats in wet or high humidity areas: 2-coats specified interior Semigloss low-VOC latex enamel.

F. Metals: Provide the following finish systems over exterior galvanized or non-galvanized metal surfaces indicated to be painted:
   1. Stair treads, risers, and stringers; railings; other items specifically indicated for urethane alkyd enamel.
      a. Two coats specified urethane alkyd enamel over specified primer or shop primer.
   2. Miscellaneous piping, bollards, equipment supports; loose lintels.
      a. Primer: Specified metal primer or shop primer.
      b. Finish Coats: Two coats specified exterior full-gloss alkyd enamel.
   3. Field Welds and Cuts in Galvanized Metals: Apply 2-coats of specified zinc-rich coating over wire-brushed and cleaned galvanized metal.
   4. Removable door mullions and wall hanger brackets: Spray apply satin black enamel to all surfaces of removable mullions (steel or aluminum), as well as their respective wall hanging brackets.
   5. Metals with intumescent paint: Coordinate with intumescent paint manufacture.

G. Exposed roof structure and roof deck (including piping, conduit, etc.): provide the following finish systems:
   1. Undercoat: Specified interior dryfall paint.
   2. Finish coat: Specify interior dryfall paint.

3.08 SCHEDULE - INTERIOR EPOXY COATINGS

A. Scheduling of paint type below is a general reference for the Project. Where specific paint types on the Color/Finish Schedule in the drawings vary from below, the Color/Finish Schedule shall govern.

B. Concrete Unit Masonry or Concrete: Provide the following epoxy system over interior concrete masonry or rubbed concrete:
   1. Semigloss Epoxy Finish: Two finish coats over specified primer.
      a. Block Filler: Concrete unit masonry block filler.
      b. Finish Coats: 2-coats specified interior water based semigloss epoxy finish.

C. Gypsum Board: Provide the following epoxy systems over interior gypsum board surfaces:
   1. Semigloss Epoxy Finish: Two finish coats over specified primer.
      a. Primer: Specified high performance gypsum board primer.
      b. Finish Coats: 2-coats specified interior water based semigloss epoxy finish.

3.09 SCHEDULE - INTERIOR TRANSPARENT COATINGS

A. Transparent Finished Woodwork: Provide the following catalyzed lacquer system over wood surfaces:
   1. Stain Coat: Specified interior oil wood stain where specifically indicated. Provide 1 or 2 coats as required to achieve selected uniform color.
   2. Finish Coats: 2-coats specified interior polyurethane satin finish.
   3. Lightly sand between all coats for best adhesion. Wipe with tack-cloth.

END OF SECTION

SECTION 09 96 53

ELASTOMERIC COATINGS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes surface preparation and application of elastomeric coatings to interior/exterior CMU surfaces where specifically indicated.

B. Related Sections:
   1. Section 09 90 00 – Painting and Coating:
      a. General preparation and painting requirements.
      b. Block filler for concrete masonry units to receive paint and coatings.

1.02 PERFORMANCE REQUIREMENT

A. Provide elastomeric coating systems with the following properties as determined by the test methods indicated:

B. Elongation at Break: Not less than 280 percent at 77 degrees Fahrenheit (25 degrees Celsius) and not less than 50 percent at 0 degrees Fahrenheit (-17.78 degrees Celsius) according to ASTM D412.

C. Low-Temperature Flexibility: Passes a 1/8 inch, 180 degree mandrel bend at minus 15 deg F at 20 mil (0.508 mm) dry film thickness according to ASTM C 711.

D. Water-Vapor Transmission: Not less than 2.0 perms according to ASTM E 96.

E. Wind-Driven Rain Resistance: No water penetration according to procedures in FS TT-C-555.

F. Minimum Solids Content by Volume: Not less than 45 percent.

1.03 SUBMITTALS

A. Product Data: For each elastomeric coating system specified. Include block fillers and primers.
   1. Material List: An inclusive list of each required coating material. Indicate each material and cross-reference the specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
   2. Manufacturer's Information: Manufacturer's technical information and instructions for handling, storing, and applying each coating material proposed for use.
   3. Certification by elastomeric coating manufacturer that products supplied comply with local regulations controlling use of VOCs.

B. Samples for Verification: Of each color and material to be applied, with texture to simulate actual conditions, on representative samples of actual substrate.
   1. Provide stepped samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing samples for review. Resubmit until required sheen, color, and texture are achieved.

2. Provide a list of materials and applications for each coat of each sample. Label each sample for location and application.
3. Submit samples on the following substrates for the Architect's review of color and texture only:
    a. Concrete, Masonry, and Stucco: Provide two 4 inch (101.6 mm) square samples of actual substrate material for each color and texture.
    b. Concrete Masonry: Two 8 inch (203.2 mm) square samples of concrete masonry, with mortar joint in the center, for each color and texture.

C. 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.

D. Product Test Reports: From a qualified independent testing and inspecting agency indicating compliance of elastomeric coatings with requirements based on comprehensive testing within the last 2 years of current product formulations.

E. Material Certificates: In lieu of agency test reports, when permitted by the Architect, certificates signed by manufacturers certifying that each material complies with requirements specified.

1.04 QUALITY ASSURANCE

A. Applicator Qualifications: Engage an experienced applicator who has completed coating system applications similar in material and extent to those indicated for this Project with a record of successful in-service performance.

B. Source Limitations: Obtain block fillers, primers, and other undercoat materials from the same manufacturer as the finish coats.

C. Benchmark Samples (Mockups): Provide full-coat benchmark finish samples of each type of coating and substrate required on the Project. Comply with procedures specified in PDCA P5. Duplicate finish of approved prepared Samples. Benchmark finish shall be applied by the Subcontractor responsible for the Project Work.
1. The Architect will select one exterior wall surface to represent surfaces and conditions for each substrate.
    a. Wall Surfaces: Prepare benchmark samples on at least 100 sq. ft. of wall surface.
2. After benchmark samples are approved, these surfaces will be used to evaluate coating systems.
3. Obtain the Architect's approval of benchmark samples before starting application of coatings.
4. Final approval of colors will be from benchmark samples, not samples submitted for verification.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the Project site in manufacturer's original, unopened packages and containers bearing the manufacturer's name and label, and the following information:
1. Product name or title of material.
2. Manufacturer's stock number and date of manufacture.
3. Contents by volume, for pigment and vehicle constituents.

4. Thinning instructions (if permitted).
5. Application instructions.
6. Color name and number.
7. Handling instructions and precautions.
8. VOC content.

B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 degrees Fahrenheit (7.22 degrees Celsius). Maintain containers used in storage of coatings in a clean condition, free of foreign materials and residue.
   1. Protect elastomeric coating materials from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure workers and work areas are protected from fire and health hazards resulting from handling, mixing, and applying coatings.

1.06 PROJECT CONDITIONS

A. Temperature Conditions: Apply coatings only when temperature of surfaces to be coated and surrounding air temperatures are between 50 and 90 degrees Fahrenheit (32.22 degrees Celsius), unless otherwise permitted by manufacturer's written instructions.

B. Weather Conditions: Do not apply coatings in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; or at temperatures less than 5 degrees Fahrenheit (-15 degrees Celsius) above the dew point; or to damp or wet surfaces.
   1. Allow wet surfaces to dry thoroughly and attain temperature and conditions specified before starting or continuing coating operation.

1.07 WARRANTY

A. Elastomeric Coating Warranty: Submit a written warranty, executed by the manufacturer, agreeing to repair or replace elastomeric coatings that fail within the specified warranty period. Failures include, but are not limited to, water penetration through the coating.

B. Warranty Period for Elastomeric Coatings: 10 years from the date of Substantial Completion.

1.08 EXTRA MATERIALS

A. Furnish extra elastomeric coating materials from the same production run as the materials applied in quantities described below. Package materials in unopened, factory-sealed containers for storage and identify with labels describing contents. Deliver extra materials to the Owner.
   1. Quantity: Furnish the Owner with an additional 5 percent, but not less than 1 gal. or 1 case, as appropriate, of each color applied.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with requirements, provide one of the products for each condition indicated in the Coating Schedule, or a comparable product by other manufacturer.

B. Manufacturers Names: The following manufacturers are referred to in the Coating Schedule by use of shortened versions of their names, which are shown in parentheses:
   1. BASF Construction Chemicals, www.buildingsystems.basf.com
   2. PPG Industries, Inc. (PPG Pittsburgh Paints), www.pittsburghpaints.com
   3. Sherwin-Williams Co., www.sherwin-williams.com

2.02 CRACK FILLERS

A. Crack Fillers: Provide the manufacturer's standard factory-formulated acrylic emulsion crack fillers that are compatible with substrate and finish coat materials indicated.

B. Products: Subject to compliance with requirements, crack fillers that may be incorporated in the Work include, but are not limited to, the following:
   1. For cracks up to 1/16 inch (1.59 mm), provide the following:
      a. PPG Pittsburgh Paints: Perma-Crete 4-1002/4-1003 Brush Grade.
      b. Sonneborn: Hydrocide 750 Brush Grade or Knife Grade Patching Compound.
      c. Thoro: Thorolastic Knife Grade.
   2. For cracks more than 1/16 inch (1.59 mm), provide the following:
      a. PPG Pittsburgh Paints: Perma-Crete 4-1002/4-1001 Knife Grade.
      b. Sonneborn: Hydrocide 750 Knife Grade Patching Compound.
      c. Tamms: Tamms Thin Patch.
      d. Thoro: Thorolastic Knife Grade.
   3. Block Filler: Reference Section 09 90 00.2.
   4. Primer: Reference Section 09 90 00.

2.03 BLOCK FILLERS AND PRIMERS

A. Materials: Block fillers and primers as specified in Section 09 90 00, or by manufacturers listed in this Section. Materials must be approved by the elastomeric coating system manufacturer.

B. Application: As specified in Section 09 90 00 and this Section.

2.04 ELASTOMERIC COATING MATERIALS

A. Material Compatibility: Provide crack fillers, block fillers, primers, elastomeric finish coat materials, and related materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

B. Material Quality: Provide the manufacturer's best-quality elastomeric coating material complying with requirements of FS TT-C-555. Material containers not displaying manufacturer's product identification are not acceptable.
   1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers.
   2. Furnish manufacturer's material data and certificates of performance of proposed substitutions.

C. Colors and Textures: Provide custom colors and textures of the finished elastomeric coating system to match the Architect's samples.

D. Products: Smooth, factory-formulated, 100 percent acrylic elastomeric coatings:
   1. Kelly-Moore: 1128 Kel-Seal Smooth Elastomeric Coating.
   2. PPG Pittsburgh Paints: 4-110 Perma-Crete Pitt-Flex Elastomeric Coating Smooth.
   3. Sherwin-Williams Co: SherLastic Smooth Elastomeric Coating.
   4. Sonneborn: Hydrocide colorflex Waterproof Elastomeric Coating.
   5. Tamms: Tammolastic Smooth Elastomeric Decorative and Protective Coating.
   6. Thoro: Thorolastic Smooth Elastomeric Coating.
   7. Primer: As recommended by the coating manufactuer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with the Applicator present, under which elastomeric coating systems will be applied for compliance with application requirements. Surfaces to receive elastomeric coatings must be thoroughly dry before coatings are applied.
   1. Notify the Architect in writing of anticipated problems using coatings specified with substrates primed by others.
   2. Begin application only after unsatisfactory conditions have been corrected and surfaces to receive coating are thoroughly dry.
   3. Start of coating within a particular area will be construed as the Applicator's acceptance of surface conditions.

3.02 PREPARATION

A. General: Remove hardware and hardware accessories, plates, machined surfaces, light fixtures, and similar items already installed that are not to be coated. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.
   1. After completing coating operations in each area, reinstall items removed, using workers skilled in trades involved.

B. Cleaning: Before applying coatings or other surface treatments, clean substrates of substances that could impair bond of coating systems. Remove oil and grease before cleaning.
   1. Schedule cleaning and coating application so dust and other contaminates will not fall on wet, newly coated surfaces.

C. Surface Preparation: Clean and prepare surfaces to be coated according to manufacturer's written instructions for the particular substrate conditions and as specified.
   1. Cementitious Surfaces: Prepare concrete, concrete masonry, stucco, and similar surfaces to receive elastomeric coatings. Remove efflorescence, chalk, dust, dirt, release agents, grease, oils, and similar conditions by water blasting followed by a clear water rinse.
      a. Remove mildew and neutralize surfaces according to manufacturer's written recommendations before patching materials are applied.
      b. Roughen as required to remove glaze. Use abrasive blast-cleaning methods if recommended by coating manufacturer.
      c. If hardeners or sealers have been used to improve concrete curing, use mechanical methods for surface preparation.

d. Determine alkalinity and moisture content of surfaces to be coated by performing appropriate tests. Do not apply coatings over surfaces where moisture content exceeds that permitted in manufacturer's written instructions.

2. Crack Repair: Fill cracks according to manufacturer's written recommendations before coating surfaces.

3. Deep Hairline Cracks: Remove dust and dirt from around cracks. Remove mildew by sterilizing before filling. Apply manufacturer's recommended primer to cracks before patching. If shrinkage occurs after applying crack filler, apply additional filler material to cracks before initially applying elastomeric coatings.

   a. Cracks up to 1/16 Inch: Clean surface around cracks. Apply primer penetrating cracks as deeply as possible, overflowing crack 2 inches (50.8 mm) on each side. When primer is dry, apply manufacturer's recommended sealant, forced well into cracks using a brush, putty knife, or trowel. Smooth edges around cracks over primed area. Allow for sealant shrinkage when applying.

   b. Cracks up to 3/8 Inch: Open cracks to 1/4 to 3/8 inch (9.52 mm) wide and 1/8 inch (3.18 mm) deep. Clean cracks and surrounding area removing dust, dirt, and other impurities. Apply primer recommended by manufacturer with a brush to obtain uniform coverage and spread approximately 2 inches (50.8 mm) on each side of cracks. Fill cracks with manufacturer's recommended crack filler applied with a putty knife or trowel, and allow for shrinkage. If excessive shrinkage occurs, reapply crack filler.

4. Material Preparation: Mix and prepare materials according to coating manufacturer's written instructions.

   a. Stir materials before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film that may form into material. Remove film and, if necessary, strain coating material before using.

   b. If manufacturer permits thinning, use only thinners recommended by manufacturer, and only within limits recommended by manufacturer.

3.03 APPLICATION

A. General: Apply elastomeric coatings to exposed surfaces indicated, according to manufacturer's written instructions.

B. Labels: Do not paint over UL, FM, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

C. Scheduling Coating: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer.

2. If undercoats or other conditions show through final coat, apply additional coats until coating film is of uniform finish, color, and appearance. Ensure that surfaces, including edges, corners, crevices, welds, and exposed fasteners, receive a dry film thickness equivalent to that of flat surfaces.

3. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until coating has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where application of another coat does not cause undercoat to lift or lose adhesion.

D. Application Procedures: Apply elastomeric coatings by brush, roller, or spray according to manufacturer's written instructions.
   1. Brushes: Use brushes best suited for material being applied.
   2. Rollers: Use professional-quality quick-release rollers of carpet, velvet back, or high-pile sheep's wool covers with a 1 to 1-1/4 inch (32 mm) nap as recommended by the manufacturer for material and texture required.
   3. Spray Equipment: Use airless spray equipment with orifice size as recommended by the manufacturer for material and texture required.
   4. Minimum Coating Thickness: Apply each material no thinner than manufacturer's recommended spreading rate. Provide total dry film thickness as recommended by the manufacturer.
   5. Wherever spray application is used, apply each coat to provide equivalent hiding of brush-applied coats. Do not double back with spray equipment, building up film thickness of 2 coats in 1 pass.

E. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.

F. Prime Coats: If recommended by the manufacturer, apply a primer to material being coated before applying finish coats.

G. Brush Application: Brush out and work brush coats into surfaces in an even film. Eliminate cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Neatly draw glass lines and color breaks.

H. Roller Application: Keep the cover wet at all times; do not dry roll. Work in sections. Lay on required amount of material, working material into grooves and rough areas; then level material, working it into surface.

I. Spray Application: Use spray equipment for application only when permitted by manufacturer's written recommendations and authorities having jurisdiction.

J. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or recoat work not complying with specified requirements.

3.04 CLEANING

A. Cleanup: At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from the Project site.
   1. After completing coating work, clean glass and spattered surfaces. Remove spattered coatings by washing, scraping, or other methods, being careful not to scratch or damage adjacent finished surfaces.

3.05 PROTECTION

A. Protect work of other trades from damage whether being coated or not. Correct damage by cleaning, repairing, replacing, and recoating as approved by the Architect. Leave in an undamaged condition.

B. Provide "Wet Paint" signs to protect newly coated finishes. Remove temporary protective wrappings provided by others to protect their work after completing coating operations.

1. After construction activities of other trades are complete, touch up and restore damaged or defaced coated surfaces.

END OF SECTION

SECTION 10 11 00

VISUAL DISPLAY SURFACES

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:
   1. Fixed Porcelain-Enamel Markerboards.
   2. Fixed Vinyl-Faced Tackboards.
   3. Sliding Visual Display Units: Custom horizontal-sliding vinyl tackboard panels.

B. Related Sections:
   1. Section 06 10 53 - Miscellaneous Rough Carpentry: Wood grounds.
   2. Section 09 77 12 – Special Wall Coverings: Dry-erase vinyl wall coverings and laminated tackable wall coverings.

1.02 REFERENCES

A. ASTM International:
   1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

1.03 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate wall elevations, dimensions, joint locations, and special anchor details and accessories.
   1. Include elevations and sections of sliding units showing track attachment to walls and clearance from interior storefront glass plane.

C. Product Data: Submit data on each type of visual display surface specified.

D. Samples:
   1. Submit two panels, 8-1/2 x 11 inches (279.4 mm) in size, illustrating materials, colors, and textures of each visual display system specified.
   2. Submit two 6-inch long sections of each piece of aluminum trim specified, illustrating profile, color, and texture.

E. Manufacturer’s Certificates: Certify that vinyl tackboard coverings comply with surface burning characteristics specifies.

1.04 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

B. Operation and Maintenance Data: Submit Operation and Maintenance Data.

1.05 QUALITY ASSURANCE

A. Surface Burning Characteristics: Maximum 200/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

B. Flame Resistant Fabric: Passes when tested in accordance with NFPA 701, Test 1 or Test 2.

C. Source Limitations: Obtain all visual display surfaces from a single manufacturer.

1.06 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience.

1.07 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.08 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Furnish 50-year manufacturer warranty for magnetic markerboards.

C. Warranty: Include coverage of markerboard surface from discoloration due to cleaning, crazing or cracking, staining, and failing to retain original writing and erasing qualities.

PART 2 - PRODUCTS

2.01 VISUAL DISPLAY BOARDS

A. Manufacturers:
   1. American Visual Display Products, LLC. www.americanvisualdisplay.com
   2. Best-Rite Chalkboard Co. www.bestrite.com
   3. Claridge Products and Equipment, Inc. www.claridgeproducts.com
   4. General Binding Corporation, www.GBC.com
   5. Lemco, Inc. www.adplemco.com
   6. New Line Products www.newlineproduct.com.
   7. Platinum Visual Systems www.pvsusa.com.
   8. Substitutions: Section 01 60 00 - Product Requirements.

2.02 COMPONENTS

A. Markerboards: Balanced, high-pressure-laminated, magnetic markerboards.
   1. Basis-of-Design: LCS3 Series Porcelain as manufactured by Claridge.
   2. Face Sheet: 28 gauge (0.0157 inch) enameling grade steel... Coat exposed face... with a 3-coat process... Fuse cover and ground coats to steel at manufacturer's standard firing temperatures, but not less than 1200 degrees Fahrenheit.

3. Cover Coat: For magnetic markerboards, provide manufacturer's standard, light-colored, special writing surface with gloss finish intended for use with erasable dry markers.
4. Panel Construction:
    a. Core: 1/2-inch thick, particleboard core material complying with requirements of ANSI A208.1, Grade 1-M-1.
    b. Backing Sheet: Manufacturer's standard 0.005-inch aluminum foil moisture barrier.
    c. Laminating Adhesive: Manufacturer's standard, moisture-resistant adhesive, factory laminated.
5. Panel Thickness: 1/2-inch, nominal.

B. Vinyl Faced Tackboards:
1. Basis-of-Design: As provided by Claridge or approved equivalent by specified manufacturer. Provide 4-VCS Panel for sliding units.
2. 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., laminated to [1/8] inch ([3.18] mm) thick cork sheet.
3. Factory laminate cork face sheet under pressure to 3/8-inch thick fiberboard core to produce a nominal 1/2-inch thick panel.
4. Provide fabric with a flame-spread rating of 25 or less when tested according to ASTM E84. Provide color and texture as scheduled or as selected from manufacturer's standards.

C. Sliding Systems: Sliding tackboard panel in normal position is adjacent to framed interior window. Tackboard will be used to slide over window, providing full window coverage, and exposed slider track on adjacent wall..
    a. Sliding Panel: Specified vinyl-faced tackboard panel laminated to 3/8” honeycomb core. overall thickness nominal 1/2”.
    b. Frames: Provide custom 1-1/2 inch wide clear anodized box frames to match corridor window frames.
    c. Panel Sizes: As indicated in the drawings.
    d. Configuration(s) as indicated in the drawings

2.03 ACCESSORIES

A. Metal Trim and Accessories: Fabricate frames and trim of not less than 0.062 inch (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. Where tackboards are combined with magnetic markerboards, chalk trays and map rails shall be continuous across width of combination unit.
1. Where size of visual display boards or other conditions require support in addition to normal trim, provide structural supports or modify trim as indicated or as selected by Architect from manufacturer's standard structural support accessories to suit conditions indicated.
2. Map Rail: Furnish map rail at top of each unit, complete with the following accessories:
    a. Display Rail: Provide continuous cork display rail, 2 inches (50.8 mm) wide, integral with map rail.
    b. End Stops: Provide one end stop at each end of map rail.
    c. Map Hooks: Provide 2 map hooks with flexible metal clips for every 48 inches (1219.2 mm) of map rail or fraction thereof. Provide a minimum of 6 map hooks per classroom.

B. Adhesives: Type used by manufacturer, waterproof.

C. Music Staff Lines: If indicated provide manufacturer’s permanently fused music staff lines where indicated or directed; 5 lines each staff with 1" between each line; 5" between each staff and 3" boarder at top and bottom; Line thickness 1/16".

2.04 FABRICATION

A. Magnetic Markerboards: Laminate facing sheet and backing sheet to core material under pressure with manufacturer's recommended flexible, waterproof adhesive.
   1. Cut joints straight and true. Space joints symmetrically. Fit and match panels before shipment to provide a continuous, uniform writing surface.
   2. Length: Furnish panels approximately equal in length with permissible variation not more than 3 inches (76.2 mm) in either direction of equal spacing. Allow 1/4 inch (6.35 mm) clearance at trim in length and width for fitting. Provide lengths of panels in each space as follows:
      a. Up to 16 feet (487.68 cm), 1 panel.
      b. More than 16 feet (487.68 cm) but less than 32 feet (975.36 cm), 2 panels.

B. Assembly: Provide factory-assembled chalkboard and tackboard 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.
   3. Provide manufacturer's standard mullion trim at joints between chalkboards and tackboards.

2.05 FACTORY FINISHING

A. Porcelain Enamel: Glass fibered enamel, baked to vitreous surfaces; Porcelain Enamel Institute Type A; white color.

B. Aluminum Frame, Chalk Rail, and Accessories: Class II clear anodized finish.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify internal wall blocking is ready to receive Work and positioning dimensions are as indicated on shop drawings.

3.02 INSTALLATION

A. Deliver and install visual display boards completely assembled in one piece without joints, where possible. If dimensions exceed panel size, install in 2 or more pieces of equal length as acceptable to Architect. When installation requires delivery in separate units, pre-fit

components at the factory, disassemble for delivery, and make final joints at the site. Use splines at joints to maintain surface alignment.

B. Establish top of chalk rail and bottom of perimeter frame at height indicated on Drawings.

C. Secure units level and plumb.

D. Coordinate units with grounds, trim, and accessories. Join parts with a neat, precision fit.

3.03 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Clean units in accordance with manufacturer’s instructions.

END OF SECTION

SECTION 10 12 00

DISPLAY CASES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Recessed display cases.

B. Surface-mounted display cases.

1.02 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry: Blocking and supports.

B. Section 09 21 16 - Gypsum Board Assemblies: Concealed supports in metal stud walls.

1.03 REFERENCE STANDARDS

A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2020.

B. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

C. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

D. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.

E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2022.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit complete printed data and installation details indicating products to be provided as specified.
   1. Submit color charts for selection by the Architect.

C. Shop Drawings: Submit complete installation details. Include dimensioned elevations.

D. Samples: Submit samples of material and trim to illustrate finish, color, and texture.

E. Specimen Warranty.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least three years of documented experience.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver display cases and materials to the Project site with manufacturer’s protective crate covering and do not open until ready for use.

B. Protect display cases before, during, and after installation. In case of damage, immediately provide necessary repairs and replacements.

1.07 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Provide five year manufacturer warranty against defects and in materials, finish product and workmanship.

PART 2 PRODUCTS

2.01 DISPLAY CASES

A. Manufacturers:
1. Provide visual display boards as manufactured by Stylmark 800-328-2495 www.stylmark.com
2. Claridge Products and Equipment, Inc; ____: www.claridgeproducts.com/#sle.
3. MooreCo, Inc; ____: www.moorecoinc.com/#sle.
4. Nelson Adams NACO; ____: www.nelsonadamsnaco.com/#sle.

2.02 COMPONENTS

A. Wood Case Construction: 3/4 inch (19 mm) 7-ply maple veneer plywood with manufacturer's standard stain.

B. Aluminum Framed Case Construction: 1-1/2 inch by 2 inch (38 mm by 51 mm) extruded aluminum tube frame with tempered glass, laminate-faced, and stained veneer plywood infill panels.

C. Aluminum Case Construction: Aluminum side, bottom, and top panels fabricated from extruded aluminum shapes.

D. Face Frame Trim for Recessed Installation: 2 inch (51 mm) flat face dimension extruded aluminum trim mitered with corner clips and mechanical fasteners.

E. Glazed Sliding Doors:
1. 1/4 inch (6 mm) clear tempered glass with plastic finger pulls.
2. Door track: Extruded aluminum glass shoe with bottom rollers and top plastic guide.
3. Lock: Glass door cylinder lock.

F. Glazed Hinged Doors:
   1. 1/4 inch (6 mm) clear tempered glass framed with 1/2 inch by 1 inch (13 mm by 25 mm) extruded aluminum trim.
   2. Hinges: 1 inch by .040 inch (25 mm by 1 mm) nickel-plated steel-continuous piano hinges.
   3. Lock: Glass door cylinder lock.

G. Glass Shelves:
   1. 1/4 inch (6 mm) clear tempered glass with flat-polished edges.
   2. Shelf Depth: 6 inches (152 mm).
   3. Shelves per Unit: Two.

H. Shelf Standards and Brackets: Single-slotted channel standards for brackets adjustable in 1 inch (25 mm) increments along entire length of standard, drilled and countersunk for screws.
   1. Standards Mounting: Recess-mounted into back panel.
   2. Face Width: 5/8 inch (16 mm).
   3. Material: 16 gauge, 0.0598 inch (1.52 mm) sheet steel.
   4. Lengths: As indicated on drawings.
   5. Finish: Anochrome.
   6. Brackets: Boltless with lip front; 16 gauge, 0.0598 inch (1.52 mm) sheet steel, reinforced, locking into slots; size to suit shelves; same finish as standards.

I. Tackable Back Panel: Fine-grained, homogeneous natural cork on hardboard.
   1. Cork Thickness: 1/8 inch (3 mm).
   2. Fabric: Vinyl fabric; minimum fabric weight: 13 oz/sq yd (440 g/sq m).
   3. Surface Burning Characteristics: Flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with ASTM E84.

J. Laminate Back Panel: Low-pressure laminate on one face of plywood substrate.

K. Lighting: Manufacturer's standard fluorescent light fixture housed at top of case with louvered aluminum access door with keyed lock.

2.03 MATERIALS

A. Aluminum Extrusions for Framing and Trim: Alloy as recommended by manufacturer for construction and specified finish; nominal 1/8 inch (3.2 mm) wall thickness.

B. Aluminum Extrusions: ASTM B221 (ASTM B221M), 6063 alloy, T5 temper.
   1. Finish: Factory anodized; AAMA 611: Clear anodized.

C. Plywood: Softwood plywood with veneer core, waterproof glue, 3/4 inch (19 mm) thick.

D. Heat-Strengthened and Fully Tempered Glass: ASTM C1048, Kind FT.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide factory trained installers.

C. Refer to drawings for display case mounting heights.

D. Clean case and glass using manufacturers recommended procedures.

E. Provide mitered and wrapped hairline joints for all trims.

3.02 ADJUSTING AND CLEANING

A. Verify that all accessories are installed as detailed for each unit.

B. At completion of work, clean glass surfaces, back panels and trim in accordance with manufacturer’s recommendations leaving units ready for use.

3.03 CLOSEOUT ACTIVITIES

A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.

END OF SECTION

SECTION 10 14 00

GRAPHICS PANELS, PLAQUES, AND BUILDING LETTERS

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes the following types of signs:
   1. Room Identification plaques.
   2. Dimensional letters and numbers.

B. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Section 01 50 00 - Temporary Facilities: Temporary project identification signs.
   2. Section 10 14 26 - Post and Panel Signs: Freestanding exterior signs.
   3. Section 14 21 23 - Elevators: Elevator door jamb markings.
   4. Division 23 for labels, tags, and nameplates for mechanical equipment.
   5. Division 26 for labels, tags, and nameplates for electrical equipment.
   6. Division 26 for illuminated exit signs.

1.02 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.
   1. Product data for each type of graphics panel and plaque specified, including details of construction relative to materials, dimensions of individual components, profiles, and finishes.
   2. Shop drawings:
      a. Drawings showing fabrication and erection of graphics panels. Include plans, elevations, and large-scale sections of typical members and other components. Show anchors, grounds, layout, reinforcement, accessories, and installation details.
      b. Schedule of room identification plaques with information about each individual sign furnished, including, but not limited to: door number, room name and number, sign type, sign text, and sign illustration graphics.
         1) Schedule shall be prepared by contractor or supplier; schedule will not be furnished by Architect.
         2) Provide message list for each plaque required, including large-scale details of wording and lettering layout.
   3. For custom graphics panels anchored to permanent construction, provide installation drawings indicating size and type of stand-offs and anchors.

B. Templates:
   1. Furnish full-size spacing templates for individually mounted dimensional letters and numbers.
   2. Furnish full-size rubbings for metal plaques.

C. Samples for initial selection of color, pattern, and texture:

1. Plastic Sheets and Plastic Laminates: Manufacturer's color charts consisting of actual sections of material including the full range of colors available for each material required.

D. Samples for verification of color, pattern, and texture selected and compliance with requirements indicated:
   1. Plastic Sheets: Provide a sample panel not less than 8-1/2 inches (216 mm) by 11 inches (279.4 mm) for each panel color selected. Include a representative sample of the graphics film applied to the sample(s).
   2. Room Identification Panels: Provide full-size representative panel in the selected color, finish, and graphics required. Sample panel may be used in project installation after approval.
   3. Dimensional Letters: Provide full-size representative samples of each dimensional letter type required, showing letter style, color, and material finish and method of attachment. Sample letters may be used in project installation after approval.
   4. Stand-Off Anchors: Submit one complete unit in selected size, configuration, and finish.

1.03 QUALITY ASSURANCE

A. Sign Fabricator Qualifications: Firm experienced in producing signs similar to those indicated for this Project, with a record of successful in-service performance, and sufficient production capacity to produce sign units required without causing delay in the Work.

B. Single-Source Responsibility: For each separate sign type required, obtain signs from one source of a single manufacturer.

C. Design Concept: The Drawings indicate sizes, profiles, and dimensional requirements of signs and are based on the specific types and models indicated. Sign units by other manufacturers may be considered provided deviations in dimensions and profiles do not change the design concept as judged by the Architect. The burden of proof of equality is on the proposer.

D. Regulatory Requirements: Comply with the Americans with Disabilities Act (ADA) and with code provisions as adopted by authorities having jurisdiction.

1.04 PROJECT CONDITIONS

A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication to ensure proper fitting. Show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
   1. Manufacturers of Panel Signs:
      a. Basis-of-Design: ASI Sign Systems, Inc.; www.asisign.com
      b. Alternate Manufactuers:
         1) Adler I.D. Systems; www.adlersign.com
         2) Takeform; www.takeform.com
   2. Manufacturers of Dimensional Letters:

a. Basis-of-Design: ASI Sign Systems, Inc.; www.asisign.com
b. Alternate Manufactuers:
    1) Adler I.D. Systems; www.adlersign.com
    2) Takeform; www.takeform.com

2.02 MATERIALS

A. Room Identification Plaques - Provide custom laminated panels constructed of matte-finished clear acrylic with opaque color coating subsurface applied, or plastic laminate in selected color and finish:
    1. 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 (110316.16 kPa) when tested according to ASTM D790, with a minimum allowable continuous service temperature of 176 degrees Fahrenheit (80 degrees Celsius), and of the following general types:
        a. Transparent Sheet: Where sheet material is indicated as "clear," provide colorless sheet in matte finish, with light transmittance of 92 percent, when tested according to the requirements of ASTM D1003.
        b. Opaque Sheet: Where sheet material is indicated as "opaque," provide colored opaque acrylic sheet in colors and finishes as selected from the manufacturer's standards.
        c. Plastic Laminate Sheet: High Pressure Decorative Laminate: NEMA LD 3, GP50 or GP28 Color, pattern, and surface texture as selected by the Architect from laminate manufacturer’s full range of colors and finishes.
            1) Manufacturers: Wilson Art, Formica, Nevamar, or Pionite.
        d. Permanently laminate face panels to backing sheets of material and thickness indicated using the manufacturer's standard process.
        e. Fabricate signs with edges mechanically and smoothly finished to conform with the following requirements:
    2. Edge Condition: Square, unless otherwise indicated.
    3. Corner Condition: Round corners, unless otherwise indicated.
        a. Colored Coatings for Acrylic Plastic Sheet: Use colored coatings, including inks and paints for copy and background colors that are recommended by acrylic sheet or plastic laminate manufacturers for optimum adherence and color fastness.
        b. Graphic Content and Style: Provide sign copy that complies with the requirements indicated for size, style, spacing, content, position, material, finishes, and colors of letters, numbers, and other graphic devices.
        c. Subsurface Copy: Apply copy to the back face of clear acrylic sheet forming the panel face by process indicated to produce precisely formed opaque images free from rough edges.
        d. Use reverse silk-screen process to print copy; overspray the copy with an opaque background color coating.
        e. Use Dupont Chromalin heat- and pressure-laminated photopolymer film system to form copy and background color.
        f. Manufacturer has the option of selecting either process indicated above, or using subsurface engraving process, as appropriate to the copy form and the economics of production.
        g. Raised Copy: Machine-cut copy characters from matte-finished opaque acrylic sheet and chemically weld onto the acrylic sheet forming sign panel face. Produce precisely formed characters with square cut edges free from burrs and cut marks.

1) Raised Copy Thickness: Not less than 1/32 inch (0.79 mm).

B. Dimensional Letters and Numbers:
1. Fabricated Letters and Numbers: Form individual letters and numbers by casting. Produce characters with smooth, flat faces, sharp corners, and precisely formed lines and profiles, free from pits, scale, sand holes, or other defects.
a. Cast aluminum with clear anodized finish, in styles, thicknesses, and heights as indicated.
b. Depending on installation type cast lugs into the back or bottom of characters and tap to receive threaded mounting studs.
c. Comply with requirements indicated for color, finish, style, and size.
2. Mounts
a. Back-Mounted: Cast lugs into the back of characters and tap to receive threaded brass or stainless steel mounting studs for mounting to building walls.
b. Free-Standing Mounted: Cast lugs into the bottom of characters and tap to receive threaded stainless steel mounting studs for bolting to continuous aluminum angle.
3. Letter Heights and Styles: As indicated.
a. Miscellaneous:
b. Aluminum Castings: Provide aluminum castings of alloy and temper recommended by the sign manufacturer for the casting process used and for the color and finish indicated.
c. Fasteners: Use concealed fasteners fabricated from metals that are not corrosive to the sign material and mounting surface.
d. Anchors and Inserts: Use stainless steel anchors and inserts for exterior installations and where exposed to view. Use aluminum or brass studs let into back of letters for anchoring letters to masonry or concrete walls.
1) Custom Graphics Panels
4. Colored Panels:
a. Translucent colored polyester resin panels in 1/4” thickness.
b. Basis of Design: Chroma as manufactured by 3-Form, Salt Lake City, Utah; www.3-Form.com
c. Color(s) as selected by the Architect.
d. Provide panels with all edges square and polished.
e. Produce smooth, even, level sign panel surfaces, constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch (1.59 mm) measured diagonally.
5. Stand-Off Anchors for Graphics Panels
a. Machined aluminum stand-offs with modified anchoring for mounting to steel structure.
b. Basis of Design: 1.0” x 1.5” Satin Aluminum Stand-Off as manufactured by Sign Bracket Store, Carlsbad, CA, www.signbracketstore.com or approved equivalent.
c. Drill-out inner ring of manufacturer’s brass mounting stud to accommodate 1/4” mounting bolt in lieu of manufacturer’s standard wood screw.
1) Cast Metal Plaques
(a) Castings shall be free from pits, scale, sand holes, or other defects. Comply with requirements specified for metal, border style, background texture, and finish and with requirements shown for thickness, size, shape, and copy. Hand-tool and buff borders and raised copy to produce the manufacturer's standard satin polished finish.

(b) Basis of Design: Style AL-300 as manufactured by A.R.K. Ramos and distributed locally by South Texas Graphics, Inc.

d. Base Plaque: Cast aluminum, 24”W x 18”H x ¾”D.

e. Border: None.

f. Edge: Square.

g. Background Texture: Manufacturer's standard leatherette finish.

h. Background and Edge Finish: Baked-enamel black color.

i. Raised Letters and Characters: Satin aluminum natural color.

2.03 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.

B. Metal Finishes: Comply with NAAMM "Metal Finishes Manual" for finish designations and applications recommendations.

C. Aluminum Finishes: Finish designations prefixed by "AA" conform to the system established by the Aluminum Association for designating aluminum finishes.

1. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: non-specular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0 inch (0.02 mm) or thicker) complying with AAMA 607.1.

PART 3 EXECUTION

3.01 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.

B. Wall-Mounted Panel Signs: Attach panel signs to wall surfaces using the methods 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. Silicone-Adhesive Mounting: Use liquid silicone adhesive recommended by the sign manufacturer to attach sign units to irregular, porous, or vinyl-covered surfaces. Use double-sided vinyl tape where recommended by the sign manufacturer to hold the sign in place until the adhesive has fully cured.
3. Shim Plate Mounting: Provide 1/8-inch-thick concealed aluminum shim plates with predrilled and countersunk holes, at locations indicated, and where other mounting methods are not practicable. Attach the plate with fasteners and anchors suitable for secure attachment to the substrate. Attach panel sign units to the plate using the method specified above.
4. Where plaques are mounted on glass and are visible from back side, provide same-size, same-color blank plate on opposite side of glass.

C. Individual Dimensional Letters and Numbers:

1. Freestanding Characters: Mount using threaded stainless steel studs set in tapped lugs at bottom of letters and shop-bolted to continuous anodized aluminum support plate. Alternate mounting using heli-arc welding prior to anodizing.
    a. Continuous Support: Bolt continuous aluminum angle supports to top of masonry walls using stainless steel expansion anchors.
    b. For security spot weld bolt heads to mounting angle.

D. Back-Mounted Characters: Mount using threaded stainless steel or brass studs set in tapped lugs at backs of letters. Drill holes in finished masonry slightly larger than threaded studs and set in two-component clear epoxy adhesive. Use sufficient epoxy such that small amount of material pushes out of the mounting holes and seals to back of letters or spacers.

E. Custom Graphics Panels:
1. Mount manufacturer’s brass mounting stud to steel frame structure using 1/4” bolt with machine threads or self-cutting threads for steel. Pre-drill hole in steel structure sized for self-cutting threads or drilled and tapped for machine threads.
2. Mount threaded stand-off barrel onto fixed threaded brass stud.
3. Locate stand-offs as indicated in the drawings, nominal 24” o.c. each way.
4. Secure graphics panels to stand-off barrels by installing threaded cap into barrel. If barrel has no set screw, provide epoxy coating of nominal 1/2” of threads prior to installing cap.

F. Cast Metal Plaques: Mount plaques using one of the following methods dependent on substrate.
1. Concealed Mounting in Masonry: Mount the plaques by inserting threaded studs into tapped lugs on the back of the plaque. Set in predrilled holes filled with quick-setting cement.
2. Mounting in Drywall: Coordinate with Contractor for installation of solid wood blocking between studs for mounting of plaque. Use countersunk, flat-head, square-drive stainless steel mounting screw in each corner.

3.02 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.

END OF SECTION

SECTION 10 14 26

POST AND PANEL SIGNS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Non-illuminated single-panel-type post and panel signs.

B. Related Sections:
   1. Section 01 50 00 - Temporary Facilities: Temporary project identification, information, and directional signs.
   2. Section 03 30 00 - Cast-In-Place Concrete: Concrete fill for post holes.
   3. Section 10 14 00 - Signs: Wall-mounted interior and exterior signs.

1.02 SUBMITTALS

A. Product Data: For each type of post and panel sign specified. Include details of construction relative to materials, dimensions of individual components, profiles, and finishes. Provide manufacturer's written instructions for maintaining and cleaning sign surfaces.

B. Shop Drawings: For each type of post and panel sign indicated.
   1. Provide plans, elevations, and at least 3/4-inch (1:20) scale sections of typical members and other components. Show anchors, reinforcement, accessories, layout, and installation details.
   2. Provide message list, including details of wording and lettering layout, at least half size. Include full-size details of special graphics.

C. Samples for Verification: Of the following products, showing color, texture, or finish selected. Where finishes involve normal color and texture variations, include Sample sets showing the full range of variations expected. Prepare Samples from the same material to be used for the Work.
   1. Aluminum: Samples of each finish type and color, on 6-inch long sections of extrusions and squares of sheet or plate at least 4 inches (101.6 mm).
   2. Include a representative sample of the graphic-image process required in each panel. Show graphic style and colors and finishes of letters, numbers, and other graphic devices.

1.03 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer who is an authorized representative of the sign manufacturer and who has completed installation of post and panel signs similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Source Limitations: Obtain post and panel signs through one source from a single manufacturer.

C. Product Options: Drawings indicate size, profiles, and dimensional requirements of post and panel signs and are based on the specific type and model indicated. Other manufacturers' signs may be considered provided deviations are minor and do not change the design concept and are approved by the Architect.

D. Do not modify intended aesthetic effects, as judged solely by the Architect, except with Architect's approval and only to the extent needed to comply with performance requirements. Where modifications are proposed, submit comprehensive explanatory data to Architect for review.

1.04 DELIVERY AND HANDLING

A. Delivery: Provide protective covering or crating as recommended by the manufacturer to protect sign components and surfaces against damage during transportation and delivery.
   1. Coordinate delivery time so signs can be installed within 24 hours of receipt at Project site.

B. Handle signs carefully to prevent breakage, surface abrasion, denting, soiling, and other defects. Comply with the manufacturer's written handling instructions for unloading components subject to damage.
   1. Inspect sign components for damage on delivery.
   2. Do not install damaged sign components.
   3. Repair minor damage to signs, provided the finished repair is equal in all respects to the original work and is approved by Architect; otherwise, remove and replace damaged sign components.

PART 2 PRODUCTS

2.01 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, the following:
   1. Apco Graphics Inc., www.apcosigns.com.
   2. ASI Sign System, Inc.,www.asisign.com
   3. Charleston Industries, Inc., www.cisigns.com.
   4. Vomar Products, Inc., www.vomarproducts.com.

2.02 MATERIALS

A. Aluminum Sheet or Plate: Alloy and temper recommended by the aluminum producer and finisher for the type of use and finish indicated, and with at least the strength and durability properties specified in ASTM B 209 (ASTM B 209M) for 5005-H15 alloy.

B. Aluminum Extrusions: Alloy and temper recommended by the aluminum producer and finisher for the type of use and finish indicated, and with at least the strength and durability properties specified in ASTM B221 (((ASTM B221M))) for 6063-T5 alloy.

C. Vinyl Film: Opaque, non-reflective vinyl film, 0.0035-inch minimum thickness, with pressure-sensitive adhesive backing, suitable for exterior applications.

D. Colored Coatings for Plastic Sheet: Use nonfading colored coatings, including inks and paints for copy and background colors that are recommended by the manufacturers for optimum adherence to the type of surface used.

2.03 COMPONENTS

A. Aluminum Posts: Manufacturer's standard 0.125-inch thick, structural aluminum tubing extruded from 6063-T5 alloy, with vertical slots to engage sign panels. Provide stop blocks in slots to hold panels in position. Include post caps, fillers, spacers, junction boxes, access panels, and related accessories required for a complete installation. Comply with the following requirements for post shape, finish, and mounting method:
   1. Post Shape: 2 by 2 inches (50.8 mm) square.
   2. Post Finish: Match finish of panel.
   3. Post Mounting Method: Provide sign posts of length required for permanent installation by direct-burial mounting method.

B. Sign Panels: Provide smooth, even, level sign panel surfaces constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch (1.59 mm) measured diagonally from corner to corner.
   1. Framed Single-Sheet Panels: Provide framed single-sheet sign panels with edges mechanically and smoothly finished to conform to the following:
      a. Panel Material: 0.125-inch thick aluminum plate.
      b. Panel Finish: Baked enamel.
   2. Frame Material: Extruded aluminum, fabricated to profile indicated with integral slots to receive sign message panel; comply with the following:
      a. Frame Finish: Match finish of panel.
      b. Corner Condition: Square corners.

C. Graphic Content and Style: Provide sign copy to comply with requirements indicated for sizes, styles, spacing, content, positions, materials, finishes, and colors of letters, numbers, symbols, and other graphic devices.
   1. Surface-Applied, Die-Cut Vinyl Copy: Provide die-cut characters from nonreflective vinyl film with pressure-sensitive adhesive backing. Apply copy to exposed face of sign panel.

2.04 ACCESSORIES

A. Fasteners: Use concealed fasteners fabricated from metals that are noncorrosive to sign material and mounting surface.

B. Anchors and Inserts: Use nonferrous metal or hot-dip galvanized anchors and inserts. Use toothed steel or lead expansion-bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete.

2.05 FABRICATION

A. General: Provide manufacturer's standard double-post, single-panel-type post and panel signs. The completed sign assembly shall consist of a message panel supported between 2 posts. Comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.
   1. Allow for thermal movement resulting from a maximum ambient temperature change (range) of 100 degrees Fahrenheit (37.78 degrees Celsius). Design, fabricate, and install

post and panel sign assemblies to prevent buckling, opening up of joints, and overstressing of welds and fasteners.

a. Base design on actual surface temperatures of metals due to both solar heat gain and nighttime-sky heat loss.

2. Welded Connections: Comply with AWS standards for recommended practices in shop welding. Provide welds behind finished surfaces without distortion or discoloration of exposed side. Clean exposed welded surfaces of welding flux and dress on exposed and contact surfaces.
3. Mill joints to a tight, hairline fit. Form joints exposed to the weather to exclude water penetration.
4. Preassemble signs in the shop to the greatest extent possible to minimize field assembly. Disassemble signs only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation, in a location not exposed to view after final assembly.
5. Conceal fasteners if possible; otherwise, locate fasteners where they will be inconspicuous.

B. Posts: Fabricate posts to lengths required for mounting method indicated.

1. Direct Burial: For permanent sign installation, provide posts 36 inches (914.4 mm) longer than height of sign to permit direct embedment in concrete foundations.

C. Panels: Form panels to required size and shape. Comply with requirements indicated for design, dimensions, finish, color, and details of construction.

1. Increase metal thickness or reinforce with concealed stiffeners or backing materials as required to produce surfaces without distortion, buckles, warp, or other surface deformations.
2. Continuously weld joints and seams, unless other methods are indicated; grind, fill, and dress welds to produce smooth, flush, exposed surfaces with welds invisible after final finishing.

2.06 FINISHES

A. 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. 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 specifications for cleaning, conversion coating, and painting.

D. Organic Coating: Thermosetting, modified-acrylic enamel primer/topcoat system complying with AAMA 603.8, except with a minimum dry film thickness of 1.5 mils (0.0381 mm), medium gloss.

E. Color: As indicated by manufacturer's color designations.

F. Colors and Textures: For exposed sign material that requires selection of materials with integral or applied colors, textures, or other characteristics related to appearance, provide color matches as selected by Architect from manufacturer's standards.

PART 3 EXECUTION

3.01 INSTALLATION

A. General: Locate sign units and accessories where indicated, using mounting methods of type described and complying with manufacturer's written instructions.

B. Excavation: In firm, undisturbed or compacted soil, drill or (using a post-hole digger) hand-excavate holes for each post to the minimum diameter recommended by sign manufacturer, but at least 4 times the largest post cross-section.

C. Excavate hole depths approximately 3 inches (76.2 mm) lower than required post bottom, with bottom of posts set at least 36 inches (914.4 mm) below finished grade.

D. Install signs level, plumb, and at height indicated, with surfaces free from distortion or other defects in appearance.

3.02 CLEANING AND PROTECTING

A. At completion of installation, clean soiled surfaces of sign units according to manufacturer's written instructions.

B. Protect installed sign units from damage until acceptance by Owner.

END OF SECTION

SECTION 10 14 63

MONUMENT MESSAGE SIGNS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Full-color animated LED electronic message board mounted on masonry base with shop-finished metal housing as indicated on the drawings.

B. Related Sections:
   1. Section 04 20 00 - Unit Masonry: Masonry base for monument-type signs.
   2. Division 26 Sections – Power and conduit to monument sign.

1.02 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide signs capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated, determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures":
   1. Wind Loads: As indicated on Drawings.

B. Thermal Movements: Provide signs that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   1. Temperature Change (Range): 120 degrees Fahrenheit (48.89 degrees Celsius) ambient; 180 degrees Fahrenheit (82.22 degrees Celsius) material surfaces.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes. Include manufacturer's written instructions for maintaining and cleaning sign surfaces.

B. Shop Drawings: Show fabrication and installation details for monument-type signs.
   1. Include plans, elevations, and at least 3/4-inch (1:20) scale sections of typical members and other components. Show anchors, reinforcement, accessories, layout, and installation details.
   2. Show locations of electrical service connections.
   3. Wiring Diagrams: For internally illuminated signs and LED message boards.

C. Samples for Initial Selection: Manufacturer's color charts consisting of actual units or sections of units showing the full range of colors available for the following:
   1. Aluminum.

D. Samples for Verification: For each type of product indicated, of size below:
   1. Aluminum: For each form, finish, and color, on 6-inch long sections of extrusions and squares of sheet at least 4 by 4 inches (101.6 mm).

1.04 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative of sign manufacturer for installation and maintenance of units required for this Project.

B. Source Limitations: Obtain monument-type signs through one source from a single manufacturer.

C. Product Options: Drawings indicate size, profiles, and dimensional requirements of monument-type signs and are based on the types and features indicated. Refer to Division 1 Section "Product Requirements."
   1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

D. 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.

1.05 DELIVERY AND HANDLING

A. Deliver monument-type signs in protective covering and crating to protect sign components and surfaces against damage.

1.06 COORDINATION

A. Coordinate installation of anchorages for monument-type signs. Furnish setting drawings, templates, and directions for installing anchorages and other items that are to be embedded in concrete. Deliver such items to Project site in time for installation.

B. Coordinate delivery time so signs can be installed within 24 hours of receipt at Project site.

1.07 WARRANTY

A. Message Sign Warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace panels and components that fail in materials or workmanship during specified warranty period. Failures include, but are not limited to, the following:
   1. Coating degradation.
   2. Chalking.
   3. Fading.
   4. Failure of LEDs or electronic message board components.

B. Warranty Period: 7 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design: Entech Signs; www.entechsigns.com

B. Daktronics, www.daktronics.com

C. Robson Corporation, www.robsonschoolsigns.com

D. Spectrum Corporation, www.spectrumscoreboards.com

E. Nevco Display, www.nevco.com

F. Substitutions: Section 01 60 00 - Product Requirements.

2.02 LED MESSAGE BOARDS

A. Basis-of-Design: Entech Signs, Alpha-LED Series.

2.03 MATERIALS

A. Aluminum Extrusions: ASTM B221/B221M, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with at least the strength and durability properties of alloy 6063-T5.

B. Structural Steel:
   1. Hot-Rolled Structural-Steel Shapes: ASTM A36/A36M or ASTM A529/A529M.
   2. Steel Tubing or Pipe: ASTM A500, Grade B.
   3. Steel Members Fabricated from Plate or Bar Stock: ASTM A529/A529M or ASTM A572/A572M, 42,000-psi minimum yield strength.
   4. Bolts for Steel Framing: ASTM A307 or ASTM A325/A325M as necessary for design loads and connection details.
   5. For steel exposed to view on completion, provide materials selected for surface flatness, smoothness, and freedom from surface blemishes. Do not use materials whose surfaces exhibit pitting, seam marks, roller marks, rolled trade names, or roughness.

C. LED Message Boards: Provide double-face LED message panels with the following characteristics:
   1. LED Matrix: 24 x 176
   2. Pitch: 0.67 inch (17 mm)
   3. Point of Convergence: 1.1 inch (28 mm)
   4. Size: As indicated.
   5. LEDs per Pixel: 1
   6. Color: RGB full color and dimming levels
   7. Minimum Character Height: 4.7 inch (119.38 mm).
   8. Graphics Capability: Text, animation, pictures, video.
   9. Frame Rate: 60 frames/sec.
   10. Scan Rate: 300 Hz
   11. Communication: Hardwired Ethernet (CAT6) connection.

2.04 ACCESSORIES

A. Fasteners: Use concealed fasteners fabricated from metals that are noncorrosive to sign material and mounting surface.

B. Anchors and Inserts: Use stainless steel or hot-dip galvanized anchors and inserts. Use torque-controlled expansion-bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete.

C. Temperature and Ambient Light Sensor: Mount sensor on side of masonry sign- support wall. Temperature probe shall provide ambient temperature read-out on screen when programmed. Light sensor shall automatically brighten and dim LED lighting for optimum brightness depending on ambient light condition.

2.05 OPERATION

A. Controlled remotely by wireless 4G cellular communication using sign-mounted cellular antennae. Label terminal as “Wireless Control”. Access to control link shall be password-protected.

B. Emergency Power: Power circuit to monument sign is from the emergency power panel. In the event of a power outage, transfer to emergency power will be delayed for several seconds. Upon temporary short-term power loss, sign shall be capable of self-rebooting and continuing to operate without manual reset.

2.06 FABRICATION, GENERAL

A. General: Provide manufacturer's standard monument-type sign assembly consisting of double-sided LED message boards mounted on masonry base with concealed structural framing system.
   1. Welded Connections: Comply with AWS standards for recommended practices in shop welding. Provide welds behind finished surfaces without distortion or discoloration of exposed side. Clean exposed welded surfaces of welding flux and dress exposed and contact surfaces.
   2. Mill joints to a tight, hairline fit. Form joints exposed to weather to exclude water penetration.
   3. Preassemble signs in the shop to greatest extent possible. Disassemble signs only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation, in location not exposed to view after final assembly.
   4. Conceal fasteners if possible; otherwise, locate fasteners where they will be inconspicuous.

2.07 STRUCTURE

A. Base: Provide monument-type signs with integral base consisting of channels, angles, plates, or other fittings. Drill holes in members for anchor-bolt connection.
   1. Provide anchor bolts of size required for connecting base to concrete foundations.

B. Internal Frames: Manufacturer's standard internal steel framing system, designed to withstand wind pressure indicated. Provide welded construction using mitered joints. Cut, drill, and tap units to receive hardware, bolts, and similar items.
   1. Hot-dip galvanize steel framing system after fabrication to comply with ASTM A123/A123M.

2.08 PAINTED FINISHES – ALUMINUM HOUSING

A. Minimum two coat fluoropolymer coating with minimum 70-percent polyvinylidene fluoride resin (Kynar).
   1. Match approved sample in color, finish, and sheen.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Set anchor bolts and other embedded items required for installation of signs. Use templates furnished by suppliers of items to be attached.

B. Install signs level and plumb, with surfaces free from distortion or other defects in appearance.

C. Install control system including primary and secondary controls including antenna, receiver and all related wiring. Install temperature/lighting sensor and related wiring. Make all final connections including data and power. Install manufacture’s control software.

3.02 CLEANING

A. At completion of installation, clean soiled surfaces of sign units according to manufacturer's written instructions.

3.03 TESTING AND TRAINING

A. Test installed equipment thoroughly for proper operation. Provide operational testing for both primary and secondary control system.

B. Train Owner’s designated personnel in the proper maintenance and operation of the sign and related equipment. Instruct Owner’s personnel in the proper use of the installed control software. Leave the sign in operating condition using the primary control system and set up initial programming as needed by the Owner.

END OF SECTION

SECTION 10 21 13

PHENOLIC-CORE TOILET COMPARTMENTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Phenolic-core through-color overhead-braced toilet compartments and matching urinal screens.

B. Related Sections:
   1. Section 06 10 00 - Rough Carpentry: Concealed wood framing and blocking for compartment support.
   2. Section 10 28 00 - Toilet Accessories.

1.02 REFERENCES

A. ASTM International:
   1. ASTM A 666 - Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

1.03 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall and floor supports, and door swings.

C. Product Data: Submit data on panel construction and each type of hardware and accessory.

D. Samples: Submit two samples, 12 x 12 inch (304.8 mm) in size, illustrating panel finish, color, and sheen.

E. Manufacturer's Installation Instructions: Submit special procedures and perimeter conditions requiring special attention.

1.04 QUALITY ASSURANCE

A. Perform Work in accordance with Texas Accessibility Standards (TAS).

B. Partition system installation company shall have a minimum of five (5) years’ experience in the installation of similar systems for projects of similar size and scope and be authorized by the system manufacturer for this installation.

1.05 MANUFACTURER’S WARRANTY

A. Provide manufacturer’s written warranty against defects in workmanship and materials for a minimum of twenty-five (25) years after date of Substantial Completion of the Project.

B. Warranted items shall include, but not limited to: color change, sagging, crazing, or cracking of panel material; corrosion of metal parts; failure or improper operation of moving parts.

1.06 PRE-INSTALLATION MEETING

A. Section 01 31 19 – Project Meetings: Schedule and coordinate pre-installation meeting that includes the trade(s) for the work of this Section and other trades that whose work is related to the work of this Section.

B. Convene minimum one week prior to commencing work of this Section.

1.07 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Coordinate Work with placement of support framing and anchors in wall and ceiling.

PART 2 PRODUCTS

2.01 TOILET COMPARTMENTS AND URINAL SCREENS

A. Manufacturers:
1. Accurate Partitions Corporation; asi-accuratepartitions.com
2. Bobrick Washroom Equipment, Inc.; www.bobrick.com
3. Bradley Corporation; www.bradleycorp.com
4. General Partitions Mfg. Corp.; www.genpartitions.com
5. Metpar; www.metpar.com
6. PSISC Partition Systems Intl. (Columbia Partitions); www.psisc.com
7. Tex-Lam Manufacturing, Inc.; www.texlam.com
8. Substitutions: Section 01 60 00 - Product Requirements.

B. Basis of Design: Floor-mounted and overhead braced compartments and matching urinal screens as manufactured by PSIAC or approved equivalent by specified manufacturer.

2.02 COMPONENTS

A. Door, Panel and Pilaster Construction: Solid phenolic-core panel material with plastic facing on both sides fused to substrate during panel manufacture (not separately laminated), and with eased and polished edges, and matching through-color cores. Provide minimum 3/4-inch material for all components.
1. Facing Sheets Color: Formica “Steller” finish in color as indicated.
2. Core Color: Manufacturer's through-color material matching faces.

B. Urinal Screens: Wall-mounted and floor-braced, of same material, finish, and color as toilet compartments. Brace with 2” x 2” x 1/8” thickness clear anodized extruded aluminum tube to floor with concealed stainless steel or aluminum floor mounting plate.

2.03 ACCESSORIES

A. Pilaster Shoe: Formed stainless steel sheet, ASTM A 666 Type 304, with No. 4 finish, 3-inch high, concealing floor fastenings.

B. Head Rails: Hollow extruded aluminum tube with anti-grip profile and cast socket wall brackets; clear anodized finish.

C. Brackets: Polished stainless steel, full-height (continuous) type.

D. Attachments, Screws, and Bolts: Stainless steel, tamper proof type.
   1. For attaching panels and pilasters to brackets: Through-bolts and nuts; tamper proof.

E. Hardware: Stainless steel:
   1. Full length stainless steel piano hinge, self-closing, adjustable to hold door open at any angle up to 90 degrees.
   2. Heavy-duty stainless steel thumb-turn or sliding-type door latch with brushed finish; at compartments indicated to be handicapped accessible, provide latches that comply with accessibility requirements of authorities having jurisdiction.
   3. Door strike and keeper with rubber bumper; mounted on pilaster in alignment with door latch.
   4. Coat hook with rubber bumper; one for each compartment, mounted on doors of regular compartments and pilasters adjacent to doors at handicapped compartments.
   5. Furnish door pull and rubber-tipped bumper for out-swinging doors. Provide pulls on both sides of doors at compartments indicated to be handicapped accessible.
   6. Furnish continuous channel brackets at walls.

2.04 FABRICATION

A. Overhead-Braced Units: 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.

B. Doors:
   1. Standard Compartments: Provide 24- inch wide in-swinging doors at toilet stalls unless indicated otherwise.
   2. Handicapped Accessible Toilet Compartments: Provide 34-inch wide out-swinging doors with a minimum 32-inch wide clear opening.

PART 3 EXECUTION

3.01 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify field measurements are as indicated on shop drawings.

C. Verify correct spacing of plumbing fixtures.

D. Verify correct location of built-in framing, anchorage, and bracing.

3.02 INSTALLATION

A. Maintain the following maximum clearances:
   1. Walls and panels: 1 inch (25.4 mm).
   2. Walls and pilasters: 1 inch (25.4 mm).
   3. Panels and pilasters: 1/2 inch (12.7 mm).

B. Attach continuous panel brackets securely to walls using anchor devices.

C. Secure pilasters to floor; level, plumb, and tighten.

D. Secure continuous head rail to each pilaster with not less than two fasteners.

E. Hang doors to align tops of doors with tops of panels and adjust so tops of doors are parallel with overhead brace when doors are in closed position.

F. Urinal Screens: Attach to floors and walls with anchoring devices to suit supporting structure. Set units level and plumb and to resist lateral impact.

3.03 ERECTION TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Maximum Variation from Indicated Position: 1/4 inch (6.35 mm).

C. Maximum Variation from Plumb: 1/8 inch (3.18 mm).

3.04 ADJUSTING

A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.

B. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch (4.76 mm).

C. Adjust hinges to position doors in partially opened position when unlatched. Return out-swinging doors to closed position.

D. Adjust adjacent components for consistency of line or plane.

END OF SECTION

SECTION 10 22 13

WIRE MESH PARTITIONS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Wire mesh partition system with hinged doors.

B. Related Sections:
1. Section 08 71 00 - Door Hardware: Cylinders for locksets.

1.02 REFERENCES

A. ASTM International:
1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
2. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
3. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
4. ASTM A510 - Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel.

B. American Welding Society:
1. AWS D1.1 - Structural Welding Code - Steel.

1.03 DESIGN REQUIREMENTS

A. Design partition system to provide for movement of components without damage, undue stress on fasteners or other detrimental effects, when subject to design loads.

B. Design system to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.

1.04 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate plan and vertical dimensions, elevations, component details; head, jamb, and sill details; location of hardware. Include component details, anchorage, type and location of fasteners, and accessories or items required of related work.

C. Product Data: Submit data for screen materials and finishes.

D. Samples: Submit two samples, 12 x 12 inch (304.8 mm) in size illustrating screen material.

E. Manufacturer's Installation Instructions: Include special procedures and perimeter conditions requiring special attention.

1.05 SUSTAINABLE DESIGN SUBMITTALS

A. For products used to meet specified goals for recycled content or local and regional materials, submit manufacturer's certificate certifying the following:
   1. Recycled Content: Recycled material content.
   2. Local and Regional Materials: Source for materials and distance from project site.

1.06 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience.

1.07 FIELD MEASUREMENTS

A. Verify field measurements are as shown on shop drawings.

PART 2 PRODUCTS

2.01 WIRE MESH PARTITIONS

A. Manufacturers:
   1. Acorn Wire and Iron Works, Inc. www.acornwire.com
   2. Avant Guards Manufacturing. www.avantguards.com
   3. G-S Company www.g-sco.com
   4. Hoosier Fence Co., Inc.
   5. Indiana Wire Products, Inc. www.indianawireproducts.com
   6. Kentucky Metal Products Co. www.kentuckymetal.com
   7. King Wire Partitions, Inc. www.kingwireusa.com
   8. Lakeside Wire and Iron Co. www.lakesidewire.com
   9. Miller Wire Works, Inc. www.millerwireworks.com
   10. SpaceGuard Products. www.spaceguardproducts.com/home.htm
   11. Wire and Iron Products, Inc. www.jescoonline.com
   12. Substitutions: Section 01 25 00 – Substitution Procedures

2.02 COMPONENTS

A. Framing Members:
   1. ASTM A36/A36M, formed steel sections
   2. ASTM A500, Grade B cold formed steel tubing.

B. Woven Screen Wire: ASTM A510 uncoated crimped steel wire; conforming to the following:
   1. Wire Size: 6 gage.
   2. Mesh Size: 2 x 2 inch (50.8 mm).
   3. Mesh Weave Design: Plain weave, intercrimp design.

C. Welding Materials: AWS D1.1; type required for materials being welded.

D. Bolts, Nuts and Washers: Hot dip galvanized.

E. Anchorage Devices: Type required for materials being anchored.

F. Exposed Mechanical Fastenings: Flush countersunk screws or bolts, unobtrusively located, consistent with design of structure.

2.03 ACCESSORIES

A. Mesh Panels: Woven screen wire securely clinched into 1-1/2 x 3/4 inch (19.05 mm) steel channel frames.

B. Corner Posts: 1-3/4 x 1-3/4 inch (44 mm) steel angles.

C. Intermediate Posts: 2-1/2 x 5/16 inch (7.94 mm) flat steel bars.
   1. Where partition runs exceed 20 feet (609.6 cm) without intersecting or connecting to overhead framing, furnish 3 inch (76.2 mm) by 4.1 lb steel channel line posts with 5 x 18 x 1/4 inch (6.35 mm) steel base plates located at recommended intervals to ensure partition rigidity and stability.

D. Floor Shoes: Manufacturer's standard, cast steel or aluminum, 2-1/2 inches (64 mm) high, with set screw adjustment to set bottom horizontal frame members approximately 3 inches (76.2 mm) above floor.

E. Intermediate Horizontal Members: 1-1/2 x 3/4 inch (19.05 mm) steel channel, mortised and tenoned into vertical member.

F. Intersection Posts for 3- or 4-Way Intersections: 2 x 2 inch (50.8 mm) steel tubes.
   1. For other than 90-degree intersections, use system's tubular steel corner posts and installation accessories.

G. Top Rail Horizontal Members: 3 inch (76.2 mm) x 4.1 lb steel channel, mortised and tenoned into vertical member.

H. Hinged Doors: Door frame of 1-1/2 x 3/4 x 1/8 inch (3.18 mm) steel channels with 1-1/2 x 1/8 inch flat steel bar cover plates on 3 sides, and 1/8 inch thick strike bar on lock side. Provide 1-1/2 pairs of 3-1/2 x 3-1/2 inch (89 mm) butt hinges riveted or welded to door and frame, and mortise-type cylinder lock operated by key outside with recessed lever handle complying with Texas Accessibilty Standards (TAS) inside. Align bottom of door with bottom of adjacent panels.

I. Cylinder Locks: As specified in Section 08 71 00.

J. Touch-Up Primer for Galvanized Surfaces: SSPC 20 zinc rich.

2.04 FABRICATION

A. Fabricate posts and panel frames with 3/8 inch (9.52 mm) diameter bolt holes spaced 18 inches (457.2 mm) oc

B. Fit and assemble in largest practical sections for delivery to site, ready for installation.

C. Make exposed joints flush and tight.

D. Furnish components required for anchorage to adjacent construction.

E. Frame openings made for penetrating mechanical and electrical components.

F. Fabricate door for hinged operation.

2.05 SHOP FINISHING

A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

B. Galvanizing: ASTM A123/A123M; galvanize after fabrication.

PART 3 EXECUTION

3.01 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify substrate surfaces and required openings are ready to receive work.

3.02 PREPARATION

A. Clean substrate surfaces.

3.03 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Provide additional field bracing as necessary for rigid, secure installation.

C. Perform field welding in accordance with AWS D1.1.

D. After installation, touch-up field welds, and scratched or damaged surfaces with touch-up primer.

3.04 ERECTION TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Maximum Variation From Plumb or Level: 1/4 inch (6.35 mm).

C. Maximum Misalignment From Indicated Position: 1/4 inch (6.35 mm).

3.05 ADJUSTING

A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.

B. Adjust hinged doors to achieve free movement.

END OF SECTION

SECTION 10 28 00

TOILET AND CUSTODIAL ACCESSORIES

PART 1 GENERAL

1.01 SUMMARY

A. The following items are Contractor furnished and Contractor installed:
   1. Sanitary napkin disposal units.
   2. Grab bars in student and adult toilet rooms.
   3. Stainless steel framed mirrors.
   4. Mop and broom holders with shelf at custodial closets.

B. The following items are Owner-Furnished and Contractor Installed (OFCI):
   1. Surface-mounted paper towel dispensers.
   2. Toilet tissue dispensers
      a. Big roll in student toilet room stalls.
      b. Double roll in adult toilet room stalls.
   3. Liquid soap dispensers.

1.02 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specifications Sections.

B. Product Data for each toilet accessory item specified, including details of construction relative to materials, dimensions, gages, profiles, method of mounting, specified options, and finishes.

C. Schedule: Indicating types, quantities, sizes, and installation locations (by room) for each toilet accessory item to be provided for project.

D. Setting Drawings: Where cutouts are required in other work, provide templates, substrate preparation instructions, and directions for preparing cutouts and for installation of anchorage devices.

1.03 QUALITY ASSURANCE

A. Inserts and Anchorages: Furnish inserts and anchoring devices that must be set in concrete or built into masonry; coordinate delivery with other work to avoid delay.

B. Single-Source Responsibility: Provide products of same manufacturer for each type of accessory unit and for units exposed to view in same areas, unless otherwise acceptable to Architect.

1.04 PROJECT CONDITIONS

A. Coordination: Coordinate accessory locations, installation, and sequencing with other work to avoid interference and to assure proper installation, operation, adjustment, cleaning, and servicing of toilet accessory items.

1.05 WARRANTY

A. Special Project Warranty: Provide manufacturer's written 5-year warranty against silver spoilage of mirrors, agreeing to replace any mirrors that develop visible defects within warranty period.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide toilet accessories by one of the following:
   1. Toilet and Bath Accessories
      a. A & J Washroom Accessories www.ajwashroom.com
      b. American Specialties, Inc. www.americanspecialties.com
      c. Bobrick Washroom Equipment, Inc. www.bobrick.com
      d. Bradley Corporation www.bradleycorp.com
      e. Georgia-Pacific www.gp.com
      f. General Accessory Manufacturing Co. www.gamcousa.com
      g. Kimberly-Clark Professional www.kcprofessional.com
      h. McKinney/Parker

2.02 MATERIALS, GENERAL

A. Stainless Steel: AISI Type 302/304, with polished No. 4 finish, 22-gage minimum thickness, unless otherwise indicated.

B. Brass: Leaded and unleaded, flat products, ASTM B 19; rods, shapes, forgings, and flat products with finished edges, ASTM B16, Castings, ASTM B-30.

C. Sheet Steel: Cold-rolled, commercial quality ASTM A366, 20-gage minimum, unless otherwise indicated. Surface preparation and metal pretreatment as required for applied finish.

D. Galvanized Steel Sheet: ASTM A527, G60.

E. Chromium Plating: Nickel and chromium electro-deposited on base metal, ASTM B456, Type SC 2.

F. Vinyl-Backed Safety Mirror Glass: Nominal ¼ inch thick, conforming to ASTM C1036, Type I, Class 1, Quality q2, and with silvering, electro- plated copper coating, and protective organic coating. Apply vinyl backing with pressure-sensitive adhesive coating over glass coating by method recommended by vinyl-backing manufacturer to produce a surface free of bubbles, blisters, or other imperfections. Use adhesives and vinyl backing compatible with glass coating as certified by organic coating manufacturer.

G. Galvanized Steel Mounting Devices: ASTM A 153, hot-dip galvanized after fabrication.

H. Fasteners: Screws, bolts, and other devices of same material as accessory unit or of galvanized steel where concealed.

I. Keys: Unless otherwise indicated, provide universal keys for access to toilet accessory units requiring internal access for servicing, resupply, etc. Provide minimum of six (6) keys to Owner's representative and obtain receipt.

2.03 SANITARY NAPKIN DISPOSAL UNITS

A. Surface-mounted stainless steel disposal unit with seamless exposed walls, tightly self-closing top cover and locking bottom panel with continuous stainless steel piano hinge.
   1. Basis-of-Design: Bradley Corporation No. 4781-15.

2.04 GRAB BARS

A. Stainless Steel Type: Provide grab bars with wall thickness not less than 18 gage and as follows:
   1. Mounting: Concealed, manufacturer's standard flanges and anchorages.
   2. Clearance: 1-1/2 inches (12.7 mm) clearance between wall surface and inside face of bar.
   3. Gripping Surfaces: Smooth, satin finish.
   4. Heavy-Duty Size: Outside diameter of 1-1/2 inches (12.7 mm).
   5. Length: 42", at sides of water closet; 36", behind water closet.
   6. Shower "L": "L" style 18" x 30".
   7. Shower "U": "L" style 36" x 48" x 36□.

2.05 FRAMED MIRRORS

A. Stainless Steel Framed Tempered Glass Mirror Units:
   1. Glass: 1/4" thick tempered.
      a. Fabricate frame with angle shapes of not less than 18 gage, with square corners mitered, welded, and ground smooth. Type 430 stainless steel in No. 4 satin polished finish.
      b. All mirrors within toilet rooms shall be stainless steel framed.

2.06 MISCELLANEOUS ACCESSORIES

A. Mop and Broom Holder: 18 gage Type 304 stainless steel "hat" channel with spring-loaded rubber cam-type mop/broom holders and integral shelf. Provide unit 48 inches (1219.2 mm) long and complete with 5 holders.
   1. Basis-of-Design: Bobrick B-224 x 48.

B. Soap Dispensers:
   1. Basis-of-Design: Bobrick B-4112 Contura liquid soap dispenser, in brushed stainless steel cabinet.

2.07 FABRICATION

A. General: Only a maximum 1-1/2 inch (12.7 mm) diameter, unobtrusive stamped logo of manufacturer, as approved by Architect, is permitted on exposed face of toilet or bath accessory units. On either interior surface not exposed to view or back surface, provide

additional identification by means of either a printed, waterproof label or a stamped nameplate, indicating manufacturer's name and product model number.

B. Surface-Mounted Toilet Accessories, General: Except where otherwise indicated, fabricate units with tight seams and joints, exposed edges rolled. Hang doors or access panels with continuous stainless steel piano hinge. Provide concealed anchorage wherever possible.

C. Recessed Toilet Accessories, General: Except where otherwise indicated, fabricate units of all welded construction, without mitered corners. Hang doors or access panels with full-length stainless steel piano hinge. Provide anchorage that is fully concealed when unit is closed.

D. Framed Mirror Units, General: Fabricate frames for glass mirror units to accommodate wood, felt, plastic, or other glass edge protection material. Provide mirror backing and support system that will permit rigid, tamperproof glass installation and prevent accumulation of moisture. Provide galvanized steel backing sheet, not less than 22 gage and full mirror size, with non-absorptive filler material. Corrugated cardboard is not an acceptable filler material.

E. Mirror Unit Hangers: Provide system of mounting mirror units that will permit rigid, tamperproof, and theft-proof installation including heavy-duty wall brackets of galvanized steel, equipped with concealed locking devices requiring special tool to remove.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install toilet accessory units in accordance with manufacturers' instructions, using fasteners appropriate to substrate and recommended by manufacturer of unit. Install units plumb and level, firmly anchored in locations and at heights indicated.

B. Secure mirrors to walls in concealed, tamperproof manner with special hangers, toggle bolts, or screws. Set units plumb, level, and square at locations indicated, in accordance with manufacturer's instructions for type of substrate involved.

C. Install grab bars to resist tensile and moment forces generated by a load of 250 lb. applied in any direction, or as otherwise required by authorities having jurisdiction, whichever is more stringent.

3.02 ADJUSTING AND CLEANING

A. Adjust toilet accessories for proper operation and verify that mechanisms function smoothly. Replace damaged or defective items.

B. Clean and polish all exposed surfaces in strict accordance with manufacturer's recommendations after removing temporary labels and protective coatings.

END OF SECTION

SECTION 10 28 10

MISCELLANEOUS SPECIALTIES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Clinic curtain and track.
   2. Wall corner guards.
   3. Ceiling suspended projectors.

B. For installation use only personnel who are skilled in the work required.

1.02 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: For each miscellaneous specialty and accessory specified.
   1. Installation Instructions: Submit manufacturer's recommended installation instructions showing all requirements for blocking and bracing.
   2. Samples: Submit samples of each finish material exposed to view, 6 x 6 inches in size, showing full range of colors and patterns.
   3. Shop drawings: Show location and extent of miscellaneous specialty items. Include plans, elevations, large-scale details of anchorages, and accessory items. Indicate typical and special details.
   4. Changing Station: Provide drawings prepared by manufacturer showing location of steel support members within wall cavity for full support of changing station.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
   1. Protection: Protect specialties before, during and after installation. Protect installed work of other trades.

B. Replacements: In event of damage, make necessary replacements.

PART 2 PRODUCTS

2.01 CLINIC CURTAIN AND TRACK

A. Manufacturers
   1. ADC Hospital Equipment, www.automaticdevices.com
   2. Clickeze Cubicle Tracking System, InPro Corp., Muskego, WI 800-222-5556
   3. General Cubicle Company Inc., www.generalcubicle.com
   4. Graber Industries, Middleton, WI 800-356-9102
   5. Imperial Fastener Company, www.imperialfastener.com

6. A. R. Nelson Co.
7. Pryor Products, www.pryorproducts.com
8. Salsbury Industries, www.mailboxes.com
9. Substitutions: Section 01 60 00 - Product Requirements.

B. Components
1. Track: Extruded aluminum sections, not less than 1-1/4 inches wide by 3/4 inch high, with minimum wall thickness of 0.062 inch; one piece for each cubicle track run.
   a. Basis of design: Model #9-994 as manufactured by Graber.
   b. Track Accessories: Fabricate splices, end caps, connectors, end stops, coupling and joining sleeves, wall flanges, brackets, ceiling clips, and other accessories from same material and with same finish as track.
   c. End Stop: Non-removable.
   d. Curtain Track: Hand-drawn ceiling mounted extruded aluminum curtain track in clear anodized finish. Provide 48” baton for hand operation and all slides and hardware required for a complete installation.
   e. Curtain Carriers: Nylon roller to accurately fit track; designed to eliminate bind when curtain is pulled; fitted to curtain to prevent accidental curtain removal; one carrier for each 6 inches of fabric width.
2. Wand: Aluminum or plastic hollow section, attached to lead carrier, for pull-to-close action.
3. Custom Curtain:
   a. Primary Fabric:
      1) Basis of Design: Vel 35, Spa as manufactured by Stinson in color/pattern as selected by the Architect.
      2) Machine Washable.
      3) NFPA 701 Method #1 flame resistance.
   b. Open Mesh Cloth: No. 50 nylon mesh to permit air circulation; flameproof.
   c. Curtain Grommets: Two-piece, rolled edge, rustproof, nickel-plated brass, machined into top hem.
   d. Curtain shall be 10% wider than opening with flat panel, grommets at 6-inch centers, and 20-inches of open mesh along top. Bottom of curtain shall hang uniformly 6-inches above the floor.
4. Curtain Tieback: Nickel-plated brass chain; one at each curtain termination.
5. Provide curtain and track configurations as indicated in the drawings.

2.02 WALL CORNER GUARDS

A. Type: 16-ga. brushed finish Type 304 stainless steel, surface-mount type. as manufactured by Powerhold or approved equivalent by Metalines or Boss

B. Size:
1. Typical: 2” x 2”. one-piece length from top of floor base to ceiling.
2. Kitchen: 4” x 4” one-piece length from top of floor base to ceiling.

C. Fastening: Flat head stainless steel screws set flush with face.

D. Provide at outside corners of drywall construction as indicated.

2.03 SUSPENDED PROJECTOR MOUNTS

A. Universal Leg Type Projector Ceiling Mount #PM-3 as provided by www.videomountstore.com, or approved equivalent by Peerless.
   1. Load capacity 75 lbs. Provide with 1-1/2” diameter steel suspension pipe, length as necessary to reach overhead building structure.
   2. Black powder coat finish.
   3. Cable Lock: Kensington MicroSaver Lock for Projectors. 6-ft x 6mm thick steel composite cable with carbon tempered steel core.
   4. Ceiling finishing ring kit for 1-1/2" diameter suspension pipe.

B. Securely bolt column to building structure above ceiling. Provide 1-1/2” Unistrut bracing between joists where necessary for proper ceiling location. Adjust location to avoid cutting of ceiling grid.

PART 3 PRODUCTS

3.01 PREPARATION

A. Review manufacturer’s installation instructions and notify Architect in the event of discrepancies or incompatibility with existing conditions; do not proceed with installation until all such discrepancies have been resolved.

B. Ensure that solid wood blocking for wall-mounted items is properly installed and sufficient to support the maximum rated loads.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions and with requirements of authorities having jurisdiction.
   1. Anchor specialties securely in place in accordance with manufacturer’s instructions.
   2. Sequence installation to accommodate required utility connections.

B. Touch-up surfaces damaged during installation. Replace damaged components that cannot be satisfactorily repaired.

3.03 CLEANING

A. Reference Section 01 71 00 – Execution and Closeout Requirements: Final cleaning.

B. Remove packing material from miscellaneous specialties and leave in clean condition, ready for operation.

END OF SECTION

SECTION 10 44 00

EMERGENCY AID AND FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes the following items provided and installed by Contractor:
   1. Portable fire extinguishers and extinguisher cabinets.
   2. Brackets for wall mounting fire extinguishers.
   3. Defibrillators and cabinets.
   4. Fire Department lock boxes.

B. Related Sections:
   1. Section 06 10 53 - Miscellaneous Rough Carpentry: Wood blocking and shims.

1.02 REFERENCES

A. National Fire Protection Association:
   1. NFPA 10 - Standard for Portable Fire Extinguishers.

B. Underwriters Laboratories Inc.:
   1. UL - Fire Protection Equipment Directory.

C. International Code Council (ICC)
   1. ICC A117.1 - Accessible and Usable Buildings and Facilities.

1.03 PERFORMANCE REQUIREMENTS

A. Conform to NFPA 10.

B. Provide extinguishers classified and labeled by Underwriters Laboratories Inc. for purpose specified and indicated.

C. Provide fire rated cabinets classified and labeled by Underwriters Laboratories Inc. for purpose specified and indicated.

D. Comply with ICC A117.1 requirements for protruding objects and maximum reach ranges for semi-recessed cabinets and wall-mounted devices.

1.04 SUBMITTALS

A. Division 01 - Submittal Procedures: Submittal procedures.

B. Product Data: For each product specified, submit operational features, color and finish, and anchorage details.
   1. Fire extinguishers: Include rating and classification.

2. Cabinets: Include rough-in dimensions, mounting details, door hardware, cabinet type, and trim style.

C. Manufacturer's Installation Instructions: Submit special criteria and wall opening coordination requirements.

D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

E. Coordination Submittal: For Fire Department Lock Boxes, including other requriements such as padlocks, gate key switches. Submit a copy of the official order form or written directive from the local Fire Marshal indicating the approved model, options, and mounting location.

1.05 CLOSEOUT SUBMITTALS

A. Division 01 - Execution and Closeout Requirements: Closeout procedures.

B. Operation and Maintenance Data: Submit test, refill or recharge schedules and re-certification requirements.

1.06 QUALITY ASSURANCE

A. Source Limitations: Obtain fire extinguishers and cabinets through one source from a single manufacturer.

PART 2 PRODUCTS

2.01 FIRE EXTINGUISHERS

A. Manufacturers:
1. JL Industries; www.jlindustries.com.
2. Larsen’s Manufacturing Co.; www.larsensmfg.com
3. Nystrom Products Co.; www.nystrom.com
4. Potter Roemer; www.potterroemer.com
5. Substitutions: Section 01 60 00 - Product Requirements.

2.02 FIRE EXTINGUISHERS

A. Multipurpose Dry Chemical Type: Cast steel tank with pressure gage; 4-A:80-B:C, 10 lb capacity.

2.03 FIRE EXTINGUISHER CABINETS

A. Tub: Formed sheet steel, 0.036 inch thick base metal.

B. Doors and Trim: Formed stainless steel sheet with satin finish.

C. Configuration: Semi-recessed type, sized to accommodate extinguisher.

D. Door: 0.0478 inch thick, partially-glazed panel, reinforced for flatness and rigidity; with nominal 1/2-inch thick square-edge frame. No more than 1/2-inch projection from face of wall.

E. Door Glazing: Clear acrylic, 1/8 inch thick.

F. Door Hardware: Manufacturer's standard door-operating hardware cam-action latch or door pull and friction latch. Provide concealed or continuous-type hinge permitting door to open 180 degrees.

G. Cabinet Mounting Hardware: Appropriate to cabinet.

H. Form cabinet enclosure with right angle inside corners and seams. Form perimeter trim in one piece with corners mitered, welded, and ground smooth.

I. Pre-drill for anchors.

J. Weld, fill, and grind components smooth.

K. Glaze doors with resilient channel gasket glazing.

L. Finishing Tub and Interior: Baked enamel, color as selected.

M. Finishing Doors and Trim: No. 4 stainless steel.

2.04 FIRE-RATED FIRE EXTINGUISHER CABINETS

A. Where cabinets are indicated to be installed in fire-rated walls, provided cabinets listed and labeled to meet requirements of ASTM E 814 for fire-resistance rating of wall.

B. Match construction of non-rated cabinets except as follows:
   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.

2.05 AUTOMATED EXTERNAL DEFIBRILLATORS (AED) AND CABINETS

A. AED Unit
   1. Manufacturer
      a. Cardiac Science; www.cardiacscience.com
      b. Substitutions: Section 01 60 00 - Product Requirements
   2. Basis of Design
      a. PowerHeart AED G3, #9390A-1001
      b. Where manufacturer has produced upgraded or replacement model, bidder shall submit manufacturer's data for the newer unit, regardless of availability of the original unit.
   3. Manufacturer’s Warranty – 7 year warranty; Batteries – 4 year warranty

B. Cabinet
   1. Cabinet with Door: Allied Medical Products AMP180-SSRM: Inside size is 14.125 inch x 14.125 inch x 7 inch. Prior to ordering, confirm interior dimensions are adequate to hold defribrillator and accessories.
      a. Cabinet Style: Semi-recessed.
      b. Components: Cold-rolled steel tub.
      c. Door and Trim Construction: Cold-rolled steel; flush doors.

d. Door: Full Glazing; Pull & AED Decal.
e. Finish for all components: Stainless Steel.
f. Alarms: Standard audible cabinet-mounted alarm standard (battery powered) to protect against theft or tampering. Alarm deactivated when door is closed.
g. Fire-Rating: As indidcated on Drawings, match wall on which product is installed.
h. Provide with wall sign: AMP 3858.

2.06 FIRE DEPARTMENT LOCK BOXES

A. Provide locking security boxes for fire department access to building and service courtyard as required by local authorities. Coordinate specific requirements with local authorities.

B. Building Mounted: Fire Department Lock Box: *Model 4400* recessed-mount with flange as manufactured by Knox Company.

C. Fence mounted: Fire Department Lock Box: *KnoxVault 440*0 surface-mount as manufactured by Knox Company.

D. Coordinate box types and general locations with local area fire department having jurisdiction. Normally located at main entry.
1. Coordinate specific location on the building front with Architect.
2. Substitutions: None.

2.07 ACCESSORIES

A. Extinguisher Brackets: Formed steel, plated or baked enamel finish.
1. Furnish brackets for extinguishers mounted inside cabinets.
2. Furnish brackets for extinguishers not mounted inside cabinets.

B. Cabinet Signage: Provide lettering to comply with authorities having jurisdiction for letter style, color, size, spacing, and location.
1. Identify bracket-mounted extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to wall surface.
2. Identify fire extinguisher in cabinet with the words "FIRE EXTINGUISHER" applied to door.

PART 3 EXECUTION

3.01 EXAMINATION

A. Division 01 - Administrative Requirements: Coordination and project conditions.

B. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION

A. Install cabinets plumb and level in wall openings.

B. Install wall brackets to walls and cabinets at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.

C. Secure rigidly in place.

D. Place extinguishers on wall brackets and brackets inside cabinets.

E. Position cabinet signage as required by authorities having jurisdiction.

F. Mount fire extinguisher cabinets, brackets, and AED cabinets to comply with the following:
   1. ADA/ICC A117.1 Protrusion: In paths of travel, mount semi-recessed and surface-mounted cabinets so that no part projects more than 4 inches from the finished wall.
   2. ADA/ICC A117.1 Reach Range: Mount units so that the highest operable part (e.g., extinguisher handle, cabinet handle, AED handle) is no more than 48 inches above the finished floor.

G. Install Fire Department Lock Boxes at locations coordinated with the local authorities having jurisdiction, typically at a height between 48 and 72 inches above the finished floor.

END OF SECTION

SECTION 10 56 13

METAL STORAGE SHELVING

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes: Metal storage shelving units.

1.02 SUBMITTALS

A. Division 01 - Submittal Procedures: Submittal requirements.

B. Shop Drawings: Indicate shelving locations and configurations; show installation details at special or non-standard conditions.

C. Product Data: Submit for each type of metal shelving unit specified, including physical characteristics, durability and resistance to fading and flame resistance characteristics.

D. Samples: Submit two samples, minimum 6 x 6 inches in size, of each color and finish specified.

E. Manufacturer's Installation Instructions: Submit manufacturer's product literature and installation instructions for each type of metal storage systems and installation accessory required. Include methods of installation for each type of substrate.

F. Maintenance Data: Include data in Maintenance Manual specified in Division 01.

1.03 QUALITY ASSURANCE

A. Provide all metal shelving units by a single manufacturer.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product warranties and product bonds.

B. Accept metal storage shelving on site. Inspect on arrival for damage.

1.05 COORDINATION

A. Division 01 - Administrative Requirements: Coordination and project conditions.

B. Sequence metal storage shelving installation with other work to minimize possibility of damage and soiling during remainder of construction period.

1.06 WARRANTY

A. Division 01 - Execution and Closeout Requirements: Requirements for warranties.

B. Special Project Warranty: Submit a written warranty, executed by the Contractor, Installer and the Manufacturer, agreeing to repair or replace shelving units which fail in materials or workmanship within the specified warranty period. This warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents.
   1. Warranty Period: 2 years from date of Substantial Completion.

1.07 MAINTENANCE

A. Maintenance Instructions: Submit manufacturer's printed instructions for maintenance of installed Work, including methods and frequency recommended for maintaining optimum condition under anticipated use conditions. Include precautions against materials and methods which may be detrimental to finishes and performance.

B. Replacement Materials: After completion of Work, deliver not less than 2 of each type, color, and pattern of metal storage shelving, exclusive of material required to properly complete installation. Furnish 2% of accessory components as scheduled. Furnish replacement materials from same production run as materials installed. Package replacement materials with protective covering, identified with appropriate labels.

PART 2 - PRODUCTS

2.01 METAL STORAGE SHELVING

A. Manufacturers:
   1. Acme Visible Records; www.acmevisible.com
   2. Dixie Shelving (Shelving Concepts, Inc.); www.dixieshelving.com
   3. E-Z Shelving Inc.; www.e-zshelving.com
   4. Lyon Workspace Products, Inc.; https://www.lyonworkspace.com/
   5. Penco Products Inc.; www.pencoproducts.com
   6. Republic Storage Systems; www.republicstorage.com
   7. Spacesaver Corp.; www.spacesaver.com
   8. Tab Products https://storage.tab.com/
   9. Aurora Storage Products, Inc. www.aurorastorage.com
   10. Substitutions: Section 01 60 00 - Product Requirements.

2.02 COMPONENTS

A. General: Minimum 18 gauge cold-rolled steel sheet metal, washed to receive powder coated baked enamel finish, higher gauge where indicated to provide appropriate loading capacity.

B. Shelving Units: Heavy-duty open shelving units consisting of four upright corner pilasters, minimum 13 gage thick, slotted to receive clips clipped together with shelves as indicated. Provide cross-braces laterally and at ends as required for stability with intended load. Shelves adjustable 1-1/2 inches on center.
   1. Size: 36-inches wide x 84-inches high unless indicated otherwise.
   2. Shelf Depth: As indicated on Drawings.
   3. Number of Shelves: As indicated on Drawings; if not indicated, provide fixed bottom and top shelves and 4 intermediate adjustable shelves.

C. Load Capacities: In addition to minimum gage, load capacity for each shelf shall be as follows:
   1. For units up to 36" wide: Minimum 400 lbs. per shelf.
   2. For units 42” to 48” wide: Minimum 425 lbs. per shelf.

2.03 SHOP FINISHING

A. Steel: Manufacturer’s standard baked enamel finish, color as selected.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Inspect areas and conditions in which metal storage shelving will be installed. Verify locations of power feeds, positioning of exits and aisle ways and overall dimensions of space, including height and HVAC venting.

C. Verify that metal shelving components, including size and finish, are as specified before beginning assembly or installation.

3.02 PREPARATION

A. Prior to installation of shelving system, vacuum floor surface to remove dust, debris and loose particles. Resilient flooring wet mopped and dried or finish buffed. Verify that components, including size and finish are those specified before installing.

3.03 INSTALLATION

A. Install metal storage shelving after finishing operations, including painting, have been completed. Install system to comply with final layout drawings, in accordance with manufacturer’s instructions. Position units level, plumb, and at proper location relative to adjoining units and related work. Adjust accessories to provide visually acceptable installation.

B. Bolt shelving units to wall and bolt adjacent end-to-end and back-to-back shelving units together to form single unit.

C. Field touch-up blemishes to original finish.

3.04 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Immediately upon completion of installation, clean components and surfaces following manufacturer's recommended procedures.

C. Remove surplus materials, rubbish and debris resulting from installation upon completion of Work and leave areas of installation in neat, clean condition.

3.05 FIELD QUALITY CONTROL

A. Remove and replace shelving components which are chipped, scratched, or otherwise damaged and which do not match adjoining work. Provide new matching units, installed as specified and in manner to eliminate evidence of replacement.

3.06 ADJUST

A. Adjust components and accessories to provide visually acceptable installation.

3.07 DEMONSTRATION

A. Upon completion of installation of system, inspect and determine capability and compliance with requirements. Repair or replace units which are not functional. All shelves and/or accessories shall be smoothly in place with no visual buckling or non-alignment of parts evident.

3.08 PROTECTION OF INSTALLED CONSTRUCTION

A. Section 01 70 00 - Execution and Closeout Requirements: Protecting installed construction.

B. Do not permit finished shelving units to be exposed to continued construction activity.

C. Protect system against damage during remainder of construction period. Advise owner of additional protection needed to ensure that system will be without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 10 56 26

HIGH DENSITY MOBILE STORAGE SHELVING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
1. Shop-manufactured manually operated high density mobile storage systems.

1.02 REFERENCES

A. American Laminators Assoc. Performance Standard ALA 1985.

B. ANSI - BHMA Standard A156.9, Grade 1.

C. American Society for Testing and Materials (ASTM)

1.03 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: For each type of product indicated.

C. Shop Drawings: Show fabrication and installation details for mobile storage system. Include plans, elevations, sections, details, and attachments to other Work. Provide precise location of tracks and anchorage points. Provide location and details of anchorage devices to be fastened to other construction or embedded within.

D. Samples: Provide nominal 6” square sample of selected laminate pattern/color.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative of the system manufacturer for installation and maintenance of units required for this Project.

B. Product Designations: Drawings and specifications indicate sizes, configurations, and finish material of frame, storage cabinets, hardware, and accessories by referencing designated manufacturer's system. Other manufacturers' systems of similar sizes and configurations, of same finish material, and complying with these Specifications may be considered.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Deliver mobile storage system components only after painting, utility roughing-in, and similar operations that could damage, soil, or deteriorate cabinets have been completed in installation areas. If system must be stored in other than installation areas, store only in areas where environmental conditions meet requirements specified in "Project Conditions" Article.

C. Keep finished surfaces covered with polyethylene film or other protective covering during handling and installation.

1.06 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Warranty: Manufacturer's ten-year written warranty agreeing to repair or replace components of system frame, cabinets, or accessory parts that fail in materials or workmanship. Failures include, but are not limited to, the following:
   1. Delamination of components or other failures of glue bond.
   2. Warping or sagging of components.
   3. Failure of operating hardware.
   4. Deterioration of finishes.

C. Maintenance Information: Submit manufacturer’s printed information for operating, repair, and periodic maintenance of installed system.

1.07 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install system 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 field measurements cannot be made without delaying the Work, coordinate dimensions with the Contractor to ensure that actual dimensions correspond to established dimensions.

1.08 SYSTEM DESCRIPTION

A. Basis of Design: Standard Mobile Storage System with capacity of 1.000 lbs. per linear ft. as manufactured by Spacesaver or approved equivalent by specified manufacturer.

B. Carriage-mounted high-density storage units movable on support rails providing uniform carriage movement along the total length of travel, with balanced or unbalanced loads using echanically-assisted manual crank.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Aurora Storage Products, www.aurorastorage.com

B. Hi-Density Spacesaving Systems, www.hdspacesaving.com

C. Patterson-Pope, www.pattersonpope.com

D. Spacesaver, www.spacesaver.com

E. Substitutions: Section 01 60 00 - Product Requirements.

2.02 COMPONENTS

A. Cabinets fabricated with 3/4” thick industrial grade composite wood, minimum 48-pcf, with no added formaldehyde and thermos-fused polyester laminated finish.
   1. Cabinet Dimensions: 24” deep x 96” long x 92-1/2” high (7-shelf unit).
   2. Finish both faces all cabinet components.
   3. Each cabinet furnished with four adjustable shelves and three fixed shelves, all reinforced with aluminum extrusion that includes slot with vinyl labeling material.
   4. Each cabinet furnished with four minimum 5-inch diameter wheels; minimum allowable load capacity of 3.200 lbs. per wheel.
   5. Provide cabinets with bumpers for control of side and outward movement.
   6. Frame shall be 1” x 1” x 16-gauge tubular steel with welded connections.
      a. Factory-applied black enamel powder coat finish.
      b. Steel floor plates at vertical cabinet standards for permanent anchorage to floor slab.
      c. Standard anchorage plates for fastening frame to wall in addition to floor anchorage.
   7. Shelving: 1” thick with maximum span of 36”. Both faces plastic laminate finished with PVC edge trim matching finish laminate.
   8. Laminate: NEMA LD 3, GP-28 for vertical surfaces, and GP-50 for horizontal surfaces. Color/pattern as selected by Architect from manufacturer’s full line of standard and custom colors. Edges finished with 1mm extruded PVC edge trim in color matching finish laminate.

B. Drive System: Positive type mechanically-assisted drive that minimizes end plan, ensures no play in the drive handle, and stopping of carriages without drifting.
   1. Triple or single arm operating wheels with rotating hand knobs provided on the drive ends of shelf units. Manually turning handle transmits power through chain drive to drive wheels on each carriage.
   2. Drive system gearing shall provide mechanically assisted units capable of being moved by exerting a maximum horizontal force of 5 pounds on the operating wheel.
   3. When unlocked, a safety lock button on each operating wheel hub permits moving of a carriage in either direction to create a new access aisle.
   4. Permanently shielded and lubricated bearings.
   5. Tensioning device located on each chain drive accessible without removing end panels.

C. Accessories Provided
   1. Safety sweep system.
   2. Top closure constructed of 3/4” plywood with polyester laminate finish to match cabinets.
   3. Hasps for Owner-provided padlock.
   4. Through-bolted pull handles.
   5. ID label on face of each cabinet.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas for compliance with requirements for installation tolerances, location of wall anchorage reinforcements, and other conditions affecting operational performance and safety of installed mobile library system.
   1. Proceed with installation only after any unsatisfactory conditions have been corrected.

2. Proceeding with installation indicates acceptance of all existing conditions and substrates.

3.02 SYSTEM INSTALLATION

A. Install frame plumb, level, and true; level rails as required using concealed shimming.
   1. Anchor floor plates to concrete slab using minimum 3/8” diameter stainless steel expansion bolts.
   2. Where mobile system abuts finished walls, apply narrow filler strips and scribe to wall for accurate fit. Conceal all wall fasteners and anchorages.

B. Storage Cabinets: Set cabinets straight, level, and plumb. Adjust all adjacent tops within 1/16-inch of a single plane. Adjust bumpers and guides for proper open, closed, and traveling positions.

C. Install pulls, ID frames, and hardware uniformly and precisely. Adjust and align locking hasps so moving parts operate freely and contact points meet accurately. Allow for final adjustment after installation.

D. Lubricate casters for smooth and noiseless operation.

3.03 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: Provide 6-mil or heavier clear plastic sheeting over finish surfaces. Tape to underside of shelves and frame, and remove protection after final Owner acceptance.

END OF SECTION

SECTION 10 73 26

ALUMINUM WALKWAY COVERS AND ENTRY CANOPIES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Aluminum walkway covers.
   2. Aluminum entry canopies.
   3. Prefinished metal canopy soffits.
   4. Flashing where connections to buildings are made.

B. Related Work:
   1. Section 04 20 00 - Unit Masonry: Items built into masonry walls.
   2. Section 07 90 00 - Joint Protection: Joint sealants.
   3. Section 07 62 00 - Sheet Metal Flashing and Trim.

1.02 QUALITY ASSURANCE

A. Installer Qualifications: Use for installation, only personnel who are skilled in the work required, familiar with the manufacturer's recommended methods of installation and the requirements of the work.

1.03 SUBMITTALS:

A. Shop Drawings: Submit Shop Drawings in accordance with Division 1 Section "Submittals".

B. Contractor shall submit shop drawings for approval by the Architect prior to fabrication of any materials. Shop Drawings shall clearly illustrate all details including but not limited to: Plan views, column layout and measurements, footing sizing and details, drainage locations and details, building wall condition details, flashing details, Canopy component sizing and thickness, Fastener sizing, large scale assembly details, and finishes by component.
   1. Contractor shall verify all dimensions and elevations prior to submittal to Architect and are to be checked by Manufacturer prior to fabrication.
      a. The site specific shop drawings and calculations shall bear the seal of a Civil or Structural engineer authorized to practice in the state of Texas where the project is located.
      b. Design loads for live load, wind uplift, and wind load shall be identified in the submittal.

C. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for units with factory-applied color finishes.

D. Samples for Verification: Of each type of exposed finish required in manufacturer's standard sizes. Where finishes involve normal color and texture variations, include Sample sets showing the full range of variations expected.

E. Installation Methods: Submit two copies of manufacturer's recommended installation methods.

1.04 PRE-INSTALLATION MEETINGS

A. Section 01 31 19 – Project Meetings: Schedule and coordinate pre-installation meeting that includes the trade(s) for the work of this Section and other trades that whose work is related to the work of this Section.
   1. Convene minimum one week prior to commencing work of this Section.

1.05 PRODUCT HANDLING

A. Protection: Protect walkway covers before, during and after installation. Protect installed work of other trades.

B. Replacements: In the event of damage, make repairs or replacements as necessary.

PART 2 PRODUCTS

2.01 GENERAL

A. Designs are based on the product of AVAdek Walkway Cover Systems.

B. Manufacturers: Subject to compliance with requirements, provide products of one of the following manufacturers.
   1. ASA Builders, Inc., www.asabuildersinc.com.
   2. AVAdek Walkway Cover Systems & Canopies www.avadek.com
   3. Dittmer Architectural Aluminum; Ditt-Deck Extruded Aluminum Walkway Covers www.ditt-deck.com
   4. E.L. Burns Company, Inc.; Burns Walkway Covers www.burnscovers.com
   5. Peachtree Protective Covers www.peachtreecovers.com
   6. Substitutions: Section 01 60 00 - Product Requirements.

C. Design Requirements:
   1. Systems shall be designed for a minimum 20 psf Live load and 25 psf Wind Uplift Load, or additional should state or local building codes require.
   2. Systems shall be designed to withstand a 150-mph wind event.
   3. It is the responsibility of the walkway cover/canopy manufacturer to verify the design meets the structural load requirements as specified.

2.02 MATERIALS

A. Beams: “U” Beams sized by manufacturer to meet all required design loads, including wind loads, (minimum 6” x 4” x .125”) Alloy 6063-T6 temper

B. Columns: 8” diameter Schedule 40 extruded aluminum round Alloy 6063-T6 temper.

C. Deck: Sized by manufacturer to meet all required design loads, including wind loads, (minimum 2-3/4” ht. x 6” x .078” thickness); extruded aluminum, Alloy 6063-T6 temper; roll-formed not acceptable.

D. Fascia / Trim: Extruded Aluminum 12”-18” ht. X 3” x 0.125” “G” Alloy 6063-T6 temper

E. Aluminum Soffit Panels: Standard 12” wide flat soffit panels as manufactured by AVAdek.

1. Basis-of-Design: AVAdek "Flat Panel" Soffit System, or approved equivalent by specified manufacturer.
2. Material: Smooth, non-vented aluminum panels, minimum 0.032-inch thickness.
3. Profile: 12-inch wide (nominal) flat-face panel with interlocking side joints.
4. Suspension: Manufacturer's standard proprietary concealed suspension system, designed to attach to the underside of the structural deck.
5. Finish: As indicated on drawings. If not indicated, match finish specified for Decking and Fascia or as indicated

F. The component sizes noted above are minimums and shall be precluded by component sizes called out on the drawings, or larger components as required to achieve the required structural performance.

G. Fasteners: Stainless Steel

H. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements, except containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.

I. Miscellaneous:
1. Provide fasteners, sealant, flashing, additional components, etc., to match bents, deck, and trim as required to provide for a complete and finished system.

2.03 ALUMINUM FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.

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.

C. Aluminum Finishes: Finish designations prefixed by "AA" conform to the system established by the Aluminum Association for designating aluminum finishes.
1. Typical: Class I, Clear Anodic Finish: AA-M12C22A41 Anodic coating, Architectural Class I, clear coating 0 inch (0.02 mm) or thicker) complying with AAMA 607.1
2. Drop-Off Canopies: As indicated.
a. Fascia: Two-coat, factory applied, baked-on fluoropolymer coil-coating system; Kynar 500 as manufactured by PPG Industries.
1) Coating system shall provide minimum 1.0 mil (0.0254 mm) dry film thickness consisting of minimum 0.20 mil (0.00508 mm) primer and minimum 0.80 mil (0.02032 mm) color coating.
2) Color: Custom as selected by the Architect.
b. Soffit Panels:
1) Faux Wood Finish: Factory polyester powder coat finish meeting AAMA 2604 in faux wood-grain design. Color(s) as selected by the Architect. Product as manufactured by Quality Powder Coating, www.qualitypowdercoating.com.
2) Finish electrostatically applied to 2-4 mil thickness and polymerized along with ink printing film for faux wood grain by baking at 400-degrees F for 20-minutes.

3. Remaining Canopies: As indicated.
    a. Fascia: Specified medium bronze color anodic coating.
    b. Soffit Panels (not faux wood):.
        1) Two-coat, factory applied, baked-on fluoropolymer coil-coating system in solid color; Kynar 500 as manufactured by PPG Industries.
        2) Color: Custom as selected by the Architect.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances, foundation locations, and other conditions affecting performance of the Work.

B. Verify that concrete footings are properly located, dimensioned, cured, and ready to receive canopy columns.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Verify all field measurements prior to beginning installation.

B. Clean all component surfaces thoroughly prior to assembly and installation.

3.03 INSTALLATION

A. Install canopy system in strict accordance with manufacturer's written instructions and approved shop drawings.

B. Install components plumb, level, and true to line, with no visible distortion or warping.

C. Coordinate installation with scheduled concrete, masonry and roofing work.
    1. Metal Protection: Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
    2. Erection shall be by manufacturer in accordance with approved Shop Drawings.

D. Anchor columns securely to concrete footings. After final alignment, place non-shrink grout at column bases to provide uniform bearing.

E. Assemble components with manufacturer's standard stainless steel fasteners. Conceal fasteners where possible.

F. Isolate Dissimilar Materials:
    1. At connections to dissimilar metals, apply a heavy coat of zinc-chromate primer or other manufacturer-approved separation coating.
    2. At contact surfaces with concrete or masonry, apply a heavy coat of bituminous paint.

3. Install flashing at connections to adjacent building walls to provide a watertight installation. Coordinate with Section 07 62 00 - Sheet Metal Flashing and Trim.

G. Soffit System Installation:
1. Install proprietary suspension carriers securely to the underside of the structural deck, per manufacturer's instructions.
2. Engage soffit panels into carriers and adjacent panels, ensuring full, positive interlock.
3. Cut and trim panels neatly to fit at perimeters, columns, and penetrations. Install perimeter trim for a finished appearance.

3.04 CLEANING

A. Clean all exposed surfaces promptly after installation using mild detergent and clean water, in accordance with manufacturer's recommendations.

B. Do not use abrasive, acid, or caustic cleaners.

C. Remove and replace any damaged components that cannot be repaired to the Architect's satisfaction.

3.05 PROTECTION

A. Protect installed canopy and soffit systems from damage during subsequent construction.

END OF SECTION

SECTION 10 75 00

FLAGS AND FLAGPOLES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Ground-set aluminum flagpoles.
   2. Flags.

B. Related Sections include the following:
   1. Section 03 30 00 - Cast-In-Place Concrete: Concrete footings for flagpoles.
   2. Section 07 90 00 - Joint Protection: Elastomeric sealant filling the top of the foundation tube.

1.02 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide flagpole assemblies, including anchorages and supports, capable of withstanding the effects of wind loads, determined according to NAAMM FP 1001, "Guide Specifications for Design of Metal Flagpoles."
   1. Base flagpole design on polyester flags of maximum standard size suitable for use with flagpole or flag size indicated, whichever is more stringent.
   2. Basic Wind Speed Resistance: 110 mph or greater for 3-second gust speed at 33 feet above ground.

1.03 SUBMITTALS

A. Product Data: For each type of flagpole required.

B. Structural Calculations: For flagpoles indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Qualification Data: For professional engineer.

1.04 QUALITY ASSURANCE

A. Source Limitations: Obtain each flagpole as a complete unit, including fittings, accessories, bases, and anchorage devices, from a single manufacturer.
   1. Obtain flagpoles through one source from a single manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

A. General: Spiral wrap flagpoles with heavy paper and enclose in a hard fiber tube or other protective container.

PART 2 PRODUCTS

2.01 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, the following:
   1. American Flagpole www.hapcopoles.com
   2. The Baartol Company Inc. www.baartol.com
   3. Concord Industries, Inc. www.flagpoles.com
   4. Lingo Inc.; Acme Flagpole Division www.lingoinc.com
   5. Pole-Tech Company Inc. www.poletech.com

2.02 FLAGPOLES

A. Flagpole Construction, General: Construct flagpoles in one piece if possible. If more than one piece is necessary, comply with the following:

B. Fabricate shop and field joints without using fasteners, screw collars, or lead calking.

C. For tapered flagpoles, provide flush hairline joints using self-aligning, snug-fitting, internal sleeves.

D. Exposed Height: 30-feet unless indicated otherwise on the drawings.

E. Aluminum Flagpoles: Provide entasis-tapered flagpoles fabricated from seamless extruded tubing complying with ASTM B 241/ (B 241M), Alloy 6063, with a minimum wall thickness of 3/16 inch (4.76 mm). Heat treat after fabrication to comply with ASTM B 597, Temper T6.

F. Foundation Tube: Galvanized corrugated-steel foundation tube, 0.064-inch minimum nominal wall thickness. Provide with 3/16 inch (4.76 mm) steel bottom plate and support plate; 3/4 inch (19.05 mm) diameter, steel ground spike; and steel centering wedges all welded together. Galvanize steel parts, including foundation tube, after assembly. Provide loose hardwood wedges at top of foundation tube for plumbing pole.
   1. Provide flashing collar of same material and finish as flagpole.

2.03 FITTINGS

A. Finial Ball: Manufacturer's standard flush-seam ball, sized as indicated or, if not indicated, to match flagpole-butt diameter.
   1. 0.063 inch (1.6 mm) spun aluminum, finished to match flagpole.

B. External Halyard: Ball-bearing, non-fouling, revolving truck assembly of cast metal with continuous 5/16 inch (7.94 mm) diameter, braided steel halyard and 9 inch (228.6 mm) cast-metal cleats with fasteners. Finish exposed metal surfaces to match flagpole.
   1. Provide one halyard and one cleat at each flagpole.
   2. Provide cast-metal cleat covers, finished to match flagpole, secured with cylinder locks.
   3. Provide halyard covers consisting of a 2 inch (50.8 mm) channel, 60 inches (1524 mm) long, finished to match flagpole.

C. Halyard Flag Snaps: Provide two stainless-steel swivel snap hooks per halyard.
   1. Provide with neoprene or vinyl covers.

2.04 MISCELLANEOUS MATERIALS

A. Concrete: Comply with requirements in Division 3 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi (20684.28 kPa) unless otherwise indicated.

B. Sand: ASTM C 33, fine aggregate.

C. Elastomeric Joint Sealant: Single-component neutral-curing silicone joint sealant complying with requirements in Division 7 Section "Joint Sealants" for Use NT (non-traffic) and for Use M, G, A, and, as applicable to joint substrates indicated, O joint substrates.

2.05 FLAGS

A. Flags: Commercial-quality nylon, 4 x 6 foot (182.88 cm) size; furnish one flag of each of the following types:
   1. United States.
   2. State of Texas.

2.06 FINISHES

A. Metal Finishes, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Aluminum: Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
   1. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: non-specular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0 inch (0.02 mm) or thicker) complying with AAMA 611.

PART 3 EXECUTION

3.01 PREPARATION

A. Prepare uncoated metal flagpoles that are set in foundation tubes by painting below-grade portions with a heavy coat of bituminous paint.

B. Foundation Excavation: Excavate to neat clean lines in undisturbed soil. Remove loose soil and foreign matter from excavation and moisten earth before placing concrete.

C. Provide forms where required due to unstable soil conditions and for perimeter of flagpole base at grade. Secure and brace forms and foundation tube, sleeve, or anchor bolts in position, to prevent displacement during concreting.

D. Place concrete immediately after mixing. Compact concrete in place by using vibrators. Moist-cure exposed concrete for not less than seven days or use non-staining curing compound.

E. Trowel exposed concrete surfaces to a smooth, dense finish, free of trowel marks, and uniform in texture and appearance. Provide positive slope for water runoff to perimeter of concrete base.

3.02 FLAGPOLE INSTALLATION

A. General: Install flagpoles where shown and according to manufacturer's written instructions.

B. Foundation-Tube Installation: Install flagpole in foundation tube, seated on bottom plate between steel centering wedges. Plumb flagpole and install hardwood wedges to secure flagpole in place. Place and compact sand in foundation tube and remove hardwood wedges. Seal top of foundation tube with a 2-inch layer of elastomeric joint sealant and cover with flashing collar.

END OF SECTION

SECTION 11 31 00

RESIDENTIAL GRADE APPLIANCES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Equipment provided and installed by Contractor:
      a. Refrigerator with freezer.
      b. Microwave Oven.
      c. Side-By-Side Clothes washers and dryers
      d. Clothes Washers and Dryers.
      e. Electric ranges.
      f. Kitchen Vent hood.
      g. Dishwasher.
   2. Equipment provided and installed under other Sections:
      a. Division 22 Sections – Plumbing: Disposal unit at Life Skills Kitchen.

B. Related Work Described Elsewhere:
   1. Division 22, 23, and 26 Sections: Power, water, drainage, and ventilation systems related to appliances is provided under Mechanical, Plumbing and Electrical Sections.
      a. Coordinate with all other trades to ensure proper and adequate provision for the required utility sizing, capacities, and locations.

1.02 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is an authorized representative of the residential appliance manufacturer for both installation and maintenance of appliances required for this Project.

B. Product Options: These specifications indicate sizes, profiles, plumbing and power requirements of residential-grade appliances that are based on the specific types and models indicated. Contractor is responsible for coordinating sizes, profiles, plumbing and power requirements for products provided by other named manufacturers (or substitute models by the same manufacturer for products no longer available). Refer to Division 1 Section "Substitutions."

C. UL and NEMA Compliance: Provide electrical components required as part of residential-grade appliances that are listed and labeled by UL and that comply with applicable NEMA standards.

1.03 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: For each appliance, indicating product specifications and options

C. Operation and Maintenance Instructions: For each appliance.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Deliver appliances only after utility rough-in is complete and construction in the spaces to receive appliances is substantially complete and ready for installation.

C. Protect appliances before, during, and after installation, including the installed work and materials of all other trades.

D. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

1.05 WARRANTY

A. Section 01 70 00 - Execution and Closeout requirements: Product warranties and product bonds.

B. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

PART 2 PRODUCTS

2.01 RESIDENTIAL APPLIANCES

A. Manufacturers:
1. GE Appliances, http://www.ge.com
2. Substitutions: No Substitutions.

2.02 COMPONENTS

A. Refrigerator/Bottom-Freezer with Internal Water Dispenser:
1. Basis of Design: *Model No. GFE24JMKES / GFE24JYKES* freestanding type as manufactured by GE or approved equivalent by specified manufacturer.
2. Cabinet Size: Nominal 69-7/8 in H x 35-3/4 in W x 31-1/4 in" D.
3. Fabrication and Components:
a. Configuration:
1) Refrigerator Compartment: Two French doors, adjustable spill-proof glass shelves, humidity-controlled drawers, and adjustable door bins.
2) Freezer Compartment: Bottom pull-out drawer with multi-level baskets.
b. Features:
1) Water Dispenser: An internal water dispenser that provides filtered water.
2) Water Filtration: Utilizes the manufacturer's advanced water filtration system (GE XWF Filter or approved equal).
3) Icemaker: Factory-installed automatic icemaker located in the freezer compartment.

4) Controls: Upfront electronic temperature controls with a digital display.
5) Lighting: High-efficiency LED lighting illuminates the interior.
6) Defrost Type: Frost-free.

c. Utility Requirements:
1) Electrical: 120V, 60 Hz, 15A. Requires a dedicated, grounded, 3-prong receptacle.
2) Plumbing: Requires a 1/4" outer diameter copper or manufacturer-approved tubing water line with a nearby, accessible shut-off valve.

B. Microwave Oven:
1. Basis of Design: *Model No. PEB9159* built-in combination convection and microwave oven as manufactured by GE or approved equivalent by specified manufacturer.
a. Capacity: 1.5 Cu. Ft.
b. Power Output (Nominal):
c. Microwave: 1000 Watts.
d. Convection: 1500 Watts.
2. Fabrication and Components
a. Cooking Technology:
1) Convection Bake and Convection Roast capability.
2) Broil function.
3) Microwave function with sensor cooking controls for automatic power level and time adjustments.
b. Controls: Electronic touch controls with a digital display.
c. Interior: Stainless steel interior for ease of cleaning. Includes a 13.5-inch recessed, removable glass turntable.
d. Lighting: Includes an interior oven light.
e. Utility Requirements:
1) Electrical: 120V, 60 Hz, 15A. Requires a dedicated, grounded, 3-prong receptacle.
3. Accessories:
a. Required Trim Kit: The oven shall be installed with the manufacturer's matching trim kit to ensure proper ventilation and a finished, built-in appearance.
b. Basis-of-Design:
1) For 27-inch wide cabinets: GE Model JX9152.
2) For 30-inch wide cabinets: GE Model JX9153.
c. Contractor shall provide the trim kit size that corresponds to the cabinet dimensions shown on the Architectural Drawings.
4. Finish:
a. Oven and Trim Kit: Fingerprint-resistant Stainless Steel (or other finish as selected by Architect from manufacturer's standard options).

C. Dishwasher:
1. Basis of Design: *Model No. GDT550PGR* built-in, undercounter dishwasher as manufactured by GE Appliances.
a. Type: Built-in, undercounter dishwasher with front controls.
b. Overall Dimensions (Nominal):
1) Width: 24 inches.

2) Height: 34 inches.
3) Depth: 24 inches.

c. Capacity: Minimum of 16 place settings.
d. Sound Level: Shall not exceed 51 dBA during operation.

2. Fabrication and Components:
a. Tub and Interior:
1) Material: The tub and inner door liner shall be fabricated from stainless steel for durability, stain resistance, and improved drying performance.
b. Racks:
1) Configuration: Three (3) racks: an adjustable upper rack, a lower rack, and a dedicated third rack for flatware and small items.
2) Material: Racks shall be nylon-coated.
c. Wash System:
1) Features: The system shall include, at a minimum:
(a) Steam + Sani: A pre-wash steam cycle and a high-temperature sanitizing rinse.
(b) Dry Boost™: A heated drying system for improved performance.
(c) Hard Food Disposer: An integrated food disposer to pulverize food particles.
(d) Multiple wash cycles, including an "Auto Sense" cycle that adjusts based on soil level.
d. Controls:
1) Type: Electronic front controls with cycle status indicator lights.
e. Utility Requirements:
1) Electrical: 120V, 60 Hz. Requires a dedicated, grounded, 15A circuit. The unit shall be hardwired in accordance with the manufacturer's instructions and local codes.
2) Plumbing (Water): Requires a 3/8-inch outer diameter copper hot water supply line with a nearby, accessible shut-off valve.
3) Plumbing (Drain): Requires a 5/8-inch minimum inner diameter drain line. The drain line must be installed with a high loop or an air gap as required by local plumbing code.
f. Finish:
1) Exterior Door: Slate finish (as indicated by "-PGR" suffix, or other finish as selected by Architect).
2) Handle: Manufacturer's standard matching pocket or bar handle.

D. Kitchen Fume Hood:
1. Basis of Design: *Model No. JVX5360SJSS* built-in, kitchen hood as manufactured by GE Appliances.
a. Type: Undercabinet-mount, 36-inch width.
b. Venting Configuration: The unit shall be convertible for multiple ducting options. For this project, the installation shall be ducted vertically or horizontally to the exterior as shown on the Mechanical Drawings. Non-ducted, recirculating installations are not permitted.
c. Performance (Ducted Operation):
1) Airflow Capacity: A minimum of 390 CFM at the maximum fan speed setting.
2) Sound Level: Shall not exceed 6.5 Sones at the maximum fan speed setting.

2. Fabrication and Components:
    a. Material and Finish:
        1) Chassis and Exterior: Fabricated from Stainless Steel.
    b. Controls:
        1) Type: Push-button controls for fan speed and lighting.
    c. Fan:
        1) Speeds: A minimum of four (4) fan speeds, including a high-speed boost setting.
    d. Lighting:
        1) Type: Integrated dual LED lighting modules with at least two brightness levels (high/low).
    e. Filtration:
        1) Grease Filter: One or more removable, dishwasher-safe aluminum mesh grease filters.
    f. Utility Requirements:
        1) Electrical: 120V, 60 Hz. Requires a dedicated, hardwired electrical connection.
        2) Ducting: The unit shall be equipped with a damper and a connection collar for a 7-inch round duct or as indicated on mechanical drawings.

E. Clothes Washer and Dryer:
1. Basis of Design: *Model No. GFW655SPVDS* - residential, front-loading automatic clothes washers and Model No. GFD65ESPVDS - residential, front-loading automatic clothes washer as manufactured by GE Appliances.
2. Clothes Washer:
    a. Type: Front-loading, automatic clothes washer.
    b. Dimensions (Nominal): 28" W x 32" D x 39-3/4" H.
    c. Capacity: 4.8 Cu. Ft.
    d. Features:
        1) Venting System: Shall include an antimicrobial gasket and a vent system to dry the interior after a cycle to prevent odor.
        2) Dispenser: Automatic detergent dispensing system.
        3) Smart Features: WiFi connectivity for remote monitoring and control.
    e. Utility Requirements:
        1) Electrical: Requires a NEMA 5-15R, 120V, 60 Hz, 15A receptacle.
        2) Plumbing: Requires hot and cold water supply connections and a 2-inch minimum diameter drain standpipe.
3. Clothes Dryer:
    a. Type: Front-loading, electric clothes dryer.
    b. Dimensions (Nominal): 28" W x 32" D x 39-3/4" H.
    c. Capacity: 7.8 Cu. Ft.
    d. Features:
        1) Drying System: Sensor-based system to monitor moisture and prevent over-drying.
        2) Steam Cycle: Includes a steam feature for de-wrinkling and refreshing clothes.
        3) Smart Features: WiFi connectivity for remote monitoring and control.
    e. Utility Requirements:
        1) Electrical: Requires a NEMA 14-30R, 240V, 60 Hz, 30A receptacle.

2) Venting: Requires a 4-inch diameter rigid metal exhaust duct connected to the exterior.

4. Accessories:
   a. Configuration: Install units as indicated on the Architectural Drawings:
      1) Stacked Configuration: If shown stacked, provide the manufacturer's corresponding stacking kit (e.g., GE Model GFA28KITN).
      2) Side-by-Side on Pedestals: If shown on pedestals, provide two (2) of the manufacturer's corresponding laundry pedestals (e.g., GE Model GFP1528).

F. Electric Range:
   1. Basis of Design: *Model No. GE-JSS86* freestanding, slide-in electric ranges as manufactured by GE Appliances.
      a. Overall Dimensions (Nominal):
         1) Width: 30 inches.
         2) Height: 37-1/4 inches.
         3) Depth: 28 inches.
   2. Cooktop Components:
      a. Type: Radiant electric cooktop with a black glass-ceramic surface.
      b. Elements: Five (5) elements, including:
         1) Two (2) 8-inch power boil elements.
         2) One (1) 12-inch/9-inch dual-ring element.
         3) One (1) 6-inch element.
         4) One (1) 6-inch warming zone.
   3. Oven Components:
      a. Type: Electric Convection Oven with Air Fry.
      b. Capacity: 5.3 Cu. Ft.
      c. Cooking System: True convection with a rear fan and heating element for even heat distribution.
      d. Features:
         1) No-Preheat Air Fry Mode.
         2) Self-Cleaning: Steam self-clean option.
         3) Bake Element: Hidden bake element for easy cleaning.
         4) Storage: Full-width storage drawer at the base of the unit.
   4. General Features and Utilities:
      a. Controls: Backlit, glass touch controls combined with professional-style control knobs.
      b. Utility Requirements:
         1) Electrical: 240V/208V, 60 Hz. Requires a dedicated, properly grounded, 40-Amp circuit terminating in a NEMA 14-50R receptacle.
      c. Finish:
         1) Exterior: Stainless Steel.
         2) Handle: Manufacturer's standard professional-style brushed handle.
   5. Installation:
      a. Install the range in strict accordance with the manufacturer's written installation instructions.

b. Install the Anti-Tip Bracket: The installer shall securely install the anti-tip bracket (supplied with the unit) to the rear wall or floor. This is a mandatory safety requirement.
c. Carefully slide the range into the opening, ensuring the rear leveling leg fully engages with the anti-tip bracket.
d. Adjust the leveling legs to ensure the range is level and the cooktop is flush with the countertop.
e. Plug the power cord into the designated receptacle.

G. Standard Clothes Washers:
1. Design Basis: G.E. #WJRR4170EWW.
2. Size: 42” H. x 25-1/2” D. x 27” W.
3. Automatic, Top-Loading Type: 3.5 cu ft capacity; stainless steel washbasket; controls as follows: presettable metered fill-level, presettable wash/rinse water temperatures, variable speed cycle/fabric selector; removable lint filter; bleach and fabric softener dispensers; spin cycle safety switch.
4. ENERGY STAR qualified.

H. Standard Clothes Dryers:
1. Design Basis: G.E. #DLSR483EGWW.
2. Size: 42”H. x 28-1/4”D. x 27”W.
3. All-Electric Type: 120/240V service with 5,000 W heat input, 7.0 cu ft capacity; timed cycle selection, fabrics selector, cycle end signal, and safety starting control; removable lint filter; long vent design for duct runs to 150 feet (4572 cm)

PART 3 EXECUTION

3.01 PREPARATION

A. Review manufacturers’ installation instructions and notify Architect in the event of discrepancies; do not proceed with installation until all such discrepancies have been resolved.

3.02 INSTALLATION

A. Install in accordance with manufacturer’s instructions and with requirements of authorities having jurisdiction.

B. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and rough openings are completely concealed. Allow for proper air circulation for all heat-generating appliances.

C. Sequence installation to accommodate required utility connections.

D. Free-Standing Equipment:
1. Clearances:
a. Install unit level and plumb.
b. Provide minimum clearances as recommended by the manufacturer.
1) Minimum Clearance: 0 inches (all sides and top).

2) Recommended Clearance for Service/Performance: 1/2 inch (each side).

c. Closet Installation: Unit is approved for closet installation. Closet doors must be louvered or otherwise ventilated with a minimum of 60 square inches (387 sq. cm) of open area.

3.03 ADJUSTING

A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.

B. Test each appliance to verify proper operation. Make necessary adjustments.

C. Verify that accessories required have been furnished and installed.

3.04 CLEANING

A. Section 01 71 00 - Execution and Closeout Requirements: Final cleaning.

B. Remove packing material from residential appliances and leave units in clean condition, ready for operation.

END OF SECTION

SECTION 11 40 00

FOOD SERVICE EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including General and Supplementary Conditions and General Documents, apply to the Work specified in this Section.

1.2 SUMMARY OF THE WORK

A. Project Name and Location: Crosby Sixth Grade Campus
Crosby, TX

B. Approval of Working Surface: Any contractor performing work over the work of other contractors shall notify the Architect of any unsatisfactory conditions. The beginning of work by any contractor shall constitute acceptance of the previous work.

C. Field Verification of All Dimensions: Before ordering any materials or doing any work, field verify all measurements of the building and be responsible for their accuracy. No extras will be allowed for variations from drawings in existing conditions or work performed under this contract. Any discrepancies found shall be submitted to the Architect or Foodservice Design Professionals (FDP) for instructions before proceeding.

D. Cutting and Patching: No excessive cutting will be permitted, nor shall any structural members be cut without the written approval of the Architect. Each Contractor shall leave all chases and openings straight, true, and of the proper size in their work, as may be necessary for the proper installation of their and other contractors' work. After such work has been installed, the contractor shall carefully fit around, close, repair, patch, and point up the same as directed to the satisfaction of the Architect.

E. Cooperation: The General Contractor, all other contractors, and all subcontractors shall coordinate their work with all adjacent work and shall cooperate with all other trades to facilitate the general progress of the work. Each trade shall afford all the other trades every reasonable opportunity to install their work and store their material.

F. Inspection and Tests: The architect, Owner, Foodservice Design Professionals (FDP), and their representative shall always have access to the work, whether in preparation or progress. Provide proper and safe facilities for such access and inspection.

G. Fees, Permits, and Inspections: Secure and pay fees for all permits, licenses, and inspections as required by all authorities having jurisdiction. Give all notices and comply with all laws, ordinances, codes, rules, regulations, and contract requirements bearing on the work.

1.3 SCOPE OF WORK

A. Include the Work specified, shown, or inferable as part of Food Service Equipment. Portions of this Work may be subcontracted to those qualified to do such work as necessary because of jurisdictional trade agreements and restrictions.

B. The General Contractor is responsible for Related Work specified in other Sections: i.e., final plumbing, electrical and mechanical connections. The Kitchen Equipment Contractor (KEC) is responsible for all internal connections.

C. Specifications and drawings have been prepared to form the basis for procurement, erection, start-up, and equipment adjustment in this contract. Plans and specifications shall be considered mutually explanatory. Work required by one, but not by the other, shall be performed as though required by both. Items required by one but not by the other shall be provided as though required by both. Work shall be accomplished as called for in specifications and shown on drawings so that all equipment items shall be entirely functional for the purpose for which they were designed and intended. Provide all necessary material, tools, equipment, and labor required for the complete delivery, un-crating, erection, and installation as designated on the food service equipment plan and, in the specifications, to be made ready for final connection by the appropriate Division contractors. When there is any discrepancy between drawings and specifications, bidders should seek clarification of any discrepancies from the Architect and or Foodservice Design Professionals (FDP) before bidding.

D. Should the drawings disagree in themselves or the specifications with the drawings *(and clarification was not sought before bidding)*, the higher cost, better quality, more stringent, and greater quantity of the work or materials shall be completed without additional costs to the Owner.

1.4 OTHER DIVISIONS/CONTRACTORS RELATED WORK

A. Division 03 (Concrete) is responsible for but not limited to:

1. Slab depressions reinforced concrete wearing bed at prefabricated walk-in assemblies.

2. Concrete or masonry platforms (with a finished top and coved base at the perimeter) for the raised setting of food service equipment.

3. Slab depressions to receive stainless steel drain trench liner/grate assemblies (provided under this Section).

B. Division 09 (Finishes) responsible for but not limited to:

1. Interior finished floor with a coved base at prefabricated walk-in assemblies.

C. Division 10 (Specialties) responsible for but not limited to:

1. S/S Corner Guards throughout the kitchen (unless specified otherwise).

2. Lockers.

D. Division 22 (Plumbing) is responsible for but not limited to:

1. All connections shall be made in accordance with local codes and national standards, except where plans and specifications exceed those codes and standards.

2. Empty EMT conduit with pull-wire and wide-sweeping bends for beverage lines, refrigeration to beverage lines, CO2 lines, and all plumbing lines required for water-cooled equipment.

3. Rough-in and final connection of plumbing systems to food service equipment and between components (including materials and labor). Accessories provided loose with food service equipment by Section 11 40 00 to be field installed by Division 22. This includes but is not limited to the installation of all faucets (water fill faucets, pre-rinse faucets, etc.), hoses, gas disconnects and drains from the equipment point of connection to building plumbing systems. All drain lines are provided and installed by Div. 22.

a. Kitchen Equipment Contractor is responsible for providing all faucets (water fill faucets, pre-rinse faucets, etc.), drain fittings, mixing valves, control valves, water pressure regulators, vacuum breakers, and all accessories for equipment specified under 11 40 00. Division 22 is responsible for installation.

4. Indirect drain line runs from the equipment to the nearest drain or floor sink—lines to be type 'K' Copper.

5. If any plumbing accessories or fittings are provided loose with equipment by 11 40 00, Div. 22 is to attach to equipment and provide final connection.

6. Gas Supply Systems with all components and fittings required for a complete system.

7. Water Supply Systems with all components and fittings required for a complete system.

8. Compressed Air Systems with all components and fittings required for a complete system (if required for this project).

9. Piping and Drainage Systems (Sanitary and Grease-laden). ***Systems must be cleaned and flushed before the final connection with food service equipment - Critical.***

10. Floor Sinks (Provide and Install). Flange and grates to be flush with the finished floor.

11. Floor Drains (Provide and Install). Flange and grates to be flush with the finished floor.

12. Trench Drains (Provide and Install). Trench Liners provided by 11 40 00. Flange and liners to be flush with the finished floor.

13. Grease Traps as required (Size, Provide, Locate, and Install). Verify with local codes to bypass or pipe through Grease Trap and/or Interceptor.

14. P-Traps as required (including all disposers).

15. Interconnect water through Water Filter (Filter provided by 11 40 00 unless otherwise specified) to equipment.

16. Gas Quick Disconnect Installation (Quick Disconnect provided by 11 40 00).

17. Safety Restraint Cable Installation (Safety Restraint Cable Provided by 11 40 00).

18. Specified couplings and piping to all equipment furnished by 11 40 00.

19. Air Compressors (if required for this project) (Size, Provide, and Install unless otherwise specified).

20. Water Softeners (if required for this project) (Size, Provide, and Install unless otherwise specified).

21. Pressure Boilers (if required for this project) (Size, Provide, and Install unless otherwise specified).

22. Hand Sinks (Provide (unless otherwise specified) and Install). Provide a hot water tempering valve if required. Water temperature to be at least 100 degrees and flow for at least 20 seconds.

23. Ice Bin Drain Insulation (if Ice Machine is provided in this project) (Provide and Install).

24. Unions at disposer solenoid valves (if Disposer is provided in this project) (Provide and Install).

25. Back Flow Prevention as required (Provide and Install - including all disposers). Back-Siphonage shall be installed at all fixtures and equipment where backflow and/or back-siphonage may occur and where a minimum air gap cannot be provided between the water to the fixture or equipment at its flood/level rim. When furnished with equipment, vacuum breakers shall override the above if acceptable with applicable codes. Division 22 is responsible for verifying requirements with local codes.

26. Janitor Sink with Faucet (Provide and Install).

27. Freeze Proof Hydrant at the exterior of the building by receiving door (Provide and Install - unless otherwise specified).

28. Reverse Osmosis Systems (Size, Provide (unless otherwise specified), Locate, and Install).

29. All piping within the counter body or under fabricated counters must be run to a connection point below the counter body by Section 11 40 00—final connection by Division 22.

30. Exhaust Hood condensate drain connections (if Exhaust Hood is provided in this project) (Provide and Install).

31. Interconnection of ½" CW to Pre-Rinse and Disposers cone/body inlets piped through the solenoid and vacuum breaker (if Disposer is provided in this project).

32. Fire System Piping. The exposed piping is to be chrome plated.

33. Pipe ½" cold water to swirl inlets at disposers (if Disposer is provided in this project).

34. Water Treatment for Ice Builders (Non-chlorinated water with a pH level of 10 or higher) and any drains and overflows. Piping from Ice Builders to Tumble Chillers by Div. 23 (if Ice Builders and Tumble Chillers are provided in this project).

35. Manifold drain lines together for all multi-compartment sinks (two-compartment, three-compartment, etc.).

36. Refer to Section 2.2 PLUMBING / MECHANICAL REQUIREMENTS for additional information.

E. Division 23 (Mechanical) responsible for but not limited to:

1. All connections shall be made following local codes and national standards, except where plans and specifications exceed those codes and standards.

2. Rough-in and final connection of mechanical systems to food service equipment, walk-in assemblies, and between components (including materials and labor).

3. A mechanical contractor will test and balance rooms and exhaust hoods. **Balance report for food service Exhaust Hoods to be provided to Foodservice Design Professionals (FDP) immediately upon completion (send to Houston.Submittal@fdp.org) and must be submitted with O&M manuals.**

4. Exhaust Hoods, Condensate Hoods, Fire Suppression Systems, connections, and controls (Provide and Install – unless otherwise specified). Provide tempered air at all supply ducts.

    a. If Exhaust/Condensate Hoods and Fire Suppression Systems are specified under Section 11 40 00, Division 23 is responsible for all Exhaust and Condensate Hood connections (Provide and Install).

5. VFD System and controllers when required by code (Provide and Install).

6. Provide and install all ventilation (direct or indirect), air conditioning, and heating systems (unless otherwise specified).

7. Coordinate Supply and Return ducts above Serving Counters. No cold air is to blow directly on hot food counters or open-air refrigerated merchandisers.

8. Coordinate Supply and Return ducts away from equipment with top-mounted refrigeration. No cold air is to blow directly on compressors.

9. Mechanical Contractor to locate temperature monitors within return ducts.

10. Circulating air above walk-in assemblies (Provide and Install).

11. Circulating air above and in air gaps at warehouse cold storage assemblies (Provide and Install).

12. Water Chillers as required (if equipment is provided in this project) (Provide, Size, and Locate).

13. Piping from Ice Builders to Tumble Chillers (if equipment is provided in this project) (Size, Provide and Install).

14. Refer to Section 2.2 PLUMBING / MECHANICAL REQUIREMENTS for additional information.

F. Division 26 (Electrical) responsible for but not limited to:

1. Rough-in and final connection of electrical systems to food service equipment, walk-in assemblies, and between components (including materials and labor). Accessories provided loose with food service equipment by Section 11 40 00 to be field installed by Division 26.

2. Empty EMT Conduit with pull-wire and wide-sweep bends for remote refrigeration evaporator control wires, temperature monitor panel, and emergency alarm/strobes as required.

3. Empty EMT Conduit with pull-wire and wide-sweep bends for interconnect cables between LAN and POS terminals, change-makers, pre-check units, printers, CPUs, etc. Division 26 to verify where the conduit will run for POS System (i.e., Manager's Office or IDF Room).

4. Empty EMT Conduit with pull-wire and wide-sweep bends for fire suppression systems. Interconnect the Fire Protection System to panel box shunt trips and building alarm.

5. Walk-in Assembly Light Fixture Installation (Provided loose by Section 11 40 00) (if Walk-in is provided in this project).

6. Table Limit Switch (Provided loose by Section 11 40 00) (if Dishmachine is provided in this project) – Install and interconnect to Dishmachine.

7. Electrical Materials and Devices (Shunt-trip breakers, surge protectors, lighting control devices, conduit, wire, etc.).

8. Switches and Stainless Steel Disconnects as required (Provide, Locate, and Install – to be in an accessible location).

9. Charging Stations for Forklifts, Pallet Stackers, and Pallet Jacks (Size, Provide, Locate, and Install) (if equipment is provided in this project).

10. Interconnection between Condensate Fan and Dishmachine control panel (if equipment is provided in this project).

11. Interconnection between Exhaust Hood fans and switch (if equipment is provided in this project).

12. Interconnection between Exhaust Hood lights and switch (if equipment is provided in this project).

13. Door Heaters, Lights, Coils, and Heated Pressure Relief Ports pre-wired to the junction box at the top of walk-in assemblies (if equipment is provided in this project) provided by Section 11 40 00—final connection by Div. 26.

14. If any electrical accessories, fittings, and cord/plugs are provided loose with equipment by 11 40 00, Div. 26 is to attach to equipment and provide final connection.

15. Provide waterproof receptacles in wet areas.

16. All electrical connections beneath Exhaust Hoods (if equipment is provided in this project) to extend to shunt trip breakers with electrical panel box for shutdown during fire mode.

17. Receptacles will be pre-wired to Junction Box or Load Center for final connection by Division 26.

18. All electrical lighting, power, and distribution systems.

19. Do not interconnect more than three (3) convenience outlets on one (1) breaker.

20. Other than convenience outlets, all electrical connections on food service plans are dedicated breakers.

21. Doorbell at receiving door (Provide and Install –audible throughout Kitchen, Office, and Dry Storage room).

22. Adequate lighting at receiving door.

23. (if Walk-in is provided in this project) Walk-in Manufacturer is to provide Three (3) Edwards 860 Series (or equal) red lens, surface-mounted Xenon Emergency Strobe Beacons. Div 26 will install One (1) located in the Kitchen in architectural ceiling above Walk-In Cooler door, One (1) located in the Kitchen in architectural ceiling above Walk-In Freezer door, and the third unit located in the Cafetorium (Division 26 to coordinate location with Owners and Architect). Division 26 is to provide all conduit and wiring required and interconnect the illuminated Push Button Panic Alarm in the Walk-In Cooler and Freezer to all Strobe Beacons (***Critical***). Coordinate with Division 27.

24. Dedicated circuit for heated drain line connection in Walk-In Freezer (120/1/16.0 Amp) at each coil (if Walk-In is provided in this project).

25. GFCI Breaker for all receptacles under Exhaust Hoods (if Hoods are provided in this project) and Holding Cabinets (if Holding Cabinets are provided in this project), to be located within Kitchen's electrical Breaker Panel and not at the receptacles.

26. Remote GFCI reset switches to be accessible to end user.

27. All electrical below Exhaust Hoods (if Hoods are provided in the project) are to have Shunt Trip Breakers.

28. Interconnect Temp Sensor to Exhaust / Supply fans (if Hoods are provided in this project).

29. Electrical contractor to provide conduit with pulled wires prior to installation of equipment.

30. Refer to Section 2.5, ELECTRICAL REQUIREMENTS, for additional information.

G. Division 27 (Communication) responsible for but not limited to:

1. Data line coordination for food service equipment.

2. Time clocks as required.

3. Video cameras for learning assistance in food service areas as required (Provide, Locate, and Install).

4. (if Walk-in is provided in this project) Provide conduit, data line, and interconnect the illuminated Push Button Panic Alarm inside the Walk-In Cooler and Freezer to the Building Automation System (BAS). When activated, facility personnel are to be notified - coordinate notification requirements with the Owner (***Critical***). Coordinate with Division 26.

5. (if Walk-in is provided in this project) Provide conduit, data line, and interconnect Leak Detection System to Building Automation System or Owner alarm system as maybe be required for communication of alarm to Owner.

H. Division 28 (Electronic Safety and Security) is responsible for but not limited to:

1. Security Cameras as required (Provide, Locate, and Install).

I. General Contractor responsible for but not limited to:

1. Any wall penetration required for food service equipment utilities. Escutcheon plates or S/S sleeves are to be provided and installed as needed.

2. Bulk Freezer Ventilation Pipe (if Bulk Freezer is provided in this project) (Provide and Install unless otherwise specified).

3. Core drilling for Guide Rails (if Guide Rails are provided in this project).

4. Refrigeration Roof Curbs / Roof Jack (if Refrigeration System is provided in this project and located on the roof).

5. Interior Bollards (if required for this project) – to be epoxy painted per local codes (Provide and Install).

6. Furnish and Install ¾" Plywood blocking in the wall for mounting equipment furnished by Section 11 40 00 as required.

7. Walk-in Depressions (to be dead level) and sand leveling bed (if Walk-in is provided in this project and recess is shown).

8. Structural bracing for Bulk Walk-in Assembly ceiling panels if required.

9. Menu System Video Monitors in Servery (unless otherwise specified).

10. Structural bracing for Menu System Video Monitors if required.

11. Interior/Exterior refrigeration penetrations and sleeves at building penetrations.

12. DoorScope viewer (peephole) with wide viewing angle at receiving door.

13. Canopy at receiving door. Coordinate height with the height of Receiving Door (8') and the mounting height of Air Screen above the door.

14. Soap and towel dispenser provided by Owner. G.C. is responsible for installation.

15. Washer and Dryer (Provide and Install, unless otherwise specified).

16. Dwarf wall at exposed front/ends of cafeteria serving counters with the finish as selected by the Architect (if required in this project).

17. Substrate (Provide and Install) at SS Wall Caps for pony walls.

18. Final cleaning of all equipment before demonstrations.

1.5 QUALITY ASSURANCE

A. In addition to complying with all applicable laws, statutes, building codes, and regulations of public authorities, comply with the following:

1. National Sanitation Foundation (all equipment to bear label)

2. National Electric Code

3. Underwriters' Laboratories, Inc. (all applicable equipment to bear label)

4. American Gas Association Laboratories

5. National Fire Protection Association

6. Americans with Disabilities Act

7. Food and Drug Administration HAACP Guidelines

8. International Energy Conservation Code (IECC)

9. Department of Energy

10. Environmental Protection Agency

11. CSA Group

B. Furnish certification of regularly manufactured equipment listing or classification by Underwriters Laboratories, Inc., with the initial submittal.

C. Furnish a list of equipment and components (internal and external) that are not of domestic origin. All equipment and components (internal and external) should be of domestic origin when possible. This information should be provided with the initial submittal.

D. Projects outside the continental United States shall adhere to all local authorities having jurisdiction over that project.

1.6 SUBSTITUTIONS

A. **The specified equipment items or components are intended to be the basis of the bid. All other brands, including any additional names, which may be listed as "Alternates" or "Approved Equal," must conform with the general and item specifications, warranties, size/dimensions, quality, accessories, function, voltage, horsepower, etc. of the first-named brand and be subject to Paragraph C-03 of this Article.**

B. Proposed Substitutions:

1. Submitted at least 14 calendar days before Bid Date.

2. Submit proposed substitutions with catalog data and manufacturer's shop details indicating all modifications required to conform with the specified brand.

3. List of deviations must include equipment name, model number, accessories, and features with deviation(s) noted for specified and proposed alternate equipment. Equipment without listed deviation(s) will be considered furnished as specified.

C. Substitutions with prior approval:

1. Submitted on Bidder's letterhead attached to Proposal Form with individual additive/deductive amounts stipulated and the documentation required in Paragraph B-02.

2. Owner reserves the right to accept or reject any or all substitution proposals before execution of the Contract.

3. Provide all design/engineering services required to adjust in space, systems, utilities, etc., and pay all additional costs of utilities, construction, or professional services that may be incurred due to the acceptance of any substitution.

D. All appliances or other equipment within a common group or category (e.g., refrigerators, kettles, ovens, shelving, etc.) must be from the same manufacturer.

1.7 INTERPRETATION OF DOCUMENTS

A. During Bidding: Bidder's, supplier's, or vendor's questions and comments about Construction Document's clarity or intent will be addressed by addendum.

B. After Award:

1. Clarification Bulletin will confirm Construction Document requirements.

2. Request for Information submitted by Contractor shall contain Contractor's proposed resolution.

1.8 WARRANTY

A. Provide a written warranty for parts and labor for one year ***from the date of Substantial Completion***, including an extended four-year replacement warranty on compressor bodies.

B. Components of equipment subject to replacement before one year's use (such as refrigerator door gaskets) and those items which may fail due to improper or inadequate periodic maintenance by the Owner/Operator (such as an uncleaned refrigeration system condenser) are not intended to be included within the scope of the Warranty.

C. Refrigeration Systems/Equipment: One-year free service available within twenty-four hours of notification.

D. Furnish three copies of a list of all equipment and their respective local service agencies, indicating the address, telephone number, and name of the person to contact. The service agencies selected shall be factory-authorized for the equipment assigned whenever possible.

E. Provide the following for refrigeration systems/equipment unless specified otherwise:

1. One (1) year of free refrigeration system service is available within twenty-four hours of notification.

2. Provide five (5) year manufacturer's registered written replacement warranty certificate covering compressor bodies. Warranty to cover labor costs for the first year.

3. Provide ten (10) years of the manufacturer's registered written replacement/repair warranty certificate covering walk-in assembly panels. Warranty to cover defects in material and workmanship. Warranty to cover labor costs for the first year.

4. Provide two (2) year parts and labor warranty for ***all parts/components (including third-party components that may be utilized)*** of the refrigeration system(s) ***(including freon)***, walk-in cooler(s), and freezer(s) not otherwise covered herein.

F. ***All above-stated warranty periods are from the date of Substantial Completion***. All replacement parts due to a warranty call should be the same quality as the original, or better if the original were defective. Replacement parts should be of domestic origin where possible.

1.9 SUBMITTAL DATA

A. **All submittals must be received, reviewed, and approved as noted prior to equipment procurement. If any equipment is procured prior to this process, it is on the KEC to replace any equipment, accessories, or other components that may not meet the specifications or design intent for the facility, including all costs associated with rectifying the errors made in procuring the equipment before this critical process.**

B. Special Requirements: The following are in addition to any general requirements given elsewhere in the Documents.

C. Submittal Requirements:

1. Kitchen Equipment Contractor to furnish all submittals via PDF, drawings to be scaled per General Specifications and provided in Three (3) submittal packages.

2. Foodservice Design Professionals requires the below-listed business days for each package submitted. Packages are to be submitted within 14 days between each issued package. Each package should contain individual submittal sets.

a. Package One to include (2) Individual sets: 10 Business Days for Review

i. Equipment rough-in

ii. Equipment Brochure

b. Package Two to include (3) Individual sets: 10 Business Days for Review

i. Exhaust Hoods

ii. Walk-in Cold Storage Assemblies

iii. Refrigeration

c. Package Three to include (4) Individual sets: 15 Business Days for Review

i. Custom Fabrication

ii. Serving Counters

iii. Merchandising Equipment

iv. Miscellaneous Submittals

D. Submittals to be identified with the below-listed file name structure:

1. 11 40 00-1 EQUIPMENT BROCHURE

2. 11 40 00-2 EQUIPMENT ROUGH-IN PLANS

3. 11 40 00-3 CUSTOM FABRICATION

4. 11 40 00-4 SERVING COUNTER

5. 11 40 00-5 EXHAUST HOODS

6. 11 40 00-6 WALK-IN COLD STORAGE ASSEMBLY

7. 11 40 00-7 REFRIGERATION

8. 11 40 00-8 BEVERAGE MERCHANDISER

E. Package One (1) requires both submittals: Brochure and Rough-in plans. **If not sent together, the submittal will be rejected.**

F. Foodservice Design Professionals (FDP) will notate all submittals in RED. Architects and General contractors will be notated in color per their direction.

G. If hard copy submittals are required, Kitchen Equipment Contractor will furnish all copies to the specified trades as required.

H. If discrepancies, missing information, or incorrect information occur within the documents, Kitchen Equipment Contractor is to seek clarification or note the need for further direction on submittals. The Kitchen Equipment Contractor is to bid the higher of the discrepancies. *Refer to Section 1.3 SCOPE OF WORK: Subsection D.*

I. Brochure Format (for regularly manufactured equipment and components):

1. Front and rear protective cover with labeled project name.

2. Brochure index: Indicate Functional Area/Room number, item number, quantity, description, and manufacturer.

3. A separate flysheet for each component or item of equipment, indicating item number, name, quantity, manufacturer, optional equipment, modifications, special instructions, and utility requirements. Any equipment or assembly containing more than one buyout sub-assembly or component shall have the second item listed in parenthesis beside the primary item name—for example, Serving Counter (hot food well).

4. Catalog specification sheet with all options notated on the specification sheet and manufacturer's drawing.

J. Shop Drawings (Rough-In Drawings):

1. Separate drawing sheets: same size as Contract Drawings (Contract Drawings are not to be traced or reproduced). Submittal drawings are to be provided by Kitchen Equipment Contractor and not copied or reproduced from Contract Documents. Any reproduced submittal drawings will be rejected.

2. ¼" scale drawing of fixed/movable food service equipment and prefabricated Walk-in assemblies with itemized schedules.

3. Special Conditions Drawings, sizing, and locating the following conditions:

a. Slab depressions, cores, sleeves, or block-outs (walk-in assemblies, drain trenches, piping, etc.).

b. Concrete or masonry platforms.

c. Pipe sleeves or roof jacks.

d. Wall openings or block-outs for pass-through equipment, recessed control panels, in-wall fire-protection system components, etc.

e. Blocking grounds or anchor plates required in walls for equipment support/attachment.

f. Above-ceiling hanger assemblies for support of exhaust hoods, ceiling-mounted pot racks, etc.

g. Access panels in walls or ceiling for service of equipment.

h. Ceiling pockets or recesses for unusually high equipment.

i. In-wall carriers for wall-hung or cantilevered equipment.

4. Electrical Rough-In Drawing

5. Plumbing and Mechanical Rough-In Drawing

6. Required information:

a. All fixed and portable food service equipment shown on Contract Drawings.

b. All prefabricated Walk-In Assemblies and Conveyor/Dishtable Assemblies shown on Contract Drawings.

c. All general-use and convenience utilities or services indicated on Contract Drawings, including those required by or connected to equipment or devices, not in this Section.

d. All Rough-In Drawings: Fully dimensioned from engineering benchmark (column lines, when provided) and finished-room surface to the point of stub-up through floor and stub-out through wall or ceiling for all mechanical, electrical, and plumbing services.

e. Connection number/tag system and symbols: Identical to Contract Drawings.

K. Shop Drawings (Manufacturer's and Fabricator's):

1. Sheet Size: Identical to Contract Drawings, drawn or plotted at a ¼" scale for plan view, ½" for elevations, and 1½" for sections and construction details.

2. Included information: The item number, name, and quantity.

3. Construction details, sections, and elevations to reflect the requirements of the Specifications and Drawings.

4. Indicate adjacent walls, columns, and equipment.

5. Indicate plumbing and electrical schematic drawings for equipment such as conveyors, waste systems, self-cleaning exhaust hoods, exhaust hood fire protection systems, and fabricated fixtures with a single electrical or plumbing connection.

6. Mechanical or electrical operating components or products integrated into a fabricated fixture: ventilation and service access required or recommended by the manufacturer, including panel size and location to permit easy lubrication, adjustment, or replacement of all moving parts.

L. All equipment and engineering rough-in plans sheet numbers are to match the contract documents. All equipment item numbers and engineer item numbers located on the schedules are to match the contract documents. All engineering requirements must be updated to accommodate the provided equipment and match the contract documents. The Kitchen Contractor coordinates any MEP revisions to accommodate the supplied and proposed equipment. The Kitchen Equipment Contractor is responsible for any costs associated with equipment substitution.

M. Foodservice Design Professionals (FDP) drawings and schedules are not to be copied in any way. Any replicated drawings of Foodservice Design Professionals (FDP) will be rejected.

1.10 SERVICE MANUAL

A. Three copies bound in 1½" hardback, three-ring binders (as many volumes as required by the scope of the project) with the same data as the brochure after installation (Refer to "Submittal Data"). Provide separate service manuals for each independent area within the project scope (Main Kitchen, Culinary, Concession, etc.).

B. Each Volume: Section for maintenance of finish materials (e.g., stainless steel, plastic laminates, FRP, Plexiglas, etc.).

C. Catalog specification sheet and/or manufacturer's shop drawings, including wiring diagrams when applicable.

D. Each Volume: Index of items, manufacturer's operating/maintenance information, replacement parts data, list of all product warranties, and price lists. Provide the name, title, and address of personnel at each respective manufacturer and service personnel to be contacted for spare/replacement parts and service after the warranty period.

E. To the greatest extent possible, provide two copies of the manufacturer's instructional video cassettes for operating, maintenance, and equipment service.

F. Internally subdivide binder contents with permanent page dividers, logically organized by equipment item number or manufacturer name, with tab titling printed under reinforced, laminated plastic tabs.

G. Electronically submitted manuals must follow the formatting requirements listed above.

H. **Service Manual to be provided to the owner before kitchen equipment demonstration.**

1.11 VERIFICATION AND COORDINATION OF PROJECT / DATA

A. Utilities Rough-in Drawings and field verifications are to be completed within four weeks after receipt of notice-to-proceed. Review Contract Drawings and Submittal Data for accuracy and completeness and notify Architect of conflicts and proposed adjustments. Coordinate work with other sub-contractors.

1. KEC to provide on-site field verification of all underground utilities before pouring concrete for capacity and location and coordinate with General Contractor. Submit a review to Architect and General Contractor. If rough-ins need to be relocated, KEC will compensate other trades for the required relocation.

2. KEC to provide on-site field verification of all other utility connections and locations and coordinate with General Contractor. Submit a review to Architect and General Contractor.

B. On-Site Inspection Reports

1. Before concrete pour: The Kitchen Equipment Contractor is to submit a copy of the report below to the Architect, General Contractor, and Foodservice Design Professionals (FDP) within 24 hours of the inspection. The form to be submitted is contained within these General Specifications.

2. Before delivery of equipment: The Kitchen Equipment Contractor is to submit a copy of the report below to the Architect, General Contractor, and Foodservice Design Professionals (FDP) within 24 hours of the inspection. The form to be submitted is contained within these General Specifications.

FOODSERVICE DESIGN PROFESSIONALS

0n - Site Inspection Report

Prior to Concrete Pour

Inspection Date_____ **Project Name** _____

Project Location_____

Inspector's Name_____ **Company** _____

Inspector's Contact Number_____ **Email** _____

Architectural Firm_____ **Project Architect** _____

Architect's Contact Number_____ **Email** _____

General Contractor_____ **Project Manager** _____

G.C. Contact Number_____ **Email** _____

Food Service Consultant Foodservice Design Professionals, LLC **Project Manager**_____

Contact Number 281.350.2323 **Email** _____

An on-site Inspection to verify the location of UNDERGROUND utilities was conducted on this date. The following conditions were observed and brought to the attention of the General Contractor. (KEC is to provide a written description and copy of the Utility Plan indicating the corrective action required).

1. What difficulties were encountered?

Inspector's Initials _____

This Inspection Report is the responsibility of the Kitchen Equipment Supplier and the General Contractor. Coordination between the two parties is mandatory.
Neither the Architect nor FDP need to be present at these inspections.

EMAIL A COPY OF THIS REPORT AND ANY ADDITIONAL INFORMATION TO THE ARCHITECT, GENERAL CONTRACTOR AND FOODSERVICE DESIGN PROFESSIONALS, LLC.

FOODSERVICE DESIGN PROFESSIONALS

CSA INSTALLATION APPROVAL REPORT

Report Date_____ **Project Name** _____

KEC Firm_____ **Phone Number**_____

Contact Name_____ **Email** _____

- ☐ **Walk-In panels are installed square, plumb, and level. Inspected prior to interior concrete pour.**
- ☐ **Ceiling panels are installed flush and tight to wall panels with undamaged gasket material. Any signs of condensation at joints or walls should be reported to FDP and addressed immediately. Caulk at panel seams will not be an acceptable solution.**
- ☐ **All cam-locks are engaged, and buttonholes are in place.**
- ☐ **Gaps under the screed or floor angle (due to shimming) are entirely sealed to the slab.**
- ☐ **Penetrations in the ceiling or wall panels are insulated and sealed.**
- ☐ **Weatherproofing / thermal barrier material is installed.**
- ☐ **All sharp edges of metal doors and diamond treadplate are clean of sharp edges and deburred.**
- ☐ **Door bumper or wall protection is installed and located as to prevent damage of door to adjacent walls.**
- ☐ **Cove base installed at all wall bases internal and external of walk-in.**
- ☐ **Door systems are correctly installed, and the door is self-closing and seals around the opening perimeter and at the floor threshold. Threshold has a smooth and level transition.**
- ☐ **Upon completion of the electrical connections, confirm the final operation of the IC/IC+ control, door heaters and light switches.**
- ☐ **Entrapment hardware and alarm systems are installed and functioning.**

KEC SIGNATURE_____

COMMENTS_____

_____

EMAIL A COPY OF THIS REPORT AND ANY ADDITIONAL INFORMATION TO THE ARCHITECT, GENERAL CONTRACTOR AND FOODSERVICE DESIGN PROFESSIONALS, LLC.

FOODSERVICE DESIGN PROFESSIONALS

0n - Site Inspection Report

Prior to Delivery of Equipment

Inspection Date_____ **Project Name** _____

Project Location_____

Inspector's Name_____ **Company** _____

Inspector's Contact Number_____ **Email** _____

Architectural Firm_____ **Project Architect** _____

Architect's Contact Number_____ **Email** _____

General Contractor_____ **Project Manager** _____

G.C. Contact Number_____ **Email** _____

Food Service Consultant Foodservice Design Professionals, LLC **Project Manager**_____

Contact Number 281.350.2323 **Email** _____

An on-site Inspection to verify the location of INSTALLED utilities was conducted on this date. The following conditions were observed and brought to the attention of the General Contractor. (KEC is to provide a written description and copy of the Utility Plan indicating the corrective action required).

1. What difficulties were encountered?

Inspector's Initials _____

This Inspection Report is the responsibility of the Kitchen Equipment Supplier and the General Contractor. Coordination between the two parties is mandatory.
Neither the Architect nor FDP need to be present at these inspections.

EMAIL A COPY OF THIS REPORT AND ANY ADDITIONAL INFORMATION TO THE ARCHITECT, GENERAL CONTRACTOR AND FOODSERVICE DESIGN PROFESSIONALS, LLC.

C. Review critical systems/components for application, performance, and capacity and submit calculation worksheets with the initial submission of brochure/rough-in drawings, with all proposed adjustments noted, including:

1. Exhaust hood removal/supply air volume, velocity, static pressure, duct collar sizes, and locations.

2. Refrigeration Systems (compressor, condenser, and evaporator) capacities/sizes, quantities, and refrigerant piping distances/sizes.

3. Exhaust Hood Fire Suppression Systems (nozzle locations, air handler, fuel interlocks, piping/distance limitations).

4. Locations of Vacuum Breakers.

5. Conformance of Refrigerated Components/Equipment with HACCP Guidelines (e.g., salad/sandwich pans, upright/open refrigerator cabinets, salad bars) with HACCP Guidelines.

6. Gas and water line sizes and manifold configurations.

7. Diameter and length of flexible connector lines for fixed/movable gas appliances.

8. Fabricated Equipment load center panels (individual and total amperage calculations and circuit balance).

9. ADA compliance of workstations, service positions, passageways, etc.

D. Ceiling mounted appliances/fixtures: Verify and coordinate dimensions/location of support framing/hangers with the General Contractor—all material and installation below 12’-0” AFF: Section 11 40 00.

E. Dimension Responsibility: Obtain actual or guaranteed measurements for the proper equipment fit. All dimensions indicated in Contract Documents are approximate and are as accurate as can be determined at the time. Field-check all horizontal/vertical measurements and conditions at the building before fabrication or delivery of equipment and notify the Architect of all conflicts or deviations from the dimensions shown.

F. Checking Dimensions at Site: Before ordering any materials or doing any work, verify all measurements of the building and be responsible for their correctness. No extras will be allowed for variations from drawings in existing conditions or work performed under this contract. Any discrepancies found shall be submitted to the Architect for instructions before proceeding.

G. Scheduling to Fit Openings: Should it become necessary to schedule the construction of walls or partitions before delivery of fixed equipment, the equipment must be fabricated for passage through finished openings. Maintain close contact with the project and be cognizant of all conditions, including vertical handling limitations within the building (elevator cabs or openings, stairs, etc.) and possible hoisting requirements. Coordinate all procedures with General Contractor and Project Team.

H. Refrigerated and Dry Storage Areas: Verify and coordinate dimensions to accommodate scheduled modular shelf sections. Notify Architect of the variance between the Contract Documents and actual conditions.

I. Color/Pattern Selections: Submit selection samples of solid polymer products, plastic laminate, paint or stain finishes, and vinyl-coated surface material of equipment as selected by the Owner.

J. Movable Equipment Interface: Rolling stock (pan racks, carts, dollies, dish/tray/rack dispensers) required to fit through or into fixed equipment (roll-in refrigerators, counter bodies, etc.) is to be reviewed and coordinated for compatibility at the time initial of shop drawing submittal. Indicate conflicts and proposed adjustments.

K. Relocation of Work: Relocate or re-route work as required to coordinate related items free of charge if no extra work is involved.

L. **Kitchen Equipment Contractor must provide FDP with the food service equipment lump sum pricing (including material and labor) after the contract has been executed and *before submittals* are provided to FDP. *This information is critical to FDP for accounting/billing purposes.***

1.12 EQUIPMENT FURNISHED / INSTALLED BY OTHERS

A. Obtain and coordinate utility requirements of Owner-Furnished/Owner-Installed (OF/OI) equipment with the building utilities and rough-in drawings/provisions.

B. Coordinate physical data of OF/OI appliances or equipment and incorporate information into Submittal Drawings. Vendor- or Purveyor-Furnished equipment (e.g., coffee/tea equipment): same as OF/OI.

1.13 WORK INSTALLED BUT FURNISHED BY OTHERS

A. Coordinate delivery/installation schedule of Owner-Furnished/Contractor-Installed (OF/CI) equipment with the Owner at least ninety (90) days before equipment requirement.

B. Obtain and coordinate utility requirements of OF/CI equipment with the building utilities and rough-in drawings/provisions.

C. Receive at the job site and fully incorporate into installation procedures as if furnished under this Section.

PART 2 - PRODUCTS

2.1 FABRICATED FIXTURES MATERIAL / COMPONENTS

A. Stainless steel sheets or shapes: 18-8, Type 302, polished to 180 grit No. 4 finish.

1. Stainless steel joints and seams: Heli-arc welded, free of pits and flaws, ground smooth, and polished to a No. 4 finish.

2. The “grain” direction of horizontal stainless-steel surfaces: Longitudinal, including the backsplash. The polishing procedure at right-angle corners of fixtures shall provide a mitered appearance.

B. Galvanized Iron Sheets: Armco copper bearing Zinc Grip or Zinc Grip/Paint Grip.

1. Galvanized iron joints and seams: Arc-welded, free of pits, flaws, and ground smooth.

2. Galvanized sheets or shapes: Washed with mineral spirits and painted with Rust-Oleum gray semi-gloss enamel.

C. Sound Deadening: Schnee Butyl Sealant ½" wide rope positioned continuously between all frame members or contact material and underside of stainless-steel surface (sinks, tabletops, food wells, over shelves, and undershelves). Tighten stud bolts for maximum compression of sealant and trim excess.

D. Plastic Laminates: Color/pattern selected by Architect, in 1/16" thickness for flat surfaces: 1/32" thickness for radiused surfaces. Plastic laminates and adhesives must be NSF-approved (Standard No. 35).

E. Solid Polymer products: Color/pattern/material selected by Architect in thickness as specified. Solid Polymers and adhesives must be N.S.F. approved (Standard No. 51).

F. Casters:

1. Fabricated fixtures with "Open Base" construction: Jarvis and Jarvis Model No. 5-405-113P-NSF swivel casters with grease seals on forks and wheels; Zerk fitting in swivel; two casters: Model No. E-75 Verti-Lock brakes. All casters: B-7" rolling bumpers with stainless steel top discs.

G. Cutting Boards: 1/2" thick Read Products, Inc. "Richlite" cutting board, size as indicated.

H. Identification Plates, Labels, Tags:

1. Prohibited Information: Names of suppliers, fabricators, and contractors.

2. NSF Labels: Required on all pieces of equipment.

3. Required Information: Function or purpose of controls such as display light switches, food warmer controls, etc.

4. Plate Construction: Engraved phenolic plastic, secured to equipment with epoxy cement or stainless-steel screws. Furnish samples.

2.2 PLUMBING / MECHANICAL REQUIREMENTS

A. Plumbing Fittings and Components: Furnished under this Section as follows:

Note: Fitting and components described in Items 1, 2, 3, 4, and 5 are furnished loose by 11 40 00 for final installation and connection by Division 22.

1. Control valves and appliance pressure regulators for water, gas, steam, and vacuum breakers: wherever required on food service equipment (chrome-plated where exposed).

2. Faucets and drains with and without connected overflows (unless otherwise indicated) for all sinks.

3. Specialty food service water-fill faucets, hose bibbs, or hose assemblies indicated in drawings/specifications.

4. Wade Model No. W-10 Shock-Stop shock absorbers for all food service equipment with quick-opening or solenoid-operated water valves.

5. Dormont Series Water Quick Disconnect hose, diameter per water connection size requirements, with safety fitting, w/coiled restraining device, full port ball valve, antimicrobial coating, lifetime warranty.

6. Extensions of indirect waste fittings to open-sight floor sink or floor drains from sinks, under bar equipment, and food-holding components of serving counters (e.g., cold pans, hot food wells, refrigerator/freezer coils not equipped with condensate evaporators) furnished and installed by Division 22. Drains: All drains to be type 'K' Copper – Paint with aluminum paint where exposed**. Div. 22 to ensure a minimum air gap of 1" and not less than twice the effective opening of the indirect waste pipe, per code. Div. 22 to ensure all drain lines are centered over floor sink grate openings and no water splashes on the floor.**

7. Piping brackets and supports beneath fabricated equipment.

8. Closed Base Bodies: Removable 18-gauge stainless steel closure panel at plumbing penetrations under the top.

9. Control valves on Open Base fixtures: Mounted on a 14-gauge stainless steel gusset-shaped panel with h 3½" setback from the countertop edge/rim to the face of the control handle.

10. Fill hose/faucet at support pedestals or Closed Base Body: Installed in a 15" x 18" x 5" deep recessed mounting panel. Panel bottom: sloped on a 60° angle, with 3/8" stainless steel rod hanger-bracket for the hose.

11. Provide filtration option as shown on contract documents (a, b, c, or combination thereof):

    a. Water Filter System:

        i. In-line System: Everpure System filters for coffee/tea brewers, water chillers, and beverage systems. They should be sized per the manufacturer's recommendation.

        ii. Combi Ovens, Convection Steamers, and Ice Maker Filter Systems: **Provided by manufacturer as required.**

    b. Remote Central Water Filter System.

    c. Remote and/or In-line Reverse Osmosis system.

B. Gas-Heated Equipment Fittings and Components: Furnished under this Section as follows:

1. Fixed Equipment: Dormont 1675KIT2S48 gas appliance connector: Diameter per fuel volume/connection size requirements. Gas valve diameter size per fuel volume/connection size requirements.

    a. Restraining device: Heavy duty steel cable, fastened to equipment and walls, 3" to 6" shorter than equipment connector length.

C. Final Plumbing Connections Provisions:

1. Fabricated equipment containing components, fittings, and devices indicated on food service connection drawings to be connected to the building systems: each component, fitting, or group thereof pre-piped to a utility compartment for final connection by Division 22. Refer to drawings for capacities.

2. Field-assembled equipment (e.g., prefabricated walk-in assemblies, exhaust hoods, ware wash machines, convection ovens, etc.): plumbing components completely interconnected under this Section for final connection arrangements indicated on Utility Connection Drawings.

3. All plumbing final connection points of equipment shall be tagged, indicating the following:

    a. Item number

    b. Name of devices or components

    c. Type of utility (water, gas, steam, drain, chilled water)

D. Ducts and Vents:

1. Exhaust hoods furred-in to ceiling: 2” high duct collar for final connection to the duct system.

2. Warewash machines equipped with integral vent cowls or extended hoods: furnished with 18-gauge stainless steel seamless duct risers to 6” above the finished ceiling for final connection. The duct: trimmed at the ceiling with a 16-gauge stainless steel angle flange with all corners welded.

E. Refer to Section 1.4: OTHER DIVISIONS/CONTRACTORS RELATED WORK; Sub Sections E. Plumbing and F. Mechanical for additional information.

2.3 FOOD SERVICE EQUIPMENT REFRIGERATION SYSTEMS

A. Install complete with all refrigerants, oil, dials, dehydrators, gauges, and controls required for the system’s proper operation.

B. Self-contained or factory-installed compressors: Check and adjust to the proper operating temperature prescribed by FDA/HACCP.

2.4 PLUMBING TRIM

A. Faucets: Furnished for all sinks or equipment requiring open water supply.

B. Fill Faucets: Furnished for appliances requiring open water supply.

C. Drain Fittings: Furnished for all sinks or equipment requiring removal of liquids. Install specified chrome-plated or stainless-steel fittings in die-stamped openings with washers and locknuts. The solder may be used as a sealer but shall not be applied to the top surface of the drain fittings.

2.5 ELECTRICAL REQUIREMENTS

A. All electrical systems, components, and accessories within the work of this Section: Certified to be in accordance with NEC 70.

B. Electrical Fittings and Components: Furnished under this Section as follows. Coordinate food service equipment loads, voltage, and phase with the building system and confirm any existing or OF/OI equipment requirements.

C. Cord and Caps:

1. Coordinate all food service equipment cord/caps with related receptacles.

2. All 120, 120/208, and 208 volts “plug-in” equipment shall have Type SO or SJO cord and plug with ground wire fastened to the frame/body of the item.

3. Cord lengths for fixed equipment: Adjusted to eliminate loose-hanging excess.

4. All non-fixed plug-in “buy-out” equipment: Hubbell configuration and ratings as required.

5. All mobile electrical support equipment (heated cabinets, dish carts, etc.) and counter appliances mounted on mobile stands (mixers, food cutters, toasters, coffee makers, microwave ovens, etc.): 8’-0” cord length with cord-hanger strap secured to the rear of equipment or mobile stand.

D. Switches and Controls:

1. Each motor-driven appliance or electrically heated unit: Equipped with a control switch or starter per Underwriters’ Laboratories, Inc., with low-voltage and overload protection.

2. Disposer controls recess-mounted in the wall: External fittings and accessories removed from the enclosure and furnished with 12-gauge stainless steel perimeter angle flange with welded corners. Install control at 4’-0” AFF to the bottom of the enclosure.

3. Disposer controls recess-mounted in counter-splash risers: External fittings and accessories removed from NEMA 4 enclosure and furnished with 12-gauge stainless steel perimeter angle flange with welded corners. Install control at 3’-0” AFF to the bottom of the enclosure. Provide the panel with a 60” long Seal-Tite electrical conduit from the bottom of the control panel for final field connections under Division 26.

4. Equipment that is not provided with built-in circuit breakers or fused terminal block and is indicated on Utility Connections Drawings to be directly connected to the building electrical system: a NEMA 4 stainless steel disconnect switch furnished and installed by Division 26.

5. All remote manual starters, disconnect switches, magnetic contactors or starters, and push-button stations: NEMA Type 4 enclosure; NEMA Type 1 enclosure only when installed in a Closed Base Body.

E. Heating Elements:

1. Electrically heated equipment: Thermostatic controls.

2. Water heating equipment: Equipped with positive low water shut-off.

F. Receptacles and Switches:

1. Receptacles installed in vertical panels of support pedestals or Closed Base Bodies: installed in 12” x 8½” x 3” deep recessed mounting panel sloped at a 60° angle and turned up to the top of the opening.

2. Pre-wire receptacles in closed base fixtures to a junction box installed within 6” from the bottom of utility or compressor compartments.

3. Receptacles mounted on Open Base fixtures: Installed on a 12” x 10½” x 4½” deep 14-gauge stainless steel panel with returned ends and sloping recess—secure panel to the underframe of fixture top.

4. Pre-wire receptacles on open base fixtures to a junction box secured to a leg or mounted on the underside of the lower shelf. Vertical runs of wiring: Made in rigid conduit or within the tubular leg.

5. Receptacles installed in/on-fabricated equipment: Hubbell, Inc. assemblies horizontally mounted in a metal box with stainless steel cover plate.

6. Switches installed in/on-fabricated equipment: Hubbell, Inc. with metal box and stainless-steel cover plate. Switches: pre-wired to the controlled device and a junction box installed within 6” from the bottom of the utility or compressor compartment. All refrigeration system switches: Installed within the compressor compartment near the door opening.

7. Load centers installed in/on fabricated equipment to have all fixture components pre-wired to the load center with balanced phase loading. Load center: Ready for final connection by Division 26 and flush-mounted within the utility compartment rear panel, set back 8” from the access door. All breaker/device information will be typewritten on the circuit schedule in the load center door (number corresponding breaker/device) with an enclosed schematic wiring diagram of fixture components.

8. All receptacles are to be pre-wired to the cord and plug assembly and routed through the over-shelf post at all island equipment locations unless specified otherwise.

G. Light Fixtures:

1. Light fixtures with lamps installed in/on fabricated or field-assembled equipment: pre-wired to a junction box for final connection (continuous-run fixtures when indicated).

2. LED Display Light: Install light fixtures full-length of Display Stand and Serving Shelf with stud bolts and pre-wire through support posts to an apron-mounted switch.

3. Heat Lamps: Installed to the underside of serving shelf assemblies. When multiple 24” heat lamps are specified, provide maximum length heat lamp chassis. Install all switches remotely from lamps.

4. **Walk-in assembly LED Light Fixtures: Furnished by Section 11 40 00, final installation by Div. 26. All electrical wiring and conduit, provided by Div. 26, electrically connected through the Vapor Proof light fixture base connection, located on the interior door header—all Conduit to be Seal-tight conduit. Door frame wiring stubs out the top of panels 8” in flexible conduit for final connection by the electrical contractor. All horizontal conduits: below ceiling panels. All lighting fixtures will be wired from inside the assembly—no penetrations through the ceiling panels. Seal-sleeved penetrations are airtight at both sides of the panel. KEC is responsible for verifying that trade contractors seal all penetrations.**

H. Final Electrical Connection Provisions:

1. Fabricated equipment containing electrically operated components or fittings indicated on Utility Connections Drawings: Direct connected, with each component, fitting, or group pre-wired to a junction box for final connection by Division 26. Refer to drawings for circuit loading.

2. Fabricated equipment containing electrically operated components and devices indicated: Circuit-breaker load center with each component or device pre-wired to a separate circuit breaker for balanced phase loading and single final connection by Division 26.

3. Field-assembled equipment (e.g., prefabricated walk-in assemblies, exhaust hoods, ware wash machines, etc.) shall have electrical components completely interconnected in this Section for final connection arrangements as indicated on Utility Connection Drawings by Division 26.

4. Pre-wire the following groups of walk-in assembly electrical devices to a top-mounted junction box for final connection by Division 26 per compartment grouping (unless otherwise indicated).

   a. Light fixtures and switches; heated pressure-relief ports.

   b. Door/jamb heaters.

   c. Evaporator fans, defrost elements and drain line heaters.

5. All electrical final connection points of equipment shall be tagged, indicating the following:

   a. Item number.

   b. Name of devices on the circuit.

   c. Total electrical load.

   d. Voltage and phase.

I. Lamps: in all food service equipment containing light fixtures. Refrigerator or heated cabinets: All exposed LED lamps above or within a food zone: Shat-R-Shield lamps or standard lamps, sleeved with end caps.

J. Refer to Section 1.4: OTHER DIVISIONS/CONTRACTORS RELATED WORK; Subsection F. Division 26 (Electrical) for additional information.

2.6 CUSTOM – FABRICATED / ASSEMBLED UNITS

A. Mechanical or electrical operating components or products integrated into a fabricated fixture: Ventilation and service access required or recommended by the manufacturer. The size and placement of the service access panel(s) permit easy lubrication, adjustment, or replacement of all moving parts and are to be indicated on fabrication shop drawings.

2.7 BAKER TABLETOPS (Unless specified otherwise)

A. 14-gauge 304 S/S top with 2” square turn down at the front, 6” high enclosed splash at two (2) sides and rear. Brace same as “Counter/Tabletops.”

B. 1¼” x 6” high integral coved riser at rear and ends unless indicated otherwise on drawings.

C. 16-gauge stainless steel flour-trough at free long sides, secured to the underside of the top. Trough: 3” diameter with eased edges/corners.

2.8 COUNTER / TABLETOPS

A. 14-gauge stainless steel; all free edges turned down 2” with ¾” tight hem at the bottom—free corners: rounded on ¾” radius.

B. Marine edges: Turned up ½" on 45º angle and turned down 2" with ¾" tight hem at the bottom.

C. Cafeteria serving countertops at hot food stations: Full-length x 3½" x ½" high raised rail at (customer's) front side with 45º integral turndown to counter surface.

D. Tops abutting high fixtures or walls: Cove up specified height and slope back 1½" at the top on 45º angle; 2½" slope where piping occurs. Turn down 1" at the rear of the splash and tight ends to the bottom of the top turndown. Secure splash turndown to the wall with a 4" long 14-gauge stainless steel "Z" clip anchored to the wall, 36" OC.

E. Freestanding tables and all serving counter splash-risers: Turned back at a 90º angle with 1" turndown at the rear.

F. Brace tops with rigid-welded 1½" x 1½" x 1/8" galvanized steel angle frame at the perimeter with cross bracing 2'-0" OC maximum. Provide 4" x 4" x 12-gauge stainless steel triangular pads where leg gusset welds to frame. Paint the entire frame with Rust-Oleum gray semi-gloss enamel. Angle frames: Secured to the underside of top surfaces with ¼" studs welded 9" OC maximum with chrome-plated washer, lock washer, and cap nut. Studs: Such length that cap nuts can be made up tight, bringing the top down snugly on the angle frame, eliminating all vibrations or "oil-canning."

G. Tops: 1½" overhang at free sides of underframe or Closed Base Body.

H. Mockett Model No. SG5-26 chrome-plated/plastic grommet assembly or integrally welded stainless-steel flange or inverted gusset where service utilities or support posts penetrate or abut tops, ground, and polished to match the top. When conditions permit, provide a 1" x 1½" rectangular backsplash opening for service utilities instead of piercing the horizontal surface. Install stainless steel split tubing at the raw edge of the opening.

I. Extend underbracing members to the wall, turn down 6", and anchor to the wall when specified to be mounted on leg/bracket assembly.

J. All openings in tops: 3/16" high raised die-formed edges.

K. All top openings for pans or inserts: 20-gauge stainless steel, watertight liners, 8½" deep, secured to the underside of the countertop.

L. All "built-in" and "drop-in" counter equipment/appliances to have framing members at the perimeter of the opening.

M. Scrap Basket: 18-gauge stainless steel construction 6½" x 6½" x 21¾" long. Top of container: 5/8" wide x ¼" high full perimeter flange with ¼" diameter stainless steel rod bail handle. Interior vertical corners coved on ½" radius. Countertop: Fitted with 6¾" square die-stamped opening.

2.9 COLD PANS

A. 14-gauge stainless steel with ¾" coved interior welded integrally to the countertop with a 3/16" raised edge at the perimeter of the opening – depth of cold pan to follow NSF 7 compliance.

B. Slope bottom to required quantity of Component Hardware Model No. E16-4021 drain fittings at 48" OC maximum. Sleeve through insulation at drain fittings and extend common drain line into utility compartment for indirect waste connection.

C. ½" OD copper refrigerant lines in a serpentine pattern, 1½" OC flattened for maximum contact. Secure tubing to the underside of ¼" thick aluminum "distribution plate" installed tight to the underside of the frost plate area and apply cold-conductive mastic to all surfaces.

D. Component Hardware Model No. E16-4021 drain fittings at 48” OC maximum, sleeved through the insulation with common drain line extended into utility compartment.

E. Heat Cable: Low-wattage, full-perimeter, below countertop at the edge of depression. Secure with “Z” clips, 9” OC, and interwire with compressor switch for simultaneous operation.

F. Enclose the sides and bottom of pans with an airtight 18-gauge galvanized jacket and pack with 2” fiberglass insulation set in mastic.

G. Compressor: Size as indicated or required to accommodate the size of the cold pan. Locate the compressor in the compartment below the unit or as shown on the drawings.

H. Sectional 16-gauge stainless steel perforated false bottom (¼” holes, @ ¾” OC). Turn down 1½” on all sides, weld corners, and provide finger rings. False bottom sections: 24” long maximum.

2.10 DRAWERS

A. Stainless Steel Liners: Component Hardware Model No. S81-2020C (20” x 20”), easily removable with drawer in the fully extended position.

B. Drawer Frame: 16-gauge stainless steel flanged out at the top. Weld the frame to a double-panel 16-gauge stainless steel drawer front with full-length recessed pull at the top (similar profile as Garcy Model No. R-1060) with closed ends.

C. Channel-formed horizontal pull: ¾” turndown at the front and ends with ½” tight hem. The front edge of the pull: flush with the face of the drawer. Recess behind pull: sloped up on a 60° angle, terminating 1” below the bottom edge of pull.

D. Mount drawer frame on Component Hardware Model No. S52-2020 self-closing slides, with Delrin bearings, full-depth of the fixture. Secure slides to the body or brackets to eliminate lateral movement in the extended position. Refrigerator drawers: Component Hardware Model No. S52-2024 stainless steel slides with Delrin bearings.

E. Drawer enclosure in an Open Base Fixture: 18-gauge stainless steel flanged out at the top for attachment to the underside of the tabletop. The lower edge of the enclosure is flanged in toward the open bottom. Mount drawer slides to enclosure and brace as required. The face of the enclosure is to be the same length and height of the drawer face. Provide ¾” deep offset in front of the enclosure and 2½” from the underside of the tabletop for a flush-fitting appearance.

F. Drawer enclosure on freestanding fixture: Full depth of table framing.

G. Drawer enclosure in a Closed Base Fixture: Completely partitioned from the adjoining area. Drawer front: Flush fitting with the face of the body.

H. Drawer Liners other than tool/utility: **Bread Drawer:** S/S liner sized to fit drawer; **Refrigerated Drawer:** S/S liner sized to fit drawer.

I. Cash Drawer: Integral stainless-steel body, 3” deep.

2.11 FOOD WELLS (UNLESS SPECIFIED OTHERWISE)

A. Food Warmer Controls: Remote-mounted in sloping recessed apron panel. The control panel is recessed 2½” from the bodyline at the top of the 60° slope and 1” at the lower edge. Terminate slope angle 2½” below the countertop. Mount panel on concealed piano hinge at bottom edge; secure with screws at upper corners.

B. Manifold all warmer drains and extend to within the utility compartment for indirect waste connection. Install valve in the drain line and extend handle through compartment door.

C. Removable 18-gauge stainless steel closure panel at the underside of warmers.

D. 14-gauge stainless steel plate/utensil shelf full-length of hot food station unless noted otherwise: 10” below countertop x 9” deep, with rear panel coved up to the underside of the countertop; end panels turned up square. Front of shelf: Turned down 1½” and returned under for closure panel attachment.

E. Food wells: Hatco Model No. HWBIBRT-FULD insulated food warmer (1200 watts, 208 volts, single phase) secured to the underside of 12” x 20” die-stamped countertop openings with thermal breaker mastic rope applied at the perimeter of food well flange.

F. Soup Warmers: Hatco Model No. HWB-11QTD soup warmer secured to the underside of 11” diameter die stamped countertop opening with thermal breaker mastic rope applied at the perimeter of soup well flange. The maximum allowable temperature of the countertop at the contact surface is: 120°F. Each warmer: Equipped with one 11-quart stainless steel round insert and slotted cover.

2.12 SINKS

A. 14-gauge stainless steel; all interior corners (horizontal/vertical) coved on ¾” radius. 1½” wide double-walled partitions with flat tops between compartments.

B. Continuous exterior panels of multiple-compartment sinks: 14-gauge stainless steel filler panel welded, ground, and polished between compartments.

C. Sinks (with overflow): Score and slope sink bottom ½” to die-stamped opening fitted with Fisher 22306 twist waste valve 3 1/2” x 2” with overflow and tailpiece. 18-gauge stainless steel bracket: Welded to sink bottom for drain stem with 1½” handle clearance.

D. Where sinks are installed in fixtures with Closed Base Body, provide a Fisher 22306 twist waste valve 3 1/2” x 2” with overflow and tailpiece. (Sinks with dimensions larger than 20” x 20” in Closed Base Body will not have overflow fitting.) 18-gauge stainless steel bracket: welded to sink bottom with T & S Model No. BL-4740-1 guide bushing. Install on shortened drain stem, one T & S Model No. BL-4710-1 remote control stem assembly only (length as required) with Model No. 113-L universal joint and white blank button. Set drain control handle in Cambro Model PSB-6 bowl with bottom omitted (dress raw edge) to permit passage of drain handle—secure bowl in utility compartment door or body panel with clear silicone.

E. When single-hole deck-mounted faucets are specified, install overflow fitting in the sidewall of the sink compartment and provide ell-fitting in connecting tubing.

F. Flush Covers when specified: 1/2” thick Read Products, Inc. “Richlite” cutting board with two (2) finger holes, size as indicated. Support clips: ¼” stainless steel rod 2” long, formed at 45º with two ¾” leg ends (¼” long threaded ends). Insert rod clips through tight-clearance holes in the sink, seal watertight, and secure with stainless steel acorn nuts or tack-weld at the exterior of the sink wall. Set support clips ½” below the top. Provide a 14-gauge stainless steel channel or angle support frame to store covers when not in use. Cover holder: Adjacent to sink compartment, below countertop, or under drawer assembly.

G. Manifold drain lines together for all multi-compartment sinks (two-compartment, three-compartment, etc.).

2.13 TRAY SLIDES (UNLESS OTHERWISE SPECIFIED)

A. Tray slides: 12” wide, solid 14-gauge stainless steel turned up 2” at the rear behind countertop turndown; turned down 4” at the front and free ends unless otherwise indicated.

B. Three ¼” high die-formed inverted “V” ridges at 4” OC, 2” from the leading edge, terminating 2” from ends of tray slide with tapered ridge ends.

C. Ridges formed on radius: Equal-length segments with 2” separation between chords.

D. Secure tray slides to countertop/body frame, same as “Countertops.” Enclose the exposed underside of the tray slide with 18-gauge stainless steel.

E. When indicated, project tray slides 2” beyond the serving countertop and return the entire width of the serving counter at free ends.

F. All tray slides are to be provided and mounted per ADA requirements.

2.14 DISHTABLES

A. Soiled/clean dishtable: 14-gauge stainless steel; free edges coved up 3” with 1½” diameter rolled rim and bullnose corners.

B. Edge of dishtables next to high fixtures or walls: Coved up 10” and sloped back 1½” on 45º angle; 2½” slope where piping occurs. Turn down 1” at the rear of splash and secure to wall with 4” long 14-gauge stainless steel “Z” clips anchored to the wall, @ 36” OC.

C. Exposed rear splash: 16-gauge stainless steel finish panel from the top of the splash to the bottom edge of the rolled rim with a welded vertical joint at the end. Secure the panel with concealed attachment and install bracing 24” OC.

D. Cove all interior corners (horizontal/vertical) on ¾” radius and slope tables 1/8” per foot to sinks, scuppers, or ware wash machines, maintaining level crown/splash.

E. Brace dishtables with 1” x 4” 12-gauge stainless steel channels down the top centerline and between each pair of legs, with closed ends. Bracing: secured to the underside of the dishtable with ¼” studs welded 6” OC maximum, with chrome-plated washer, lock washer, and cap nut. Studs: such length that the cap nuts can be made up tight, bringing the dishtable down on the channel members, eliminating all vibration and “oil-canning.”

F. Integrally welded stainless steel flange or inverted gusset where service utilities or support posts penetrate or abut tops; ground and polished to match the top.

G. Hose Bibb: Chicago Model No. 305VBRCF; mounted on 12-gauge stainless steel flange or inverted gusset bracket with 3/8” stainless steel rod hose hanger.

H. Extend underbracing members to the wall, turn down 6”, and anchor to the wall when specified to be mounted on leg/bracket assembly.

I. Paper-Drop Opening: 9” square with 4” integral chute having hemmed bottom edge. Slope dishtable top 1” toward the opening, forming a 16” square tapered deposit point.

J. Accessible Tray-Drop Opening: 10” x 18” with integral 16-gauge stainless steel seamless chute sloped at 45º angle toward the center of mobile soak sink position.

K. All dishtables with a conveyor-type Type Dishmachine must have a table limit switch provided by Manufacturer and installed by Division 26. Prepare clean dishtable with holes for table limit switch and provide s/s back cover. Wiring must be concealed within dishtable fabrication.

2.15 DISH / TRAY DEPOSIT ASSEMBLY

A. 14-gauge stainless steel deposit shelf, size as indicated. Extend the frame through the opening, flush with the public side of the partition, height as local code authorities require. Turn the shelf down 1" at the front with ¾" return at the bottom (either scribed into a partition or forming reveal). Shelf: 1" square turndown at the long rear side, integral with conveyor slider pan, tray-accumulator, or dishtable. Extend the rear/end splash to align with the head of the deposit station opening. Modify rolled rim at the operator's side of the tray drop window to have a 3" rolled rim.

B. 18-gauge stainless steel window frame with perimeter flange channel-formed 1" x ¾" at both wall sides. Weld all corners of the frame and install with concealed attachment. Align/abut one jamb of the frame with end splash of conveyor slider pan or dishtable whenever adjacent.

2.16 UTENSIL – WASH COUNTERS

A. 14-gauge stainless steel; all free edges coved up 3" with 1½" diameter rolled rim and bullnose corners.

B. Edges of utensil-wash counters next to high fixtures or walls: Coved up 10" and sloped back 1½" on 45º angle; 2½" slope where piping occurs. Turn down 1" at the rear of splash and secure backsplash to the wall with 4" long 14-gauge stainless steel "Z" clip anchored to wall @ 36" OC. Vacuum breaker pockets: 4" long square turnback sections aligned with the slope break line.

C. Exposed Rear Splash: 16-gauge stainless steel finished panel from the top of the splash to the bottom edge of the rolled rim with a welded vertical joint at the end of the splash and ½" turnback at the bottom of the panel. Secure the panel with concealed attachment and install bracing 24" OC.

D. Cove all interior corners (horizontal/vertical) on ¾" radius and slope tables 1/8" per foot, maintaining level crown.

E. Brace utensil-wash counters with 1" x 4" 12-gauge stainless steel channels down the centerline of the top and between each pair of legs, with closed ends. Bracing: Secured to underside of dishtable with ¼" studs welded 6" OC. maximum, with a chrome-plated washer, lock washer, and cap nut. Studs: Such length that the cap nuts can be made up tight, bringing the dishtable down on the channel members, eliminating all vibration and "oil-canning."

F. Integrally welded stainless steel flange or inverted gusset where service utilities or support posts penetrate or abut tops: ground and polished to match the top.

G. Extend underbracing members to the wall, turn down 6", and anchor to the wall when specified to be mounted on a leg/bracket assembly.

H. Hose Bibb: Chicago Model No. 305VBRCF; mounted on 12-gauge stainless steel flange or inverted gusset bracket with 3/8" stainless steel rod hose hanger.

2.17 DOORS

A. 18-gauge x 1” stainless steel double pan-formed welded construction, insulated with 1” thick polyurethane boards. Seal the perimeter joint of the pans. Offset the lower horizontal framing member of the Closed Base Body to align the flush access door with the bottom of the Body.

B. Channel-formed full-length horizontal recessed pull: ¾” turndown at the front and ends with ½” tight hem. The front edge of the pull: Flush with the face of the door. Recess behind pull: Sloped up on a 60° angle and terminated 1” below the bottom edge of pull.

C. Door Hardware

1. Two Component Hardware Model No. M75-1002 stainless steel hinges (notch door/jamb at hinge location).

2. Component Hardware Model No. 35-2000 Concealed Magnetic Catch.

3. Component Hardware Model No. D30-4780 lock in the upper free corner of the door.

D. Louvered opening: Cut out opening size as indicated, turn in 1”, and weld. All corners: Ground and polished.

1. Full-height 18-gauge stainless steel louver with 1” vanes at 45º, ½” spacing. Perimeter channel-formed frame: 1½” x 1”.

2. 45º x 1” x ½” x opening width plus ½” 18-gauge stainless steel louver.

3. Tack the louver flange's weld tab to the door's back panel.

E. Drain handles opening: 6” diameter hole through the double pan to accommodate Cambro Model No. PSB-6 Bowl:

1. Secure the bowl to the door panel with clear silicone.

2. Omit the bottom of the bowl. Dress raw edges of opening for passage of drain handle.

3. Exposed insulation at the penetration of the door pan: Painted black.

F. Sliding Doors: fabricate same as Paragraph “A.”

1. Aluminum Sliding Door Track: Component Hardware Model No. B57-0000 Series, length as required. Secure to angle frame at the top of the underside.

2. Front/rear door sheaves: Stainless steel ¾” side-mounted door hangers; two (2) required per door.

3. Recessed Vertical Pull at Upper Corner of Door: Component Hardware Model No. P63-1012.

4. By-Passing Door Guides secured to bottom shelf: Component Hardware Model No. B62-1093.

5. Door Stop at the bottom edge of door: Component Hardware Model No. B60-1086.

G. Offset the lower horizontal framing member of the Closed Base Body/utility compressor compartment to align the door flush with the bottom of the Body.

2.18 CLOSED BASE BODIES

A. Frame: Rigid-welded 1½" x 1½" x 1/8" galvanized steel angle forming a continuous structure around the top and bottom perimeters of the fixture, a post at each corner, studs spaced 48" OC maximum. The top of the frame is cross-braced with 1½" angles, 2'-0" OC maximum.

B. 18-gauge stainless steel panels and trim with concealed attachment. All seams: Welded, ground, and polished.

C. Exposed Vertical Corners: Rounded on ¾" radius. Closed Base Bodies adjacent to walls or fixtures: square corners.

D. Vertical and horizontal channel members at shelf interior or drawer enclosures, such as corners and center mullions: Closed and sealed.

E. Closed Base Bodies set on finished masonry platforms: closed and caulked at the underside of equipment overhang and bolted to the platform. Body overhang of the platform: 1" at free ends and 2" at the front and exposed rear sides.

F. Closed Base Bodies not set on the platform: Component Hardware Model No. A54-2-6, 6" legs spaced 4'-0" OC maximum.

2.19 COMPRESSOR COMPARTMENTS

A. Same material as Closed Base Bodies with back and end partitions; omit bottoms only.

B. 10-gauge steel slide-out support: Channel frame on full extension slides with 125 lb. minimum capacity secured to fixture frame with anti-vibration mountings for maximum sound deadening. Closed Base Body on the solid platform: front-to-back slide-out support channels set 4" above the bottom for air circulation.

C. Access Door: 18-gauge stainless steel double-pan type with a channel formed horizontal recessed pull full length of the top (similar profile as Garcy Model No. R-1060) with closed ends. Channel-formed horizontal pull: ¾" turndown at front and face of the door. Recess behind pull slopes up on a 60° angle, terminating 1" below the bottom edge of pull. Offset the lower horizontal framing member of the Closed Base Body to align the flush access door with the bottom of the body. Door hardware: two Component Hardware Model No. M75-1002 stainless steel hinges (notch door/jamb at hinge locations) and Component Hardware Model No. 35-2000 concealed magnetic catch.

D. Access Doors Louver: Full-height, with 1½" x 1" x 18-gauge stainless steel channel-formed frame with welded corners. 18-gauge stainless steel louver. Submit a sample of the design for approval.

2.20 UTILITY COMPARTMENTS

A. Closed Base Bodies or Pedestal Supports: Fitted with utility compartments wherever piping or wiring is required in/on the fixture.

B. Same material as Closed Base Bodies with full-height back and end partitions. Omit bottoms except at hose-reel locations.

C. Access Doors: 18-gauge stainless steel double-pan type with a channel formed horizontal recessed pull full-length of the top (similar profile to Garcy Model No. R-1060) with closed ends. Channel-formed horizontal pull: ¾" turn down at the front of the door, a recess behind the pull slopes up on a 60° angle, terminating 1" below the bottom edge of the pull. Offset the

lower horizontal framing member of the Closed Base Fixture to permit flush alignment of the door with the face and bottom edge of the body. Door hardware: two (2) Component Hardware Model No. M75-1002 stainless steel hinges (notch door/jamb at hinge locations) and one Component Hardware Model No. 35-2000 concealed magnetic catch.

D. No shelves of Closed Base Fixtures are to be penetrated.

2.21 UTENSIL RACKS

A. Rack: ¼" x 2" 300 series stainless steel flat bar with No. 4 finish, fully welded and formed to match the shape shown on drawings. Lowest band - 7'-6" AFF unless otherwise indicated.

B. Ceiling Mount Supports 1-5/8" diameter 16-gauge stainless steel tubing from band to 18" above the ceiling. Anti-sway bracing above the ceiling - 1½" Unistrut members. Tubing penetrations at the ceiling - Component Hardware Model No. A16-0206 stainless steel gussets.

C. Table Mount Supports 1-5/8" diameter 16-gauge stainless steel tubing extended through countertop. Secure to closed base framing or cross rail/undershelf on the open base fixture. Tubing penetrations of countertops - integrally welded stainless steel inverted gusset.

D. Utensil Rack Hooks - Component Hardware Model No. J77-4401 stainless steel hooks spaced 8" OC maximum.

E. Electrical Receptacle: NEMA No. 5-20-R or as noted. Mount in fully welded 3½" x 5½" x 3" 14-gauge stainless steel enclosure with ½" radius corners. Stainless steel cover plate to fit specified receptacle. Pre-wire through tubular support for final connection above the ceiling by Division 26.

2.22 CASHIER / SERVING COUNTERS

A. Exterior Body Panels, when specified: ¾" thick marine grade hardwood plywood with plastic laminate or solid polymer in Architect's selection of color/pattern at all exposed surfaces; backing sheet where concealed.

B. Position, size, and finish horizontal or vertical reveal as Architect directs.

C. Secure panels to counter body framing in a concealed manner. Install removable panels with "Z" clips overlapping body framing members.

D. Hinged doors in exterior body panel(s) - Grass Model No. 1200VZ or 1200VZ8 self-closing hinges. Three (3) required per door; Grass Model No. G/HRZ base plate at each hinge; Ives Model No. TM820 concealed push latch at each door. Confirm Model No. and provide samples with the submittal.

E. Cashier counter to have 16-gauge s/s intermediate shelf, turned down 1 1/2" with tight hem at front. Cove up 2" at rear and sides. Brace undershelf with 1" x 4" 14-gauge stainless steel channel at the longitudinal centerline. Provide an outlet for power/data within the body above the intermediate shelf. Provide cash drawer inserts per district standards.

F. Sneeze Guards to be adjustable and meet NSF standards.

2.23 OPEN BASE STRUCTURES

A. 1-5/8" OD x 16-gauge seamless stainless-steel tubing legs bevelled at the bottom. 1¼" OD cross rails fully welded (360° smooth and polished) to legs at 10" AFF, OC.

B. Top of Leg: Inserted in Component Hardware Model No. A20-0206 gusset fully welded to table frame or sink bottom.

C. Bullet Foot: Component Hardware Model No. A10-0851.

D. Freestanding fixtures requiring utility connections: Component Hardware Model No. A10-0854 flanged feet at the fixture corners, anchored to the floor with non-corrosive bolts.

E. Table Bases: Maximum leg spacing of 6'-0" OC; dishtable and utensil wash counter bases at 5'-0" OC.

F. Open Base equipment specified to be supported by brackets at the rear side only (not completely cantilevered): Tubular legs at the front side only with Component Hardware Model No. A10-0854 flanged feet anchored to the floor with non-corrosive bolts. Front-to-back cross rail: fitted into Component Hardware Model No. A20-0406 circular gusset secured to the wall with non-corrosive bolts.

2.24 UNDER SHELVES

A. Open Base Structures: 16-gauge stainless steel turned down 1½" with tight hem at the bottom. Notch all corners to fit tubular legs and weld from the underside to fill the gap, grind, and polish. Cove up 2" at the rear or ends adjacent to wall, columns, refrigerators, etc. The turn-up at freestanding fixtures is to be hemmed tight to the bottom of the turndown. Brace undershelf with 1" x 4" 14-gauge stainless steel channel at the longitudinal centerline and each intermediate pair of legs.

B. Open Base Structure specified to be supported by brackets at the rear side only (not completely cantilevered): 16-gauge stainless steel turned down 1 ½" at free sides with tight hem at the bottom edge. Notch all corners to fit tubular legs as required and weld from the underside to fill the gap, grind, and polish. Cove up 2" at rear ends, as indicated. Fill the gap at the front-to-back rail, grind, and polish. Brace undershelf with 1" x 4" x 1" 14-gauge stainless steel channel at longitudinal centerline between front to back rails.

C. Closed Base Fixtures: 16-gauge stainless steel turned down 1½" at front. Front edge of bottom shelf: Turned back and sealed to finished masonry platform or boxed for leg application. Center shelf has ¾" tight hem.

1. Shelves: Turn up square at ends (coved up at rear only) to the shelf above or countertop flanged out for attachment with no open spaces at interior.

2. All shelf partitions at exposed ends of cabinet bodies or interiors: Free of exposed framing members.

3. Reinforce shelves with full-length 1" x 4" x 14-gauge stainless steel closed hat channel.

4. Unless otherwise noted, all closed base undershelves must be 22" deep and clear.

5. Fully weld smooth and polish the vertical seam of the shelf turndown/turn up with the face of the body partition.

6. Seal the vertical seam of the square turn-in at the exposed interior of open shelf sections.

2.25 ANCHOR PLATES / WOOD GROUNDS

A. Behind the finished surface, wherever building walls, partitions, or ceiling construction will not accommodate direct attachment of equipment such as over shelves, wall cabinets, hose reels, utensil racks, exhaust hoods, display cases, etc. Material and installation by General Contractor. Location and coordination with trades by Section 11 40 00.

B. Anchor Plates: Not less than 12” x 12” x ¼” thick steel, secured to the structure above or behind the finished surface, positioned at attachment points.

C. Wood Grounds: Length required by fixture, component, or device, 24” wide x ¾” thick plywood secured to partition system before gypsum board installation.

D. Above ceiling supports: Structural shapes (4” x 8.0 lb. channel) suspended from the structure. Maximum height 15’-0” AFF. Size: width of equipment x length of equipment plus 6’-0”. Cross bracing at 6’-0” OC maximum.

2.26 OVER SHELVES

A. 16-gauge stainless steel with free edges turned down 1” with ½” tight hem at the bottom—¾” radius at free corners.

B. Turn up 2” raw at walls and sides with a horizontal coved corner at the rear. Round front corners of turn up on ¾” radius.

C. Where shelf width exceeds 12” width, reinforce with ½” x 4” x 14-gauge stainless steel closed hat channel full-length of the shelf.

D. Wall-Mounted Shelves: 16-gauge stainless steel brackets 48” OC maximum, set in 6” from ends.

E. Freestanding Shelves: Where splash is required at free over shelves, turn up square 2” at ends, cove up at the rear, and hem tight to lower edge of front turndown. Weld exposed corners.

1. Freestanding over shelves: 16-gauge stainless steel cantilevered brackets at the rear of the table; double-cantilevered brackets at the center of the table. Posts for cantilevered over shelves are 1-5/8” OD x 16-gauge stainless steel secured to the underframe, 4’-0” OC. Ends of shelves: Secured to adjacent wall/fixture or mounted on 1¼” diameter stainless steel posts.

2. Freestanding over shelves not on cantilevered brackets: 1¼” OD x 16-gauge stainless steel posts, each pair at 4’-0” OC maximum.

F. Baker Table Over shelves: Supported 18” above the top with 1¼” OD stainless steel tubular supports with channel shoe secured to risers.

G. Glass/Cup Rack Over shelf at Dishtables: 14-gauge stainless steel with 1½” deep “vee” trough at free long sides with 1” tight hem inside the trough. Provide a ½” marine edge at free ends and; a 4” splash at the wall. Suspend shelf at 18” above dishtable surface on posts/brackets anchored to dishtable frame/wall at rear; 1” OD stainless steel tubing supports from the structure above the ceiling at front edge, 60” OC at each end.

1. Install at both ends a ½" stainless steel drain tube (connecting both vee-troughs) extended to the dishtable surface through splash turnback.

2. Rack-rest: horizontal full-length 1-5/8" OD stainless steel tubing supported at 10" OC above shelf (8" OC for double service shelf) by 1¼" OD stainless steel tubing with closed ends. Support tubing: welded, ground, and polished, spaced 60" OC.

3. Rack-rest supports to wall: 4" x 4" x 10-gauge stainless steel flange plates welded to support tubing. Anchor flanged plates to blocking ground with non-corrosive bolts.

2.27 DRAIN TRENCH LINER / GRATING

A. Liners: 14-gauge stainless steel in sizes as indicated.

B. Interior of liners: 6" deep with all interior corners (horizontal/vertical) coved on ¾" radius; sloped and scored 1" to integrally welded Component Hardware Model No. D34-Y011 basket drain assemblies @ 48" OC, fitted with 6" long welded tailpiece. Stainless steel safety chain: connected to basket strainer assembly and top of liner wall.

C. Liners: 1" wide perimeter shoulder at the top, turned up flush with finished floor, tight hemmed back down to the shoulder level, and flanged out 2" for attachment to the slab.

D. Underside of sloping liner portion: 2" long "Z" clips.

E. Grating: IMC-TEDDY PFD-ADA removable fiberglass grating:

1. 1" deep "I" bearing bars with 0.6" wide top flange.

2. Full perimeter frame, section quantities, and sizes indicated.

3. Maximum of 2'-0" sections.

4. Grating bars should be spaced 0.4" apart per ADA requirements.

5. Grating to be two (2) equal sizes.

2.28 WALL PANELS

A. Wall Panels: 18-gauge stainless steel, double pan-formed ½" thick with internal stiffener members. Fill with USDA-approved thermal insulation, full height, and width of panels, and attach to the interior with mastic. The maximum allowable temperature at the rear side of the panel: is 120°F.

1. Height of panels as required: Top of tile base to the underside of the hood, top of tile base to the top cap of stub wall, or top of splash to the underside of the hood.

2. Level and square lower edge and sides.

3. Butt joints on all panels.

2.29 EXHAUST HOODS (SURFACE-MOUNTED CONDENSATE)

A. Hoods: Size/shape as indicated: 18" high on the interior.

B. Body: 16-gauge stainless steel, with all seams welded, ground, and polished.

C. Continuous condensate trough at perimeter: 3" x 1".

D. Frame the top of the hood with 1½" angle iron assembly and suspend from the structure above the ceiling by ½" diameter steel rods, drawn tight against the finished ceiling surface.

E. Duct opening/collar as specified with stainless steel louvered grille over the opening.

F. Div. 22 to extend drain line to floor sink when shown. The drain line is to be silver painted. Div. 22 to ensure all drain lines are centered over floor sink grate openings and no water splashes on the floor.

G. ½" diameter steel hanger rods at 4'-0" OC maximum to be by Kitchen Equipment Contractor, but they are to be anchored to the supporting structure (or slab) by the General Contractor in the locations required by exhaust hood shop detail.

H. Hoods and components to meet all NSF standards, NFPA 96, UL 710 and current IECC requirements.

2.30 EXHAUST HOODS (UNLESS SPECIFIED OTHERWISE)

A. Exhaust to be provided to meet all current local jurisdiction mechanical and energy code requirements. Kitchen Equipment Contractor to verify code requirements and coordinate with Divisions 23 and 26. Hoods over production equipment to be Type 1 with continuous capture. All Type 1 hoods should be 6' deep to ensure smoke/steam capture unless otherwise noted.

B. Install fire suppression system(s) in all ventilators specified in this section. Install per the manufacturer's recommendations and applicable codes or standards. Submit installation certification form to Architect.

C. Locate chemical cylinders as indicated on drawings and install piping to exhaust hood(s) in a concealed manner. Set cylinders and cabinets at 7'-0" clear AFF unless noted otherwise. Provide polished chrome plated tubing piping/fittings, where exposed at cylinder location and at the interior of exhaust ventilator—exposed pipe threads in/above the food zone are not allowed. Submit a schematic installation diagram and confirm critical distances from cylinders to nozzles.

D. Remote manual release located in the path of egress from the protected exhaust hood area. Kitchen Equipment Contractor to coordinate location with local Fire Marshal requirements before submittal review. All conduits will be recessed within the wall; SURFACE MOUNTING WILL NOT BE ACCEPTED.

E. Provide one (1) handheld Type 'K' and ABC 6-liter fire extinguisher per Ansul system, surface wall mounted.

F. Required quantity and sizes of mechanically operated gas valves.

G. Confirm interconnection of all equipment as required to ensure exhaust hood and fire suppression systems are entirely operational and meet local jurisdiction code requirements.

H. ½" diameter steel hanger rods at 4'-0" OC maximum to be by Kitchen Equipment Contractor, but they are to be anchored to the supporting structure (or slab) by the General Contractor in the locations required by exhaust hood shop detail.

I. Provide an appropriate quantity of fire suppression systems as required by local jurisdiction code requirements.

J. Double wall insulated construction at ends. S/S where exposed.

K. Hoods and components to meet all NSF standards, NFPA 96, UL 710 and current IECC requirements.

L. Refer to Section 1.4: OTHER DIVISIONS/CONTRACTORS RELATED WORK; Subsection E. Division 23 (Mechanical) for additional information.

2.31 HIGHLIGHTING

A. Polish the following vertical surfaces to a No. 8 finish:

1. Serving and display shelf turndowns.

2. Conveyor and dish/tray deposit station turndowns/frame.

3. Tray slide turndowns.

2.32 SHOP / FIELD JOINTS

A. Field joints: The least number is used only when equipment size must be limited for building or interior space access.

B. Stainless steel tops (including edges and splashes): Fully welded, ground, and polished to match adjacent surfaces.

C. Vertical field joints of fixture backsplashes that are inaccessible from the back: terminate 1” above the horizontal coved corner. The remaining height of the field joint: hairline butt joint with offset draw-angle behind. All horizontal/vertical draw joints: located and noted on shop drawings.

D. Hairline butt joint: 1½” x 1½” x 1/8” steel angles welded to the back/underside of countertop/shelf. Offset angle beyond joining metal edge ½” (min.) to provide a flat backing surface for a joint with the angle of other joining metal edge, set for ½” space between vertical legs of angles. Bolt sections together with 5/16” machine bolts, lock washers, acorn head cap nuts, set 3” OC.

E. Closed Base Bodies: Draw-type with hairline seam fully field-welded.

F. Millwork: Plastic laminated joints shall be dowelled, glued, and draw-bolted with fasteners.

G. Solid Polymer: Surfaces drawn tight, filled, sanded, and finished to match adjacent surfaces.

2.33 PREFABRICATED WALK-IN COLD STORAGE ASSEMBLIES

A. Assembly to be installed by Factory Authorized Installers only.

B. KEC to provide a 1-year walk-in assembly panel installation warranty. Panel installation warranty to cover labor and part replacement issues resulting from a failure to complete the following during installation:

1. Walk-in assembly panels to be installed square, plumb, and level.

2. To create a proper seal, ceiling panels must be installed flush and tight to wall panels with undamaged gasket material. Any signs of condensation at joints or assembly wall panels should be reported to FDP and addressed immediately. Caulk at panel seams will not be an acceptable solution.

3. All cam-locks should be engaged and cam-lock covers in place.

4. Any gaps under the floor angle (due to shimming) must be entirely sealed to the slab.

5. All penetrations in the ceiling or wall panels should be insulated and sealed by appropriate trade contractors and verified by KEC, including but not limited to Light Fixtures, Refrigeration Lines, Sprinklers, Temperature Sensors, etc.

6. Proper installation of the door systems should allow the door to self-close and seal around the perimeter of the door opening and at the floor threshold.

7. Final operation of the IC/IC+ control, door heaters, and light switches should be confirmed upon completion of the electrical connections.

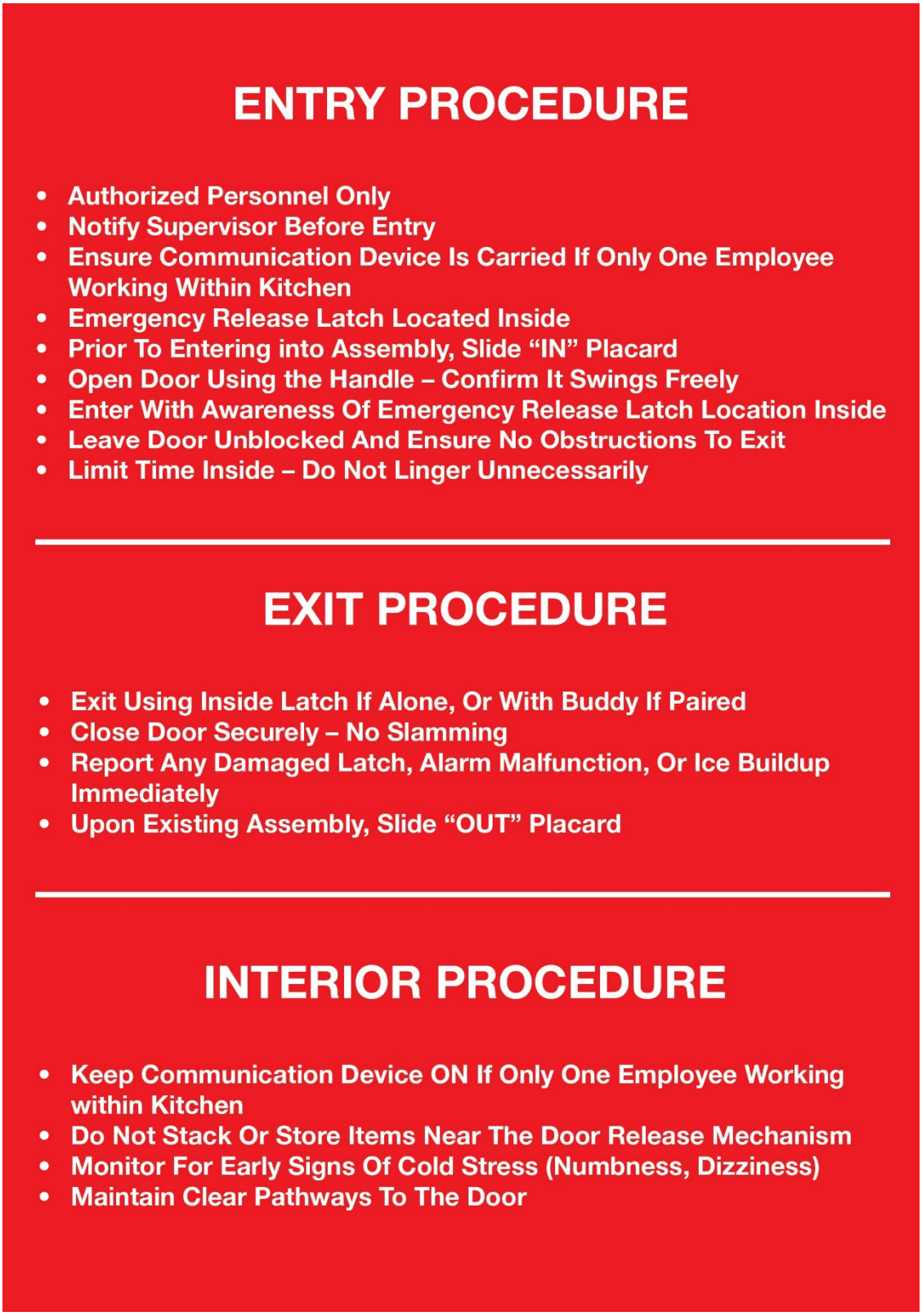
8. Manufacturer to provide component-specific safety/emergency placards at the exterior and interior of all cold storage door assemblies. Signage to be mounted on door at ADA level when a window is not present or below view window when window is included **(see below)**.



4" X 4" PLACARD FOR INTERIOR OF WALK-IN COOLER AND FREEZER

9. The walk-in assembly panel installation warranty will cover service issues resulting from faulty installation.

7” X 10” PLACARD FOR EXTERIOR OF WALK-IN COOLER AND FREEZER


ENTRY PROCEDURE
• Authorized Personnel Only
• Notify Supervisor Before Entry
• Ensure Communication Device Is Carried If Only One Employee Working Within Kitchen
• Emergency Release Latch Located Inside
• Prior To Entering into Assembly, Slide "IN" Placard
• Open Door Using the Handle – Confirm It Swings Freely
• Enter With Awareness Of Emergency Release Latch Location Inside
• Leave Door Unblocked And Ensure No Obstructions To Exit
• Limit Time Inside – Do Not Linger Unnecessarily
EXIT PROCEDURE
• Exit Using Inside Latch If Alone, Or With Buddy If Paired
• Close Door Securely – No Slamming
• Report Any Damaged Latch, Alarm Malfunction, Or Ice Buildup Immediately
• Upon Existing Assembly, Slide "OUT" Placard
INTERIOR PROCEDURE
• Keep Communication Device ON If Only One Employee Working within Kitchen
• Do Not Stack Or Store Items Near The Door Release Mechanism
• Monitor For Early Signs Of Cold Stress (Numbness, Dizziness)
• Maintain Clear Pathways To The Door

C. **KEC is responsible for overall install accuracy/quality and quality control of work performed, regardless of the installer or any field modifications due to building/construction conditions. KEC is to provide the CSA Installation Approval Report (provided in this document) to Foodservice Design Professionals (FDP) upon completed installation, verifying that all items above have been inspected by the KEC for completeness and installed per manufacturer requirements. This report will be required as part of the completion of the contract.**

D. Sectional Assemblies: Size/shape indicated on drawings; 9'-6" interior clearance unless otherwise specified. Door locations/size: exactly as shown.

E. Sandwich Panel Insulation: Class 1 Urethane with a vapor barrier, 4" thickness (unless specified otherwise) with mature "U" factor of .030 or lower. Finished panels shall be UL-listed and demonstrate a flame spread rating of 20 or less. Panels must meet performance standards as outlined in U.S. Government legislation.

F. Wherever compartment dimension exceeds the clear-span ability of ceiling panels, provide I-beam support on the exterior of the ceiling or spline-hangers. Install ½" diameter steel rods through beams/hangers and secure them to the structure above. Beams or posts within compartments are not acceptable.

G. Reinforce prefabricated wall panels to rigidly support the door assemblies. The perimeter of the door and frame shall be built of a fiberglass reinforced polymer (FRP) pultrusion. All pultrusion's shall be non-conductive, non-corrosive, rust proof and NSF listed. All doors shall be furnished with a replaceable aluminum braided heater wire, electronically monitored, and controlled as to initiation temperature, termination temperature and percentage of operation time as required. Install 2" x 4" 16-gauge stainless steel hat-channel full-width of the jamb with 1/8" stainless steel removable flush sill, secured with stainless steel screws and sealed watertight to channel.

H. Reinforcement as required to be provided in panel for Push Button Panic Alarm and Release knob..

I. Provide an aluminum cove base at the interior and exterior of exposed panels (unless otherwise specified) for all floor assemblies.

J. Floor Installations:

1. **4" Recessed Exposed Factory Floor Installation (if required):**

   a. 6 mil polyethylene sheets in slab recess with all joints lapped 6 inches and sealed to form a watertight seal.

   b. Level and square prefabricated perimeter and partition wall panels anchored to slab recess. Protect the exposed surface of panels.

   c. Provide and install factory or custom fabricated door threshold as required. To be flush and level to finished kitchen floor. Floor threshold to be surfaced with Graphene Oxide Anti-Slip or similar surface to reduce freezing and prevent slip hazards.

   d. 4" commercial grade manufacturer's dura floor with diamond treadplate surface and marine grade plywood subfloor.

   e. 15# felt slip sheet over insulation with 6" lapped joints flashed up the height of the finished floor base.

f. 1/2” sand leveling bed by G.C.

2. **8-1/2” Recessed Floor Installation (if required):**

a. Factory floor in slab recess with all joints lapped 6 inches and sealed to form a watertight seal.

b. Level and square prefabricated perimeter and partition wall panels anchored to slab recess. Protect the exposed surface of panels.

c. Provide and install factory or custom fabricated door threshold as required. To be flush and level to finished kitchen floor. Floor threshold to be surfaced with Graphene Oxide Anti-Slip or similar surface to reduce freezing and prevent slip hazards.

d. 4” manufacturer’s floor.

e. 15# felt slip sheet over insulation with 6” lapped joints flashed up the height of the finished floor base.

f. 1/2” sand leveling bed by G.C.

g. Concrete flooring and tile over insulation by Divisions 03/09.

3. **12” Recessed Floor Installation (if required):**

a. 6 mil polyethylene sheets in slab recess with all joints lapped 6 inches and sealed to form a watertight seal.

b. Level and square prefabricated perimeter and partition wall panels anchored to slab recess. Protect the exposed surface of panels.

c. Provide and install factory or custom fabricated door threshold as required. To be flush and level to finished kitchen floor. Floor threshold to be surfaced with Graphene Oxide Anti-Slip or similar surface to reduce freezing and prevent slip hazards.

d. 4” manufacturer’s floor.

e. 15# felt slip sheet over insulation with 6” lapped joints flashed up the height of the finished floor base.

f. 1/2” sand leveling bed by G.C.

g. Concrete flooring over insulation by Division 03:

i. Concrete mix: 5000 psi @ Freezers and 3000 psi @ Coolers.

ii. No limestone or fly ash; fiberglass reinforced.

iii. #3 rebar, set on 12” centers in both directions.

iv. Center rebar vertically in wearing bed.

v. 10” high concrete 45° angled wall curb at interior perimeter per food service details.

h. Diamond treadplate wall panels on the interior and exposed exterior by 11 40 00. Refer to drawings for height. Coordinate diamond treadplate wall covering at the interior with angled wall curb.

i. Ventilation Pipe Requirements by G.C.:

i. Bottom perforated vent pipes to be #40 PVC on six ft. max centers open on both ends with the thermostatically controlled fan on (1) end and perforated mesh on the opposite end of the fan at the exterior of the building.

ii. Vent pipes are to be turned parallel with the exterior wall - 180°turn down.

iii. Vent pipe openings to be held at 24” above grade or roof per design.

iv. Fans to be Grainger Manufacturer and sized per airflow needs. Airflow is to be sized based on the length and number of bends.

v. If no exterior wall is adjacent, vent pipes will route up and extend past the roof. Roof penetrations by Division 07.

4. **Surface Mounted Factory Floor Installation (if required):**

a. 4” commercial grade manufacturer’s dura floor with diamond treadplate surface and marine grade plywood subfloor.

b. 36” reinforced diamond treadplate internal ramp.

c. 10-gauge stainless steel threshold to provide a smooth transition to the interior walk-in assembly floor.

K. KE2 Therm Combo Display model no. 21877 (Unless otherwise specified). Integrated, flush-mounted temperature monitor/alarm with sensor and probe-cord length required to extend from the exterior front of the assembly to a mounting position of the sensor within the evaporator return airstream. System to have an easy-to-read LCD with high and low alarm set points with audible and visual alerts for alarm conditions. System to include Adaptive Programming for automatic set point control. Wi-Fi connectivity is included for remote notifications of alarms such as power failure, high and low temperatures, entrapment, and door open. System to include a built-in panic alarm. The system is to be interconnected to the Building Automation System (BAS) or the Owner’s Network (by Division 27) and to notify facility personnel of the district/owner choosing when activated. Refrigeration Installer to interconnect panic alarm to refrigeration system to shut off evaporator coils when panic alarm is engaged.

L. Kason Interior Panic Alarm model no. 1967-A7 (unless otherwise specified). Illuminated Push Button Panic Alarm with protective cover and Phenolic Label “PANIC” for entrapment **within Cooler and within Freezer** (ADA mounting height). Panic Alarm encasing is to be Safety Yellow/Black. ***Installer to maintain 18" clearance in front of controls for ease of access.***

Manufacturer to pre-run conduit within panel from Panic Alarm to junction above Cooler and Freezer door panel (or Cooler door if ‘inline’ assembly) for installation of Emergency Strobe/Horn and furnish loose (3) external Emergency Strobe/Horn Beacons. Division 11 40 00 to interconnect Panic Button to KE2 Switch at refrigeration system to disable refrigeration system when engaged.

Division 26 to install strobes/horns at locations indicated and interconnect to Panic Button at Walk-In Cooler and Walk-In Freezer junction. Division 27 will interconnect the Push Button

Panic Alarm to the Building Automation System for Owner notification. Refer to Section 1.4: OTHER DIVISIONS/CONTRACTORS RELATED WORK; Subsections F. Division 26 (**Electrical**) and G. Division 27 (**Communication**) for additional information.

M. ***CRITICAL- Required: Manufacturer Representative to provide training on controls and inside emergency release mechanisms.***

N. KE2 Combo Therm (unless otherwise specified). Confirm all component model numbers for complete installation and operation.

O. LED surface-mounted light fixture, in quantity/arrangement shown on drawings. Light fixtures to be perpendicular to coils. Light fixtures wired to interior and exterior temperature control panel. Light fixtures are to be provided by Section 11 40 00 and installed by Division 26. Division 26 is to seal all conduit penetrations at light fixtures. KEC to verify that penetrations are sealed.

P. Penetrations of Panels: To be sealed by factory installer and appropriate trade contractors, with Dow Corning 3-6548 silicone RTV foam, total depth of the panel. Trim excess flush. KEC to verify that all penetrations are sealed.

Q. Install closure panels and trim strips to building walls and ceiling with concealed attachment. Closure material: same as wall panels unless noted otherwise.

R. Compartment Entrance Doors: 36” x 78” nominal clearance unless otherwise noted.

1. Mount hinged doors on two Kason Model No. 1346; polished chrome-plated nylon cam-lift hinges. All doors to be equipped with polished chrome Kason 1094 or equivalent door closer assembly. Doors to be adjusted so all doors fully self-close.

2. Hinge doors as indicated on drawings.

3. Defrost heater: Thermostatically controlled and replaceable at the entire perimeter of all doors. ***-CRITICAL- Defrost heaters to be wired for continuous service***.

4. 36” high x full-length diamond aluminum treadplate at front and rear of all hinged doors.

5. 12” x 2” engraved phenolic plastic compartment identification sign in Architect’s color selection with 1” letters, mounted above door window.

6. 14” x 24” four-panel glass view window with heater and molded non-metallic inner and outer frame. The heater is to be wired and controlled via the door monitor for continuous service.

7. Padlock/key provisions in the door latch with safety release mechanisms.

8. Kason 1826 Intelli-Vent LED Heated Pressure Relief Ports with Dual Port Vent and Security Light. Locate Two (2) 12” below ceiling on Cooler/Freezer common wall panel and Two (2) 12” below ceiling on Cooler wall panel. If Cooler and Freezer are separate units, locate one on the Freezer wall panel as well, 12” below ceiling and mounted in the door frame assembly. All ports to have separate dedicated electrical connections and be wired for continuous service. Located and installed by Manufacturer.

9. Kason Model No. 1238 (unless specified otherwise) Pacesetter Locking Handle QTLC with twist-off knob disassembly type inside release.

10. Provide Three (3) Edwards 860 Series (or equal) red lens, surface-mounted Xenon Emergency Strobe Beacons. Div 26 will install one (1) located in the Kitchen in

architectural ceiling above Walk-In Cooler door, one (1) located in the Kitchen in architectural ceiling above Walk-In Freezer door and provide the third unit located in the Cafetorium (Division 26 to coordinate location with Owners and Architect). Division 26 is to provide all conduit and wiring required and interconnect the Push Button Panic Alarm in the Walk-In Cooler and Freezer to Strobe Beacons (***Critical***).

S. Provide refrigeration calculations and refrigeration alarm to meet local jurisdiction code requirements.

T. If air screens or air shields are specified above doors or on the interior of the assembly, the manufacturer must provide adequate blocking in panels to support these components and pre-wired electrical connections. Installer to coordinate location of door closure to not interfere with air screens or air shields. Clear-VU, swinging door assemblies, are not required if air shields are specified.

U. S/S trim above walk-in assembly to conceal manufacturer ceiling grid.

V. Field-check all horizontal/vertical measurements and conditions at the building before fabrication or delivery of equipment.

W. Walk-in Assemblies to be installed by the PRE-APPROVED INSTALLERS listed below:

1. QBR Refrigeration, 30083 Hwy 90 Blvd., Katy, TX 77493, Mr. Andy Spellins, 713-973-2875, andy.spellins@qbrsales.com

2. Machine Ice, 8915 Sweetwater Ln., Houston, TX 77037, Mr. Will Weaver, 281-448-7823

3. Coolers Inc., 6922 Alder Dr., Houston, TX 77081, Mr. Lee Mamone, 713-665-8886

2.34 WALK-IN COLD STORAGE ASSEMBLY REFRIGERATION SYSTEMS

A. Unit Coolers: specified quantity and model, ceiling-hung by ½" OD nylon bolts with stainless steel washers and nuts. Insert hanger bolts through the plastic sleeve and seal penetration airtight.

1. Unit cooler drain fittings: positioned as indicated on drawings. Installation of cast tee-fittings on drain pan outlet with union and cleanout plug, and extension of 1" Type K copper drain line through wall panel to airgap fitting or floor drain under this Section.

2. Slope drain line ½" per foot, trap at the exterior of assembly and turn down into the drain. Manifold drain lines of adjacent compartments wherever possible.

3. Install drain line plastic sleeve through compartment wall, seal around drain line, and install stainless steel escutcheon with setscrews.

4. Electric drain line heater cable (self-regulating 7 watts): on all unit coolers operating below 36°F., installed from coil drain line fitting to wall penetration under this Section. Heater cables: the minimum rating of 15 watts/lineal foot, 208 volts, single phase. Wrap drain line with maximum 2" loop spacing and interwire to unit cooler for continuous operation.

5. Mounted, pre-piped, and pre-wired evaporator components:

   a. Sporlan thermostatic expansion valve with external equalizer.

   b. Shut-off valve at evaporator suction and liquid lines.

   c. Sporlan "Catch-All" refrigerant filter/dehydrator on liquid line.

   d. White Rogers 1609-101 adjustable thermostat with remote bulb positioned in return airstream of the evaporator.

   e. Electrical disconnect switch in NEMA 4 enclosure.

   f. **For any facility within 20 miles of a salt air environment:** Condenser and Evaporators to be built with Electrofin coating to retard salt air deterioration. Coils are to be coated with Technicoat 10-2 coating for protection against a salt air environment.

   g. 110° Ambient Temperature Operation.

6. Two (2) fan door activation switches to turn off evaporator coils when the door is opened. Interconnect door activation switches through Panic Alarm to turn off evaporator coils also when Panic Switch is engaged.

B. Refrigerant System Installation:

1. Refrigerant Lines; Type "L" rigid copper tubing. Fittings: Wrought copper or brass designed for use with high-temperature solder. Piping joints: Made with silver solder (Sil-Fos). Piping: Properly suspended from and anchored to the structure with adjustable hangers 6' OC maximum. Suction lines: Sized to have a maximum pressure drop of two pounds in medium-temperature systems; one pound in low-temperature systems. Liquid lines: Sized to give maximum pressure to prevent trapping of oil. Insulation on all suction lines: Armaflex insulation by Armstrong. ¾" thick at medium-temp 1" thick at low temp. Refrigerant lines in PVC conduit: Sealed at both ends with Dow Corning 3-6548 silicone RTV foam. The refrigeration system installer will wrap Exterior Refrigerant Lines in the self-fastening jacket of Type 3003-H14 aluminum alloy, 0.016-inch thick. Provide aluminum strapping and seals for applying aluminum jackets and covers, per the manufacturer's recommendations, to ensure a completely weather-tight covering.

2. System to include a leak detection system as required for any A2L system with the capability to turn on the main blower, shut off compressors, and shut off any additional sources of heat in the system. Leak detection is critically important and must be wired to interrupt all controls when the system is in failure. System to include connectors for the Building Automation System or the Owner alarm system, as may be required for communication of alarm to the Owner. Connection to external systems by Div. 27. Refer to Section 1.4: OTHER DIVISIONS/CONTRACTORS RELATED WORK; Subsection G. Division 27 (**Communication**) for additional information

C. Evacuation and Charging:

1. After completion of the pressure test, the system shall be evacuated using an approved auxiliary vacuum pump. Connections for evacuation: Following the manufacturer's recommendations.

2. Charging the condensing unit (R454A Non-CFC Ozone Depletion Refrigerant for use in High, Medium, and Low Temp units) – (Refrigerant must meet Industry Standards and Local Codes): given through the charging valve in the high side, passing all the liquid refrigerants through a charging dehydrator. All charging lines and gauges must be purged of air before connection with the system. Refrigerant: unused and shall be delivered in a clean container. After the system is fully charged, start and place it in full operation.

D. Refrigeration system to be installed by the **PRE-APPROVED INSTALLERS** listed below:

1. QBR Refrigeration, Mr. Andy Spellins 30083 Hwy 90 Blvd., Katy, TX 77493, 713.973.2875, andy.spellins@qbrsales.com

2. Machine Ice, Mr. Will Weaver, 8915 Sweetwater Ln., Houston, TX 77037, 281.448.7823

3. Coolers Inc., 6922 Alder Dr, Houston, TX 77081, Mr. Lee Mamone, (713) 665-8886

2.35 PRE-APPROVED KITCHEN EQUIPMENT CONTRACTORS

A. Only the following named Subcontractors and those approved later, if any, are approved for inclusion in the Contractor's Bid.

B. **Any contractor requesting inclusion within this bid must submit AIA form 305 a minimum of 14 days before the bid date for review or as required by Architect.**

1. Stafford Smith, Mr. JP Garcia, 7129 North Loop East, Houston, TX 77028, Phone: 713.892.5001, Email: jpgarcia@staffordsmith.com

2. Texas Metal Equipment Company, Mr. Travis Andrews, 23518 Coons Road, Tomball, Texas 77375, Phone: 713.466.8722, Email: tandrews@tmeco.com

3. Kirby Restaurant Supply, Mr. Dave Newman, 809 S. Eastman Road, Longview, Texas 75602, Phone: 903.746.0421, Email: daven@kirbysupply.com

4. Mission Restaurant Supply, Mr. Robert Snoddy, 1126 S. St. Mary's Street, San Antonio, Texas 78210, Phone: 832.970.4020, Email: roberts@missionrs.com

5. Kommercial Kitchens, Mr. Terry Woodard, 13544 East Fwy., Houston, TX 77015, Phone: 409.769.1199, Email: terry@kommercialkitchens.com

6. Supreme Fixtures Co., Inc., Mr. Tim Hampel, 11900 Vinny Ridge Road, P.O. Box 193655, Little Rock, AR 72219, Phone: 501.455.2552, Email: tim@supremefixture.com

7. Amundsen Commercial Kitchens, Mr. Lewis Beville, 105 Montie, Longview, TX 75604, Phone: 903.576.6354, E-mail: lewis@afeok.com

2.36 PRE-APPROVED STAINLESS-STEEL FABRICATION SUPPLIERS

A. Only the following named Subcontractors and those approved later, if any, are approved for inclusion in the Contractor's Bid. Pre-approved fabricators shown below shall not sub-out fabrication.

B. **Any supplier requesting inclusion within this bid must submit AIA form 305 at least 14 days before the bid date for review or as required by Architect.**

1. Texas Metal Equipment Company, Mr. Travis Andrews, 23518 Coons Road, Tomball, Texas 77375, Phone: 713.466.8722, Email: tandrews@tmeco.com

2. Kommercial Kitchens, Mr. Terry Woodard, 13544 East Fwy., Houston, TX 77015, Phone: 832.767.5287, Email: terry@kommercialkitchens.com

3. Mission Restaurant Supply, Mr. Robert Snoddy, 1126 S. St. Mary's Street, San Antonio, Texas 78210, Phone: 832.970.4020, Email: roberts@missionrs.com

4. CSS Manufacturing, Mr. Jared Woodard, 7430 Fairbanks North Houston Rd., Houston, Texas 77040, Phone: 832.444.6311, Email: jared.woodard@css-mfg.com

PART 3 - EXECUTION

3.1 DELIVERY AND INSTALLATION

A. Supervision: Provide a skilled and proficient foreman or supervisor who shall remain on the job during the entire installation.

B. Delivery: Coordinate with the progress of construction and Owner's operation schedules. Unless otherwise instructed and documented by Owner or General Contractor, the following procedures apply:

1. Field-assembled fixed equipment integrated into the structure (e.g., walk-in assemblies, exhaust hoods, drain trench/grate assemblies, conveyor systems, ceiling-mounted utensil racks) are to be sent to the job site when directed by the General Contractor and installed or protected accordingly.

2. All other Fixed Equipment: delivered after completion of work on adjacent finished ceilings, lighting, finished floor, wall systems (including painting), and painted gas lines.

3. Major Movable Equipment: delivered, when possible, to inventory in a secured area for interim job-site storage or, if the secured area is unavailable when fixed equipment installation/clean-up has been completed.

4. Minor appliances and loose items (e.g., pans, covers, flatware containers, etc.) should be delivered only when the Owner is prepared to receive and inventory such items.

C. Installation: performed by the manufacturer of custom fabricated fixtures.

1. Assemble, square, level, and ready all items for the final utility connections.

2. Cut neatly around obstructions to provide sanitary conditions.

3. Where gaps of ¼" or less occur adjacent to or between equipment, insert rope backing and smoothly apply General Electric construction sealant Series SE-1200 silicone mastic (clear color). Mask both sides of the gap for neat sealant application and remove excess. If space exceeds ¼," neatly install 18-gauge stainless steel trim molding of proper shape with concealed attachment. Use epoxy cement or "Z" clips wherever possible to secure stainless steel trim. Exposed edges or corners of trim: eased and smooth.

4. Refrigeration coil drain line runs to an indirect drain connection greater than 2" from the face of the wall or panel: Either of the following field procedures:

a. Trench the floor and provide a 6” wide x 2” deep 16-gauge stainless steel sloping (-1” to -2”) trough from the face of the cooler/freezer wall to the body of the floor sink/floor drain. Trough: turned up 4” at the wall; ¾” flange with ½” turndown at both long sides. Set trough in waterproof mastic and seal 1” OD drain tube penetration into floor sink/floor drain at -2½” BFF. Patch the floor to match adjacent material/surface.

b. Provide 12” x 6” x 2” deep 16-gauge stainless steel condensate pan mounted to cooler/freezer wall at 6” AFF clear. Trench the floor and install a 1” OD drain line from the bottom of the pan to the body of the floor sink/drain. Slope drain line ¼” per foot and seal all connections watertight. Patch the floor to match adjacent material/surface.

D. Protection of Work:

1. Fabricated fixtures: Fiberboard or plywood taped to tops and exposed body panels/components.

2. Manufactured Equipment: Fiberboard or plywood taped as required by equipment shape and installation-access requirements.

3. Prohibited use of equipment: Tool and materials storage, workbench, scaffold, stacking area, etc.

4. Damaged Equipment: Immediately documented and submitted to the Owner with the Contractor’s recommendation of action for repair or replacement and its impact on the Project Schedule and Contract Amount, if any.

3.2 CLEAN AND ADJUST

A. Clean up and remove all debris from this Work from the job site as the installation progresses.

B. Lubricate and adjust drawer slides, hinges, and casters.

C. Adjust pressure regulating valves, timed-delay relays, thermostatic controls, temperature sensors, exhaust hood grilles, etc.

D. Clean or replace faucet aerators and line strainers.

E. Touch-up damage to painted finishes.

F. Start up and check the operation of all refrigeration systems for at least 72 hours before acceptance.

3.3 EQUIPMENT START-UP/DEMONSTRATION

A. Carefully test, adjust, and regulate all equipment following the manufacturer’s instructions and certify in writing to the Owner that the installation, adjustments, and performance are in full compliance.

B. Provide the Owner or food service Operators with a thorough operational demonstration of all equipment and furnish instructions for general and specific care and maintenance. Coordinate and schedule selected equipment items and attendees with the Owner at least two weeks before the demonstration starts.

3.4 FINAL OBSERVATION

A. Final observation will be made when the Contractor certifies that they have completed their work, thoroughly reviewed the installation/operation of each item in the contract and found it to comply with the Construction Documents.

B. Repetitive final observations (more than two) and all costs associated with it which may be incurred due to the Contractor's failure to comply with the requirements of this Article will be invoiced to this Contractor on a $70.00/hr and expense basis.

PART 4 - EQUIPMENT SCHEDULE

4.1 REGULARLY MANUFACTURED EQUIPMENT/COMPONENTS: Standard finishes and accessories unless specifically deleted or superseded by the Contract Documents.

4.2 FABRICATED AND FIELD-ASSEMBLED EQUIPMENT: Arrangement and configuration as shown on Plans, Elevations, Detail Drawings, and outlined in Specifications.

4.3 REFER TO DRAWINGS: For unit quantities and plumbing, electrical or mechanical provisions are required, including the manufacturer's optional voltages, wattages, burner capacities, etc.

4.4 REFER TO PART 2 – PRODUCTS: For accessories, fittings, requirements, and procedures related to the listed buy-out and fabricated equipment.

4.5 ALTERNATE MANUFACTURER REQUIREMENTS: A specific product manufactured by the listed pre-approved equals shown under Section 4.7 Food Service Equipment are acceptable only if the specific product can evidence compliance with the specified line items and the contract documents (Refer to Section 1.6; Sub-Section A.).

4.6 RE-USED EXISTING EQUIPMENT IF PROVIDED IN THIS PROJECT

A. Existing equipment scheduled for re-use is to be inventoried and documented that equipment is in operating condition once Kitchen Contractor has taken ownership.

B. Provide pictures of all equipment once inventoried and issue them to the architect to ensure that equipment has not been damaged.

C. Verify the locations of all equipment with the owner.

D. Existing equipment that is to be reused may need parts or accessories for proper and complete operation. Submit a report listing all items with pricing for approval to allow complete installation.

E. Utility disconnection and re-connection: Under Divisions 22 and 26. Kitchen Contractor to verify utility requirements of existing equipment and coordinate with Foodservice Design Professionals (FDP) as required. If utilities shown on FDP drawings do not match the requirements of existing equipment – KEC is to relay that to FDP immediately. All utilities not scheduled for re-use must be capped and covered by required disciplines.

F. Disassembly, removal, transportation, and relocation: under this Section and scheduled with General Contractor. The owner's representative must be present and coordinate the date/time with the owner.

G. Thoroughly clean inside and out before relocation.

H. Review functional parts (e.g., doors, controls, heating elements, compressors, etc.) and submit a report of required repairs and cost estimates. Any finishes or equipment damaged due to construction will be repaired as required.

I. Existing equipment not scheduled for reuse is to be carefully removed/relocated by the Kitchen Contractor per the Owner's direction. Kitchen Contractor to coordinate the date/time with General Contractor and Owner.

J. Removal or replacement of existing equipment is to be scheduled for times of least interruption and inconvenience to the food service operation. Submit the proposed time frame schedule, task sequence, and process for approval before starting work.

K. Kitchen Contractor to verify size and shape for all existing re-used equipment and coordinate with Foodservice Design Professionals (FDP) as required.

L. Any modification(s) required/desired for re-used existing equipment to be verified by the Kitchen Contractor. Before the changes are made, all modifications must be approved by the Owner and Foodservice Design Professionals (FDP).

M. The KEC is to verify and coordinate all the utility requirements with the construction documents as required. Refer to the general specifications regarding conflicts.

4.7 FOOD SERVICE EQUIPMENT

A. All equipment is to have a performance check from factory-authorized personnel. Warranties will begin on the day of the performance check.

B. All equipment and internal components should be of domestic origin where possible.

C. Architect to verify/coordinate the aesthetic options below (Food Service color, material, or signage selections) if these items are provided in this project:

1. Countertops: Stone (stainless steel is provided unless otherwise specified)
2. Tray slides: Corian or Stone (stainless steel is provided unless otherwise specified)
3. Counter fronts: Ceramic tile, 3 Form, or Plastic Laminate
4. Sneeze Guards: Stone insets
5. General color, material, and graphic selections:
    a. Display Air Screen Merchandisers – Color selection: Powder Coat or Plastic Laminate (stainless steel is provided unless otherwise specified)
    b. Bakery Display Cases – Color selection: Powder Coat or Plastic Laminate (stainless steel is provided unless otherwise specified)
    c. Pass Thru or Reach-In Holding Cabinets - Color selection: Powder Coat (Mfg.: True) or Plastic Laminate (Mfg.: Traulsen) (Stainless steel is provided unless otherwise specified)
    d. Hanging Heat Lamps – Track and Fixture color selection
    e. Heated Merchandisers
    f. Portable Guide Rails – Stanchion and Belt color selection

g. Popcorn machine – Signage selection

h. Bottle Cooler – Signage selection

i. Graphics Package information

j. Hot Food Well covers

D. Architect to verify/coordinate the finishes below:

1. Walls: Ceramic Tile, Flat FRP, or Molded FRP (Smooth, Impervious, and easily cleanable as approved by local jurisdiction)

2. Ceilings: Removable Vinyl Face Tile (Smooth, impervious, and easily cleanable as approved by local jurisdiction)

3. Floors: Tile, Epoxy, or Rubberized flooring system (Smooth, impervious, easily cleanable and slip resistant as approved by local jurisdiction) (Coordinate floor tile transition at serving lines)

4. Floors: Walk-in Assembly – Extend kitchen floor flush into Walk-in assembly with coved base

5. Furr Downs above Serving Counters

KITCHEN

ITEM NO. 102 COLD STORAGE ASSEMBLY

QUANTITY 1

Manufacturer:	Thermokool
Model:	---
Size and Shape:	Refer to drawings
Alternate:	American Panel, ThermalRite, Kolpak,

1. Installation to be completed by Factory Approved / Authorized installer. Refer to Section 2.33 Submittal drawings to include factory approval letter or certificate. The warranty will not start until letter has been provided to FDP confirming installation meets manufacturer requirements.
2. Manufacturer to review final installation and provide a letter confirming installation meets manufacturer requirements.
3. Assembly to have 9'-6” interior clearance.
4. 304 #3 finish 20 gauge stainless steel finish where exposed, 26 gauge acrylume where concealed.
5. Factory floor with smooth aluminum finish, recessed in slab 8 1/2". Secure floor to wall assembly with cam-lock assembly. KEC to ensure the floor assembly is level prior to the wearing bed installation. Kitchens finished floor to extend to walk-in. Critical: Floor to be smooth and level prior to concrete pour and at each stage of installation.
6. Threshold to be smooth and level with finished floor. Critical: Floor threshold to be surfaced with Graphine Oxide Anti-Slip or similar surface to reduce freezing and prevent slip hazards.
7. Interior walls to be baked white enamel embossed texture .040” aluminum.
8. Ceiling to be baked white enamel smooth textured .040” aluminum.
9. Two (2) 36" doors. Doors to be 20 gauge stainless steel, type 304 (18-8), #3 finish, with heated perimeter / door jambs / windows and threshold heaters. Each door to be equipped with 3'-0" high diamond tread kick plate on both sides of doors. Mount hinged doors on two (2) Kason model no. 1346 (or equal); polished chrome plated nylon cam-lift hinges. All doors to be equipped with polished chrome Kason 1094 or equivalent door closer assembly.
10. Each door to be equipped with 3'-0" high diamond tread kick plate on both sides of doors. Mount hinged doors on two (2) Kason model no. 1346 (or equal); polished chrome plated nylon cam-lift hinges. All doors to be equipped with polished chrome Kason 1094 or equivalent door closer assembly.
11. Doors to be provided with CCI Industries, Inc., Clear-VU swinging door assemblies, Alternate: Kason.
12. Provide Kason model No. 1238CQ door handles with Kason 0485 Quarter Turn Frost Free inside release, glow in dark surface, tether to external strike mechanism, ADA compliant.
13. Kason Model No. 0027C Safeguard Deadbolt Locking Handle with Kason 0485 glow-in-the-dark backplate and turn knob safety release.
14. Provide heated illuminated Push Button Panic Alarm with protective cover and Phenolic Label “PANIC ALARM” for entrapment within Freezer (ADA mounting height). Panic Alarm Encasing is to be stainless steel (not plastic). Manufacturer to pre-run conduit within panel from Panic

Alarm to panel above Freezer door (or Cooler door if 'inline' assembly) for installation of Emergency Strobe/Horn. Division 114000 to provide (2) external Emergency Strobe/Horn Beacons and interconnect the Push Button Panic Alarm to external Beacons (One above the Freezer door and One in the Cafetorium in location as directed by Architect) furnished loose for install by Division 26. Division 27 will interconnect the Push Button Panic Alarm to the Building Automation System for Owner notification.

15. Reinforcement as required to be provided above Freezer door (exterior) and panel next to door (handle side - interior) for mounting of Emergency Strobe Beacon, Push Button Panic Alarm and Release Knob.
16. The Cooler and Freezer will have the standard control panel with standard panic button tied into the Owner's network for notification.
17. Manual backup vacuum release mechanism to punch 6" diameter hole in ceiling panel to release vacuum within freezer assembly. Mechanism to include a pull-down handle with freeze-proof hand grip. Handle to have the ability to penetrate and/or punch hole in wall accordingly to assist with opening of door assembly in the event of entrapment (and failure of inside release knob). Release mechanism assembly to be built-in/mounted to panel structural frame to minimize mechanism tear-out and/or failure. Handle to be glow-in-dark yellow with phenolic label "Vacuum Pressure Release." Punch out portion to be replaceable in opening without the use of tools or sealants. Punch out is not to be located directly over interior ramp.
18. 18-gauge stainless steel, type 304 (18-8), #3 finish trim where adjacent to walls and enclosure panels that extend to 2" above finished ceiling.
19. Freezer: One (1) lot LED light fixtures to operate in temperatures to -20 F. Lights to be installed perpendicular to coils.
20. Cooler: One (1) lot LED light fixtures. Lights to be installed perpendicular to coils.
21. Provide door bumper at doors.
22. Interior and exterior to be sealed with clear silicone. Stainless steel surfaces can be sealed factory approved waterproof and mildew resistant aluminum based metallic sealant.
23. 3'-0" high diamond tread plate at exposed exterior surfaces. Fasten to wall with stainless steel fasteners.
24. Compartments to have all electrical concealed within the walls or located above the ceiling.
25. Electrical conduit for lights to be exposed, ran from fixture to fixture with no penetration in ceiling panel. Tap off existing light fixture circuit at door. Div. 26 to provide watertight conduit for lights.
26. Provide Manufacturers alarm/control system that includes hi/low limits. Route temperature sensor to be located to the side of evaporator coil.
27. All holes in assembly are to be sealed by assembly installer.
28. KEC to coordinate location of network switch with cold storage assembly as required.
29. Kason 1832 Large Spring Valve Heated Pressure Relief Port. Locate at 12" below ceiling on cooler/freezer common wall panel and at 12" below ceiling on exterior cooler wall. All ports are to have separate dedicated electrical circuits. Pressure relief ports to be wired for continuous service. Relief port to be located, sized, and installed by Walk-in Manufacturer.

30. KEC to field verify all horizontal/vertical measurements and conditions at the building prior to fabrication or delivery of equipment.
31. KEC to provide 1-year walk-in panel installation warranty. KEC is responsible for overall install accuracy/quality and quality control of work performed regardless of installer or any field modifications due to building/construction conditions. KEC to provide Letter of Install Approval to FDP upon completed install.
32. Manufacturer to provide One Year Parts and Labor Warranty upon receipt of warranty letter.
33. Interwiring of temperature monitor panel to master building alarm system or to the Owner's network. Technology department to provide all interfacing of alarm system and with the building alarm system. Conduit from refrigeration system to monitor by Division 26. Temperature Monitor installation at 4'-0" above finished floor. All conduit to be located above walk-in cooler/freezer ceiling. Exposed electrical conduit is not acceptable.
34. Manufacturer Representative to provide training on controls and inside emergency release mechanisms.

ITEM NO. 103.1 REFRIGERATION SYSTEM - LARGE

QUANTITY 1

Manufacturer:	RDT
Model:	ZS1-2 EcoSmart
Size and Shape:	Refer to drawings
Alternate:	---

1. Air cooled system.
2. Scroll Compressors.
3. Cooler temperature to be +35 degrees.
4. Freezer temperature to be -10 degrees.
5. EcoSmart system on demand defrost.
6. Refrigeration system to accommodate 110F ambient exterior temperature. Coils to be oversized by 20%.
7. KE2 Evap Controllers located per Owner requirements.
8. S/S covered housing.
9. A dedicated electrical connection to be provided for heated condensate drain line. Refer to electrical plan for location.
10. All exterior piping to be aluminum wrapped.
11. System to accommodate Item No. 102 Cold Storage Assembly.
12. S/S covered housing mounted to a 24" tall 1/8 galvanized angle iron frame anchored to concrete pad. Provide S/S skirting around frame.
13. Mount condensing unit on common exterior rack. Refer to Architectural and Engineering drawings for exact location of remote unit. Coordinate routing of refrigeration lines and conduit with appropriate trades. Heat tape and insulate all drain lines. General Contractor to seal all building penetrations at refrigeration lines.
14. Provide two (2) year parts and labor warranty for all parts and components (including third-party components that may be utilized).

ITEM NO. 104 COLD STORAGE SHELVING

QUANTITY 2

Manufacturer:	Metro
Model:	Metro Max Q
Size and Shape:	Refer to drawings
Alternate:	---

1. Each unit to be four (4) tiers high with open grid mats.
2. Four (4) 74" post per unit. Provide foot plates at all posts when assembly is supplied with walk-in floor.
3. Refer to drawings for size, width and lengths.
4. Quantity Two (2) to equal One (1) lot: all shelving shown within cold storage assembly.
5. Verify shelving requirements with approved submittal prior to ordering.

ITEM NO. 105 DUNNAGE RACK

QUANTITY 3

Manufacturer:	Metro
Model:	Bow Tie Series
Size and Shape:	Refer to drawings
Alternate:	---

1. Size as shown.

ITEM NO. 107 DRY STORAGE SHELVING

QUANTITY 1

Manufacturer:	Metro
Model:	MetroMax Q
Size and Shape:	Refer to drawings
Alternate:	---

1. Each unit to be five (5) tiers high with open grid shelving.
2. Four (4) 86" posts per unit.
3. Quantity One (1) to equal One (1) Lot: all shelving shown within the dry storage room.
4. Refer to drawings for size, width and lengths.
5. Verify shelving requirements with approved submittal prior to ordering.

ITEM NO. 108 CAN RACK

QUANTITY 1

Manufacturer:	New Age
Model:	97294CK
Size and Shape:	Refer to drawings
Alternate:	---

1. Four (4) 6" plate casters, (2) swivel with brakes, (2) rigid.

ITEM NO. 109 ICE MAKER WITH BIN - 500 LB CAPACITY

QUANTITY 1

Manufacturer:	Manitowoc
Model:	IYT-0450A/D570
Size and Shape:	Refer to drawings
Alternate:	Scotsman

1. Energy Star Rated.
2. Stainless steel bin.
3. Stainless steel legs.
4. Provide bin adapter kit as required.
5. Easy Touch Controls, set filter reminders, get error messages/faults, program run/stop times, display serial/model information, view step-by-step cleaning/sanitizing prompts, view warranty expiration timer.
6. Provide Luminice II Virus and Bacteria Inhibitor.
7. Provide sizes and quantities as required: Dormont s/s water disconnect from filter to Ice Machine.
8. Cord and plug assembly, coordinate NEMA configuration with electrician.
9. One (1) pre-filter and water filter sized to manufacturers recommendations. Provide two (2) sets of replacement filters. Mount on wall adjacent to ice machine in an easily accessible location.
10. Coordinate cord and cap with receptacle. Water supply to filter to be hard copper plumbed. 72" long flex hose from filter to ice maker with 48" wall restraint cable. Interconnection thru water filter to ice machine and final connection by Division 22. Water filter overflow tube to be strapped to back side of ice machine and extend to 1" above floor sink.

ITEM NO. 110 CLOTHES WASHER

QUANTITY 1

Manufacturer:	Whirlpool
Model:	Residential
Size and Shape:	Refer to drawings
Alternate:	GE

1. Contractor to provide current model numbers at the time of delivery.
2. Top load washer.
3. 4.2 cu. Ft. capacity, minimum.
4. Six (6) cycle, two (2) speed washer.
5. White acrylic finish.
6. Cord and plug.
7. Water and drain connection hoses as required.

ITEM NO. 110A CLOTHES DRYER

QUANTITY 1

Manufacturer:	Whirlpool
Model:	Residential
Size and Shape:	Refer to drawings
Alternate:	GE

1. Front load dryer.
2. 3.4 cu. ft. capacity, minimum.
3. Seven (7) cycle-four (4) temperature, Dryer.
4. White acrylic finish.
5. Cord and plug.
6. Vent kit with dryer.
7. Contractor to provide current model numbers at the time of delivery.

ITEM NO. 111 CHEMICAL SHELF

QUANTITY 1

Manufacturer:	Metro
Model:	MetroMax Q
Size and Shape:	Refer to drawings
Alternate:	---

1. Each unit to be four (4) tiers high with open grid mats.
2. Four (4) 74" posts per unit.

ITEM NO. 121 TWO COMPARTMENT SINK W. DISPOSER

QUANTITY 1

Manufacturer:	Custom Fabricated
Model:	---
Size and Shape:	Refer to drawings
Alternate:	---

1. Top: 14 gauge type 304 S/S marine edge with 2" turndown at free sides.
2. Open base construction.
3. 10" high splash where adjacent to walls/fixtures.
4. Two (2) 24" x 26" x 15" deep sink compartments.
5. One (1) T&S model no. B-0291, splash mount faucet, 18" swing nozzle,LL inlets, for ¾" hot and cold water connections.
6. Two (2) Fisher 22306 twist waste valve 3 1/2" x 2" with overflow and tailpiece. Provide 18 gauge S/S bracket for drain handle welded to sink bottom.
7. Provide One (1) T&S model no. B-0133-EE-CR-8C pre-rinse, ***two (2)*** B-0108-C spray head, two(2) B-0109-04 18" long wall bracket (dealer to cut to correct length), one (1) additional spray face model no. 108SFRK with ceramic cartridges.
8. 16 gauge S/S undershelf per drawings.

9. Disposer - installed in top integrally welded disposer cone. Notch and punch splash turn back for vacuum breaker. 14 gauge S/S bracket mounted below counter top for disposer control panel ground and polished to match top.
10. 12" deep single post mounted overshelf at 18" above counter top, punched to accommodate spray rinse.
11. Post mounted utensil rack, extend 1-5/8" diameter S/S post from back splash, turn forward 12" and weld full length x 2" x ¼" S/S bar with Component Hardware model no. V-77-4401 S/S sliding hooks at 8" on center. Verify height with owner.
12. One (1) Chicago model no. 305-VBRCF hose bibb and rack mounted on 14 gauge S/S bracket ground and polished to match top. Hose and spray nozzle by owner.
13. Omit rear rail at sink compartments, disposer and front rail at hose bibb.
14. Two (2) "Richlite" ½" thick removable sink covers installed at each sink. Weld ¼" bar stock, set 5/8" below work surface at all four corners for support of sink covers. Two (2) finger holes per board.
15. Provide top and bottom c-channel support storage for sink covers at right or left end of counter.
16. One (1) Edlund model no. S-11 Manual can opener, mounted on raised platform.
17. Flanged feet at front only.
18. Seal at all splash penetrations.

ITEM NO. 123 DISPOSER-CONE MOUNT

QUANTITY 2

Manufacturer:	Salvajor
Model:	300-CA-18-ARSS -LD
Size and Shape:	Refer to drawings
Alternate:	In-Sink-Erator

1. Fixed nozzle.
2. Delete standard syphon breakers and provide T & S B-0456-04 vacuum breakers and mount 6” from tabletop to base of breaker.
3. Solenoid valve.
4. Flow control.
5. Model no. ARSS-LD control panel.
6. Auto-reverse.
7. Dejamming tool.
8. Install vacuum breaker in splash
9. S/S cone cover.
10. Perforated silver saver and disposer cone with scrap ring.
11. Two (2) Swirl inlet located in disposer cone at a 45 degree angle.
12. GC to pipe 1/2" cold water to disposer body and swirl inlets. Excess electrical cord to be secured to fabrication as required. Install into counter by section 114000.

ITEM NO. 134 40 QUART MIXER

QUANTITY 1

Manufacturer:	Hobart
Model:	HL400
Size and Shape:	Refer to drawings
Alternate:	---

1. Mixer, floor model, 40 qt. Capacity.
2. 208/60/1 cord and cap assembly by KEC.
3. 15 Minute timer, thermal overload, with magnetic starter
4. Epoxy enamel finish-floor model.
5. Stainless steel 40 & 30 qt bowl.
6. Aluminum "B" flat beater 40 & 30 qt.
7. Stainless steel "D" wire whip 40 & 30 qt.
8. One (1) "ED" dough hook 40 & 30 qt.
9. Bowl Scraper D340.
10. Aluminum Bowl truck.
11. One (1) CHUTE-D34 D340 40 & 30 qt, bowl guard with ingredient chute.
12. One (1) Year Extended warranty - parts and labor.
13. One (1) custom fabricated mixer accessory rack, wall mounted per the contract documents. To be located in an accessible location by the owner.
14. Coordinate cord and cap assembly with receptacle. KEC to provide cord and plug assembly to Division 26 for installation.

ITEM NO. 136 BAKER'S TABLE

QUANTITY 1

Manufacturer:	Custom Fabricated
Model:	---
Size and Shape:	Refer to drawings
Alternate:	---

1. Top: 14 gauge S/S top, type 304, with 2” turndown at all free sides. Provide 10" high backsplash at wall. Provide 10" high back/end splash at wall, equipment, columns, and chases as required.
2. Provide finished back at exposed backsplash.
3. 12" deep post mounted overshelf at 18" above counter top.
4. 18 gauge butt joint wall panel from splash to underside of shelf.
5. One (1) tier of three (3) 20" x 20" x 5" deep all stainless steel drawers. To be in #18 gauge stainless steel housing having 3/4" radius (vertical) exterior corners. S/S drawer liners.
6. Rear rail only.
7. One (1) lot Rubbermaid no. FG360288WHT ingredient bins.
8. Post mounted utensil rack, extend 1-5/8" diameter S/S post from back splash, turn forward 12" and weld full length x 2" x ¼" S/S bar with Component Hardware model no. V-77-4401 S/S sliding hooks at 8" on center. Verify height with owner.
9. 16 gauge S/S flour trough.

ITEM NO. 138 PAN RACK

QUANTITY 5

Manufacturer:	CresCor
Model:	207-UA-13A
Size and Shape:	Refer to drawings
Alternate:	Lakeside

1. Four (4) 5" casters.
2. Adjustable universal slides on 1-1/2" centers.
3. Corner bumpers.
4. Omit bumper on roll-in racks.
5. Coordinate pan rack with roll-in cabinets.

ITEM NO. 139 INSUL. MOBILE PROOFER

QUANTITY 1

Manufacturer:	CresCor
Model:	H-137-WSUA-12D
Size and Shape:	Refer to drawings
Alternate:	Metro, FWE

1. Insulated proofer/heated cabinet.
2. Field reversible doors.
3. Adjustable universal angles.
4. Four (4) 5" casters, two (2) with brakes.
5. Tempered glass door windows.
6. Key lock handle.
7. Corner bumpers.
8. Cord and plug. Coordinate NEMA configuration with Electrician.
9. Thermometer.
10. 1500 watt heater.

ITEM NO. 145 WORKTABLE W. SINK & DBL BAR UT RACK

QUANTITY 1

Manufacturer:	Custom Fabricated
Model:	---
Size and Shape:	Refer to drawings
Alternate:	---

1. Top: 14 gauge type 304 S/S, 2" turn down at all sides.
2. Provide table in two (2) sections-one (1) 27" and one (1) 33" section. Refer to detail.
3. Open base construction.
4. Full length 16 gauge S/S undershelf.
5. Four (4) 20" W x 20" L drawer assemblies. Component Hardware #S52-2020 drawer slides with delrin bearings - 200lb capacity. Component Hardware #S81-2020C drawer pan.
6. One (1) 15" x 20" x 10" deep sink compartment. Coordinate location with drain overflow.

7. One (1) T&S model no. B-0320-BB-CR, rigid gooseneck, ceramic cartridges, deck faucet for ¾" hot and cold water connections.
8. One (1) Fisher 22306 twist waste valve 3 1/2" x 2" with overflow and tailpiece. Provide 18 gauge S/S bracket for drain handle welded to sink bottom.
9. Post mounted double bar utensil rack, extend 1-5/8" diameter S/S posts from cross rail thru top and weld Two (2) full length 2" x 1/4" S/S bars with 12" radiused outside ends and One (1) additional bar between post with Component Hardware model no. V-77-4401 sliding hooks at 8" on center. Provide gussets for posts at countertop penetrations. Verify height with Owner. 48" max. upright post spacing.
10. Provide a duplex receptacle and housing mounted below countertop per drawings. Interconnect and prewire a 5'-0" cord and plug out of receptacle housing for plugging into ceiling drop cord receptacle. 114000 and Div. 26 to coordinate location of drop cord receptacle.
11. Omit rear cross rail at sink section.
12. Flanged feet, secured to the floor with non corrosive anchors.

ITEM NO. 151 FIRE PROTECTION SYSTEM

QUANTITY 3

Manufacturer:	Ansul
Model:	R102
Size and Shape:	Refer to drawings
Alternate:	---

1. Duct and plenum protection to exhaust hood.
2. Surface protection for cooking equipment.
3. Locate remote fire pulls as recommended by Fire Marshal.
4. One (1) lot Mechanical gas valve (maximum diameter as required). Size as required. Furnished by Section 114000, installed by Division 22. Kitchen Equipment Contractor to coordinate location with local Fire Marshal requirements prior to submittal review. All conduits to be recessed within wall, SURFACE MOUNTING WILL NOT BE ACCEPTED.
5. System to meet U.L. 300 requirements.
6. Provide one (1) hand held Type 'K' and ABC 6 liter fire extinguisher per Ansul System, surface wall mounted. Verify mounting locations as required.
7. Exposed pipe threads are unacceptable.
8. All exposed piping to be chrome plated.
9. All hood penetrations to have U.L. listed "Quick Seal". Provide s/s escutcheons at all hood penetrations.
10. Provide phenolic I.D. labels for exhaust hood, remote fire pull, light/fan switches and fire protection system.
11. Provide a manufacturer performance test and report that verifies this system is fully operational.
12. Provide s/s cabinet as shown on plan.
13. Installer to provide one (1) Ansul system per exhaust hood, review drawings and provide systems as required.

14. Install hand held extinguishers, maximum of 3'-2" A.F.F. to top of unit.

ITEM NO. 152 EXHAUST HOOD

QUANTITY 1

Manufacturer:	Mod-U-Serve
Model:	W
Size and Shape:	Refer to drawings
Alternate:	---

1. Size and shape as per plan.
2. Supply Air. Ceiling mounted supply plenumwith light fixtures, coordinate conditioned/tempered air with engineer. Locate supply plenum in ceiling, coordinate location with GC as required.
3. Exhaust only canopy (W).
4. U.L. Listed and fire rated 48” recessed LED lights located within the hood canopy. To meet minimum requirements of 50’ candles of illumination.
5. Simple on/off switches for hood fans and lights to be provided by Division 26. Control panels will not be accepted.
6. Hood to meet requirements of ALL current local Mechanical and local Energy Codes.
7. Collars to be field installed. Coordinate with existing conditions and install as approved by Hood manufacturer.
8. All 18 gauge S/S construction. S/S finish where exposed.
9. For extended cooking line-ups provide Continuous Capture canopies without partitions between hoods.
10. Hood to have insulated front face and ends to allow for ceiling grid attachment where ceiling grid meets hood capture area.
11. S/S filters and grease cup. Provide filter removal tool.
12. ½" diameter steel hanger rods at 4'-0" O.C. maximum to be by Kitchen Equipment Supplier, but they are to be anchored to supporting structure (or slab) by the General Contractor in the locations required by exhaust hood shop detail.
13. All hood penetration to be fire rated and U.L. Listed and sealed with s/s escutcheons.
14. S/S c-channel closure panel from top of hood to ceiling.
15. S/S filler panel between hoods if back-to-back.
16. 4" air space at rear of hood. Provide S/S finished back where rear air space would otherwise be exposed.
17. Ductwork and final connection to hood above ceiling to be by the Mechanical Contractor.
18. Clearance requirement: Where any exterior surface of a hood is installed less than 18" from a combustible or semi-combustible surface, provide a minimum of 4" air space containing a code approved fire resistant material to that surface in a manner as prescribed by the manufacturer of that fire-resistant material. Protective materials provided by 3M Fire Barrier Duct Wrap 615+ and Fry Ware Elite are compliant with state and local mechanical codes. In addition, both systems meet the requirements of the testing standards of ASTM E2336 AND ARE THEREFORE APPROVED TO BE USED IN CLEARANCE REDUCTION APPLICATIONS.

19. Provide Mod-U-Serve model number ASTS-90 pre-set temperature sensor for automatic start of exhaust fan when the condition exists where the exhaust fan is not initiated at the wall switch and the temperature in the exhaust canopy reaches 110 degrees F. At the end of the cooking day when the fan is disengaged at the wall switch the thermostat (temperature sensor) will keep the exhaust fan on until the temperature in the exhaust canopy drops below 110 degrees F.
20. Provide minimum 18-gauge stainless steel non-insulated flat wall panel. Extend from top of cove base to underside of hood. Provide with panels, "T" type joining strips at interior seams and "C" type strips at outside panel ends. Wall panels to extend the full length of the hood or to top of half wall.
21. Refer to individual hood lengths as shown on drawings for each assembly required. Install at 6'-10" A.F.F. to bottom of hood, coordinate duct and fan requirements with Mechanical Contractor. Interconnect to wall mounted light switch by Division 26. Bulbs for light fixtures to be furnished and installed by Kitchen Equipment Contractor.
22. Mechanical contractor to test and balance exhaust hoods. Balance report to be provided to FDP upon completion.
23. **Special Instruction:** Refer to individual hood and plenum box lengths as shown on drawings for each assembly required. Install bottom of hood at 6'-10" A.F.F. Install plenum boxes recessed and interconnect to wall mounted light switch by Division 26.

ITEM NO. 153 EXHAUST HOOD

QUANTITY 1

Manufacturer:	Mod-U-Serve
Model:	W-CPB
Size and Shape:	Refer to drawings
Alternate:	---

1. Size and shape as per plan.
2. Supply Air. Ceiling mounted supply plenum with light fixtures, coordinate conditioned/tempered air with engineer. Locate supply plenum in ceiling, coordinate location with GC as required.
3. Exhaust only canopy (W).
4. U.L. Listed and fire rated 48” recessed LED lights located within the hood canopy. To meet minimum requirements of 50’ candles of illumination.
5. Simple on/off switches for hood fans and lights to be provided by Division 26. Control panels will not be accepted.
6. Hood to meet requirements of ALL current local Mechanical and local Energy Codes.
7. Collars to be field installed. Coordinate with existing conditions and install as approved by Hood manufacturer.
8. All 18 gauge S/S construction. S/S finish where exposed.
9. For extended cooking line-ups provide Continuous Capture canopies without partitions between hoods.
10. Hood to have insulated front face and ends to allow for ceiling grid attachment where ceiling grid meets hood capture area.
11. S/S filters and grease cup. Provide filter removal tool.

12. ½" diameter steel hanger rods at 4'-0" O.C. maximum to be by Kitchen Equipment Supplier, but they are to be anchored to supporting structure (or slab) by the General Contractor in the locations required by exhaust hood shop detail.
13. All hood penetration to be fire rated and U.L. Listed and sealed with s/s escutcheons.
14. S/S c-channel closure panel from top of hood to ceiling.
15. S/S filler panel between hoods if back-to-back.
16. 4" air space at rear of hood. Provide S/S finished back where rear air space would otherwise be exposed.
17. Ductwork and final connection to hood above ceiling to be by the Mechanical Contractor.
18. Clearance requirement: Where any exterior surface of a hood is installed less than 18" from a combustible or semi-combustible surface, provide a minimum of 4" air space containing a code approved fire resistant material to that surface in a manner as prescribed by the manufacturer of that fire-resistant material. Protective materials provided by 3M Fire Barrier Duct Wrap 615+ and Fry Ware Elite are compliant with state and local mechanical codes. In addition, both systems meet the requirements of the testing standards of ASTM E2336 AND ARE THEREFORE APPROVED TO BE USED IN CLEARANCE REDUCTION APPLICATIONS.
19. Provide Mod-U-Serve model number ASTS-90 pre-set temperature sensor for automatic start of exhaust fan when the condition exists where the exhaust fan is not initiated at the wall switch and the temperature in the exhaust canopy reaches 110 degrees F. At the end of the cooking day when the fan is disengaged at the wall switch the thermostat (temperature sensor) will keep the exhaust fan on until the temperature in the exhaust canopy drops below 110 degrees F.
20. Provide minimum 18-gauge stainless steel non-insulated flat wall panel. Extend from top of cove base to underside of hood. Provide with panels, "T" type joining strips at interior seams and "C" type strips at outside panel ends. Wall panels to extend the full length of the hood or to top of half wall.
21. Refer to individual hood lengths as shown on drawings for each assembly required. Install at 6'-10" A.F.F. to bottom of hood, coordinate duct and fan requirements with Mechanical Contractor. Interconnect to wall mounted light switch by Division 26. Bulbs for light fixtures to be furnished and installed by Kitchen Equipment Contractor.
22. Mechanical contractor to test and balance exhaust hoods. Balance report to be provided to FDP upon completion.
23. **Special Instruction:** Refer to individual hood and plenum box lengths as shown on drawings for each assembly required. Install bottom of hood at 6'-10" A.F.F. Install plenum boxes recessed and interconnect to wall mounted light switch by Division 26.

ITEM NO. 154 EXHAUST HOOD

QUANTITY 1

Manufacturer:	Mod-U-Serve
Model:	W-CPB
Size and Shape:	Refer to drawings
Alternate:	---

1. Size and shape as per plan.

2. Supply Air. Ceiling mounted supply plenum with light fixtures, coordinate conditioned/tempered air with engineer. Locate supply plenum in ceiling, coordinate location with GC as required.
3. Exhaust only canopy (W).
4. U.L. Listed and fire rated 48” recessed LED lights located within the hood canopy. To meet minimum requirements of 50’ candles of illumination.
5. Simple on/off switches for hood fans and lights to be provided by Division 26. Control panels will not be accepted.
6. Hood to meet requirements of ALL current local Mechanical and local Energy Codes.
7. Collars to be field installed. Coordinate with existing conditions and install as approved by Hood manufacturer.
8. All 18 gauge S/S construction. S/S finish where exposed.
9. For extended cooking line-ups provide Continuous Capture canopies without partitions between hoods.
10. Hood to have insulated front face and ends to allow for ceiling grid attachment where ceiling grid meets hood capture area.
11. S/S filters and grease cup. Provide filter removal tool.
12. ½" diameter steel hanger rods at 4'-0" O.C. maximum to be by Kitchen Equipment Supplier, but they are to be anchored to supporting structure (or slab) by the General Contractor in the locations required by exhaust hood shop detail.
13. All hood penetration to be fire rated and U.L. Listed and sealed with s/s escutcheons.
14. S/S c-channel closure panel from top of hood to ceiling.
15. S/S filler panel between hoods if back-to-back.
16. 4" air space at rear of hood. Provide S/S finished back where rear air space would otherwise be exposed.
17. Ductwork and final connection to hood above ceiling to be by the Mechanical Contractor.
18. Clearance requirement: Where any exterior surface of a hood is installed less than 18" from a combustible or semi-combustible surface, provide a minimum of 4" air space containing a code approved fire resistant material to that surface in a manner as prescribed by the manufacturer of that fire-resistant material. Protective materials provided by 3M Fire Barrier Duct Wrap 615+ and Fry Ware Elite are compliant with state and local mechanical codes. In addition, both systems meet the requirements of the testing standards of ASTM E2336 AND ARE THEREFORE APPROVED TO BE USED IN CLEARANCE REDUCTION APPLICATIONS.
19. Provide Mod-U-Serve model number ASTS-90 pre-set temperature sensor for automatic start of exhaust fan when the condition exists where the exhaust fan is not initiated at the wall switch and the temperature in the exhaust canopy reaches 110 degrees F. At the end of the cooking day when the fan is disengaged at the wall switch the thermostat (temperature sensor) will keep the exhaust fan on until the temperature in the exhaust canopy drops below 110 degrees F.
20. Provide minimum 18-gauge stainless steel non-insulated flat wall panel. Extend from top of cove base to underside of hood. Provide with panels, "T" type joining strips at interior seams and "C" type strips at outside panel ends. Wall panels to extend the full length of the hood or to top of half wall.

21. Refer to individual hood lengths as shown on drawings for each assembly required. Install at 6'-10" A.F.F. to bottom of hood, coordinate duct and fan requirements with Mechanical Contractor. Interconnect to wall mounted light switch by Division 26. Bulbs for light fixtures to be furnished and installed by Kitchen Equipment Contractor.
22. Mechanical contractor to test and balance exhaust hoods. Balance report to be provided to FDP upon completion.
23. **Special Instruction:** Refer to individual hood and plenum box lengths as shown on drawings for each assembly required. Install bottom of hood at 6'-10" A.F.F. Install plenum boxes recessed and interconnect to wall mounted light switch by Division 26.

ITEM NO. 161 CONVECTION OVEN- GAS DBL

QUANTITY 2

Manufacturer:	Blodgett
Model:	DFG-200 DBL
Size and Shape:	Refer to drawings
Alternate:	Vulcan

1. S/S front, top and sides.
2. Two (2) 1/2 HP 2-speed motors.
3. Natural gas.
4. SSI-M solid state infinite control with manual timer.
5. Electronic spark ignition.
6. Five (5) oven racks per compartment.
7. Dual pane thermal windows.
8. Simultaneous door operation.
9. Heavy duty casters, two (2) with brakes.
10. Provide quantities and sizes required: Dormont Model #VER-KIT-2S-48” Gas Conn. Kit, 48” long, Moveable Gas Connector Kit, covered with stainless steel braid, coated with blue antimicrobial PVC, SnapFast® Quick Disconnect, Swivel MAX®, full port valve, coiled restraining cable with hardware, limited lifetime warranty.
11. Dedicated gas connections, do not manifold.
12. Shunt trip breaker by Division 26.
13. Provide Eagle model CC-S, Stainless Steel Caster Cradle Stabilizing Device for all mobile production equipment under the exhaust hoods. Coordinate locations with the Owner prior to installation. Quantity One (1) equals One (1) lot. Alternate: Regency Stainless Steel Caster Placement System, model #600Safetyset.

ITEM NO. 162 CONVECTION STEAMER - GAS DBL

QUANTITY 1

Manufacturer:	Cleveland
Model:	(2) 22CGT66.1 Double
Size and Shape:	Refer to drawings
Alternate:	Groen

1. SteamChef™ 6 Convection Steamer, Gas, boilerless, double stacked, twelve (12) pan capacity. Stainless steel exterior, UL, NSF, and ENERGY STAR® rated.
2. Two (2) compartments each with individual connections.
3. 60-minute electro-mechanical timer & manual (continuous steaming) bypass switch.
4. Automatic drain & water level controls, KleanShield™ interior.
5. Model #ES26304466G equipment stand, 4" adjustable legs with flanged feet.
6. One (1) year parts and labor warranty.
7. Provide quantities and sizes required: Dormont Model #VER-KIT-2S-48” Gas Conn. Kit, 48” long, Moveable Gas Connector Kit, covered with stainless steel braid, coated with blue antimicrobial PVC, SnapFast® Quick Disconnect, Swivel MAX®, full port valve, coiled restraining cable with hardware, limited lifetime warranty.
8. Provide sizes and quantities as required: Dormont s/s water disconnect from filter to steamer,color coded for filtered and non-filtered water.
9. Provide filtration system as recommended by the manufacturer. Provide one set of replacement filters. Div 22 to interconnect equipment to the filter system.
10. KEC to coordinate filtered and unfiltered water with steamer, do not connect filtered water to unfiltered water connection.
11. Coordinate location; Floor sink to be outside equipment footprint and outside steam-free zone. Division 26 to provide shunt trip breaker.

ITEM NO. 164.1 40 GAL. TILT BRAISING PAN- GAS POWER TILT

QUANTITY 1

Manufacturer:	Cleveland
Model:	SGL40T1
Size and Shape:	Refer to drawings
Alternate:	Groen

1. PowerPan tilt braising pan with easyDial Controls, selector dial with LED ring, large display screen.
2. Power tilt with spring-assisted cover with vent.
3. S/S construction.
4. Open leg frame.
5. Steamer pan inserts.
6. Pan carrier.
7. Etch marks.
8. Double pantry swing faucet.
9. Provide sizes and quantities as required: Dormont s/s water disconnect from water connection to pantry faucet.
10. Flanged feet. Secure rear to floor with non-corrosive anchors.
11. Provide quantities and sizes required: Dormont Model #VER-KIT-2S-48” Gas Conn. Kit, 48” long, Moveable Gas Connector Kit, covered with stainless steel braid, coated with blue antimicrobial PVC, SnapFast® Quick Disconnect, Swivel MAX®, full port valve, coiled restraining cable with hardware, limited lifetime warranty.

12. Trench liner to consist of:
13. S/S trench liner by 114000. Installation by G.C.
14. IMC/Teddy or Custom Fabrication.
15. Fibergrate: Gray #2 1" Thick, 1 1/2" squares mesh, Quartz grit top. Provide in two (2) equal sections, all ends to be finished ends.
16. 14 gauge s/s liner.
17. IMC Teddy model no. BSPC basket strainer with pullout handle and chain.
18. Location of trench liner is critical. G.C. and 114000 to verify location prior to concrete pour. Oversize trench liner block out to accommodate equipment pour path.

ITEM NO. 168 SS WALL CAP

QUANTITY 2

Manufacturer:	Custom Fabricated
Model:	---
Size and Shape:	Refer to drawings
Alternate:	---

1. 2" square turndown at free ends.
2. Caulk and seal at wall with clear silicone.
3. Eased edges at exposed corners.
4. Coved turn up at full height wall, extended to ceiling.
5. Locate per drawings.
6. GC to provide and install substrate at all wall caps.

ITEM NO. 172 COMBI OVEN - GAS DBL

QUANTITY 2

Manufacturer:	Rational
Model:	ICP 6-FULL/6-FULL N/G
Size and Shape:	Refer to drawings
Alternate:	Alto-Shaam, Convotherm

1. Pre-Installation Site Consultation, to verify building utilities and access are in place for the units ordered prior to units being installed on site.
2. 208/240V 1PH
3. Standard door hinging.
4. Six (6) 18" x 26" or twelve (12) 12" x 20" pan capacity, per unit.
5. Standard warranty: 2 year parts and labor, installation inspection/start up.
6. Doors hinged per drawings.
7. Combi-Duo Stacking Kit, mobile.
8. Cleaner Tablets
9. Care Tablets.
10. **AutoDose option, with Cartridge chemicals.**
11. Fry baskets, qty. 3 per oven.
12. KEC to coordinate pan accessories with Owner prior to ordering.

13. Four hour chef training.
14. Heat shield.
15. Installation Kit "10", per unit, article number 8720.1560US.
16. Rational offers Certified Installation of units by Commercial Kitchens.
17. System installation to be reviewed by an authorized factory installer, provide report confirming installation meets factory's requirements.
18. Provide filtration system as recommended by the manufacturer. Provide one set of replacement filters. Div 22 to interconnect equipment to the filter system.
19. Provide sizes and quantities as required: Dormont s/s water disconnect from filter to Combi Oven,color coded for filtered and non-filtered water.
20. KEC to coordinate filtered and unfiltered water with Combi Oven, do not connect filtered water to unfiltered water connection.
21. Provide quantities and sizes required: Dormont Model #VER-KIT-2S-48” Gas Conn. Kit, 48” long, Moveable Gas Connector Kit, covered with stainless steel braid, coated with blue antimicrobial PVC, SnapFast® Quick Disconnect, Swivel MAX®, full port valve, coiled restraining cable with hardware, limited lifetime warranty.
22. Provide Eagle model CC-S, Stainless Steel Caster Cradle Stabilizing Device for all mobile production equipment under the exhaust hoods. Coordinate locations with the Owner prior to installation. Quantity One (1) equals One (1) lot. Alternate: Regency Stainless Steel Caster Placement System, model #600Safetyset.
23. Water supply to have shut-off valve and back flow preventer furnished and installed by Division 22. Supply water to interconnect thru water filter and then to each oven. Indirect drain line to be ran outside of the footprint of the unit, coordinate location of the related floor sink.

ITEM NO. 186 PASS-THRU HEATED CABINET- 1DR

QUANTITY 1

Manufacturer:	Traulsen
Model:	HF-132WP
Size and Shape:	Refer to drawings
Alternate:	---

1. Anodized aluminum interior and S/S exterior.
2. Interior lights with bulbs.
3. Exterior digital thermometer.
4. Locking hardware.
5. EZ-Clean Tray racks, for 18" x 26", 14" x 18" or 12" x 20" pans. Provide a total of (12) levels for each section.
6. Four (4) 6" casters with L14-30P plug.
7. Furnish start-up and Six (6) year parts and labor warranty.
8. Controls mounted on kitchen side.
9. Half height doors hinged as per plan. Glass doors located on kitchen side, solid doors located on server side.
10. Re-hinging feature.

11. Fully welded telescoping S/S trim at wall. Trim is not to be secured to the equipment.
12. **Special Instruction:** Provide opening in wall 2" taller than equipment and 2" wider, KEC to coordinate with GC as required. Trim is not to be secured to the equipment.

ITEM NO. 187 PASS-THRU HEATED CABINET- 2DR

QUANTITY 2

Manufacturer:	Traulsen
Model:	HF-232WP-HHS
Size and Shape:	Refer to drawings
Alternate:	---

1. Anodized aluminum interior and S/S exterior.
2. Interior lights with bulbs.
3. Exterior digital thermometer.
4. Locking hardware.
5. EZ-Clean Tray racks, for 18" x 26", 14" x 18" or 12" x 20" pans. Provide a total of (12) levels for each section.
6. Four (4) 6" casters with L14-30P plug.
7. Furnish startup and Six (6) years parts and labor warranty.
8. Controls mounted on kitchen side.
9. Half height doors hinged as per plan. Glass doors located on kitchen side, solid doors located on server side.
10. Re-hinging feature.
11. Fully welded telescoping S/S trim at wall. Trim is not to be secured to the equipment.
12. **Special Instructions:** Provide opening in wall 2" taller than equipment and 2" wider, KEC to coordinate with GC as required. Trim is not to be secured to the equipment.

ITEM NO. 188 PASS-THRU REFRIGERATOR - 1DR

QUANTITY 2

Manufacturer:	Traulsen
Model:	HT-132WPUT
Size and Shape:	Refer to drawings
Alternate:	---

1. Anodized aluminum interior and S/S exterior.
2. Interior lights with bulbs.
3. Exterior digital thermometer.
4. Locking hardware.
5. EZ-Clean Tray racks, for 18" x 26", 14" x 18" or 12" x 20" pans. Provide a total of (12) levels for each section.
6. Four (4) 6" casters with 5-15P plug.
7. Furnish start-up and Six (6) year parts and labor warranty.
8. Controls mounted on kitchen side.
9. Five (5) Year compressor warranty.

10. Half height doors hinged as per plan. Glass doors located on kitchen side, solid doors located on server side.
11. Re-hinging feature.
12. Fully welded telescoping S/S trim at wall. Trim is not to be secured to the equipment.
13. **Special Instruction:** Provide opening in wall 2" taller than equipment and 2" wider, KEC to coordinate with GC as required. Trim is not to be secured to the equipment.

ITEM NO. 189 PASS-THRU REFRIGERATOR - 2DR

QUANTITY 1

Manufacturer:	Traulsen
Model:	HT-232WPUT
Size and Shape:	Refer to drawings
Alternate:	---

1. Anodized aluminum interior and S/S exterior.
2. Interior lights with bulbs.
3. Exterior digital thermometer.
4. Locking hardware.
5. EZ-Clean Tray racks, for 18" x 26", 14" x 18" or 12" x 20" pans. Provide a total of (12) levels for each section.
6. Four (4) 6" casters with 5-15P plug.
7. Furnish start-up and Six (6) years parts and labor warranty.
8. Seven (7) Year compressor warranty.
9. Controls mounted on kitchen side.
10. Half height doors hinged as per plan. Glass doors located on kitchen side, solid doors located on server side.
11. Re-hinging feature.
12. Fully welded telescoping S/S trim at wall. Trim is not to be secured to the equipment.
13. **Special Instruction:** Provide opening in wall 2" taller than equipment and 2" wider, KEC to coordinate with GC as required. Trim is not to be secured to the equipment.

ITEM NO. 201M.1 SERVING COUNTER-MODULAR

QUANTITY 1

Manufacturer:	Mod-U-Serve
Model:	---
Size and Shape:	Refer to drawings
Alternate:	Counter Craft

1. Modular counter, size and shape per drawings.
2. CONSTRUCTION:
3. All electrical to be pre-wired to single point receptacle per module. Coordinate receptacles with slab rough-ins.
4. Pin and sleeve connection for final connection to load center located per drawings.

5. Cashiers station to be integral with counter, lockable cashiers drawer, undershelf to accommodate owners POS System, outlet to accommodate POS system and data line.
6. S/S removable intermediate shelves and undershelves where possible.
7. Provide remote on/off switch for beverage merchandising if location is not accessible.
8. Adjustable kickplates.
   6" adjustable s/s legs.
9. Line-up locks as required per factory.
10. Dedicated Convenience outlet to accommodate beverage or milk merchandiser.
11. Convenience outlet located at flat top countertops, provide grommetted hole in counter as required.
12. TRAYSLIDE:
13. Group "E" corian trayslide with 1/4" rounded s/s runners. Trayslide to be supported with finished plywood with white melamine at exposed areas. Trayslide brackets to be fully welded to angle iron frame.
14. LED lights located at tray slide.
15. COUNTER COMPONENTS:
16. Size, shape, and quantities as shown on plans.
17. One (1) lot hot/cold dry wells as shown on drawings, recess in countertop to accommodate 18"X26" sheet pan.
18. Stainless steel flat top counter sized per drawings. Dedicated electrical for countertop equipment or convenience outlet.
19. One (1) lot Hatco drop in mechanical cold pan, 3 pan capacity unless counter drawings shows otherwise.
20. One (1) lot Hatco drop in frost top pan, to accommodate two (2) 18" x 26" sheet pan capacity unless counter drawings shows otherwiset.
21. Coordinate counter fabrication with Item 800 Built-In Refrigerated Merhcandiser.
22. Hot food well covers, verify color selection with architect.
23. Stainless steel louvered panels to be provided on operator's side only at compressor locations. Louvers to be provided per manufacturer's minimum requirements.
24. SNEEZE GUARDS:
25. Sneeze guards, mirror finish, single tier at hot food wells and two tier at cold pans/frost tops. Lights only at hot/cold sections. All posts to be fully welded to countertop. 3/8" Tempered glass. Glass to be adjustable to accommodate self and full service operation. Heat lamps located at hot food well and heated tops, sized to accommodate equipment. Sneeze guards to meet NSF requirements.
26. Frost top in overshelf where shown on drawings.
27. Sneeze guards to be secured to base of counter and welded to countertop.
28. COUNTER FINISHES:
29. 14-gauge Stainless Steel top at 32" aff.
30. Backer board finish installed by manufacturer to accept tile by G.C. Coordinate finish with GC, provide s/s shelf as required to accommodate finish.

31. Plastic laminate front panels. Color as selected by Architect.
32. Manufacturers are to bid all items per specifications, deviations from the specified manufacturers or fabrication will not be accepted.
33. Counter template to coordinate with servery walls, furr downs, electrical and plumbing locations. KEC to coordinate installation and any site conditions with the Trade/General Contractor as required.

ITEM NO. 201M.2 SERVING COUNTER-MODULAR

QUANTITY 1

Manufacturer:	Mod-U-Serve
Model:	---
Size and Shape:	Refer to drawings
Alternate:	Counter Craft

1. Modular counter, size and shape per drawings.
2. CONSTRUCTION:
3. All electrical to be pre-wired to single point receptacle per module. Coordinate receptacles with slab rough-ins.
4. Pin and sleeve connection for final connection to load center located per drawings.
5. Cashiers station to be integral with counter, lockable cashiers drawer, undershelf to accommodate owners POS System, outlet to accommodate POS system and data line.
6. S/S removable intermediate shelves and undershelves where possible.
7. Provide remote on/off switch for beverage merchandising if location is not accessible.
8. Adjustable kickplates.
9. 6" adjustable s/s legs.
10. Line-up locks as required per factory.
11. Dedicated Convenience outlet to accommodate beverage or milk merchandiser.
12. Convenience outlet located at flat top countertops, provide grommetted hole in counter as required.
13. TRAYSLIDE:
14. Group "E" corian trayslide with 1/4" rounded s/s runners. Trayslide to be supported with finished plywood with white melamine at exposed areas. Trayslide brackets to be fully welded to angle iron frame.
15. LED lights located at tray slide.
16. COUNTER COMPONENTS:
17. Size, shape, and quantities as shown on plans.
18. Stainless steel flat top counter sized per drawings. Dedicated electrical for countertop equipment or convenience outlet.
19. One (1) lot Hatco drop in mechanical cold pan, 3 pan capacity unless counter drawings shows otherwise.
20. One (1) lot Hatco drop in frost top pan, to accommodate two (2) 18" x 26" sheet pan capacity unless counter drawings shows otherwise.
21. Coordinate counter fabrication cut outs with Refrigerated Merchandisers.

22. Stainless steel louvered panels to be provided on operator's side only at compressor locations. Louvers to be provided per manufacturer's minimum requirements.
23. SNEEZE GUARDS:
24. Sneeze guards, mirror finish, single tier at hot food wells and two tier at cold pans/frost tops. All posts to be fully welded to countertop. 3/8" Tempered glass. Glass to be adjustable to accommodate self and full service operation. Heat lamps located at hot food well and heated tops, sized to accommodate equipment. Sneeze guards to meet NSF requirements.
25. Frost top in overshelf where shown on drawings.
26. Sneeze guards to be secured to base of counter and welded to countertop.
27. COUNTER FINISHES:
28. 14-gauge Stainless Steel top at 32" aff.
29. Backer board finish installed by manufacturer to accept tile by G.C. Coordinate finish with GC, provide s/s shelf as required to accommodate finish.
30. Plastic laminate front panels. Color as selected by Architect.
31. Manufacturers are to bid all items per specifications, deviations from the specified manufacturers or fabrication will not be accepted.
32. Counter template to coordinate with servery walls, furr downs, electrical and plumbing locations. KEC to coordinate installation and any site conditions with the Trade/General Contractor as required.

ITEM NO. 204 HEATED MERCHANDISER - 40”

QUANTITY 2

Manufacturer:	Hatco
Model:	HZMH-36D
Size and Shape:	Refer to drawings
Alternate:	---

1. Refer to drawings for size.
2. LED red accent light at support post.
3. Verify color selection with Owner/Architect.
4. Coordinate NEMA configurations/requirements with 201 Counter.

ITEM NO. 207 48 REAR LOAD REF MERCHANDISER MILK CASE

QUANTITY 2

Manufacturer:	RPI Olympus
Model:	SCAS48R-III MC
Size and Shape:	Refer to drawings
Alternate:	Federal LMDM4878SC

1. 48" slide-in air screen merchandiser with rear loading doors. Recess bottom compartment to accommodate milk crates.
2. Custom model, MLED-4.
3. Extra tall hinged rear door, to be hinged per plans in lieu of sliding doors.
4. Roll up security door with insulated plex sides with lock.

5. Fully insulated glass to reduce condensation.
6. One-way mirror backed with hinged rear loading doors.
7. Three (3) tempered glass shelves with lights
8. LED lighting.
9. Locate recessed on/off and light switch in back side of unit, accessible to operator.
10. Five (5) Year compressor part warranty.
11. Drain to floor sink. Floor sink to be located below Air Screen.
12. KEC to verify unit is 5-6’ away from air vents. Coordinate in field.
13. Glass sides, door windows and perimeter of doors to be heated.
14. Cord and plug assembly.
15. Stainless steel trim as required to seal gaps at counters.
16. Provide finished stainless steel front and sides if unit is freestanding in lieu of a counter slide-in.
17. Provide submittal shop drawing for review by Consultant.
18. **Special Instruction:**Start-up and calibration of unit must be by factory authorized service agency, prior to customer demonstration. K.E.C. to coordinate 18” height clearance at top of unit.

ITEM NO. 214 CASH REGISTER

QUANTITY 4

Manufacturer: Owner Furnished
Model: ---
Size and Shape: Refer to drawings
Alternate: ---

ITEM NO. 215 GUIDE RAIL

QUANTITY 5

Manufacturer: Custom Fabricated
Model: ---
Size and Shape: Refer to drawings
Alternate: ---

1. 1-5/8" O.D. stainless steel tubular guide rails with 1-5/8" uprights set in sleeves set in concrete at maximum 4'-0" on center.
2. Top of rails to be 34" A.F.F. for high schools.
3. Section 11 40 00 to coordinate guide rails with ADA requirements.

ITEM NO. 249 THREE COMPARTMENT SINK WITHOUT DISPOSER

QUANTITY 1

Manufacturer: Custom Fabricated
Model: ---
Size and Shape: Refer to drawings
Alternate: ---

1. Top: 14-gauge S/S 3" high 1-1/2" rolled rim at free sides, 10" high splash at walls.
2. Open base construction.

3. Omit rear rail at sink.
4. Three (3) 30" x 26" x 15" deep sink compartment.
5. Two (2) T&S model no. B-0291, splash mount faucet, 18" swing nozzle, LL inlets, for ¾" hot and cold water connections.
6. Three (3) Fisher 22306 twist waste valve 3 1/2" x 2" with overflow and tailpiece. Provide 18 gauge S/S bracket for drain handle welded to sink bottom.
7. 12" deep single post mounted perforated overshelf mounted at 18" above counter top.
8. 18-gaugebutt jointwall panel from splash to underside of shelf.
9. Post mounted utensil rack, extend 1-5/8" diameter S/S post from back splash, turn forward 12" and weld full length x 2" x ¼" S/S bar with Component Hardware model no. V-77-4401 S/S sliding hooks at 8" on center.
10. 16-gauge S/S undershelf as per drawings.
11. Flanged feet at front only of counter.
12. Anchor flanged feet to floor with non-corrosive bolts. Secure wall mounted equipment / components to in wall grounds or anchor plates. Coordinate installation with the general contractor.

ITEM NO. 250.1 CONVEYOR DISHMACHINE W. BUILT-IN BOOSTER

QUANTITY 1

Manufacturer:	Hobart
Model:	CL44-BAS
Size and Shape:	Refer to drawings
Alternate:	Champion

1. 44" Conveyor dishmachine with built-in water tempering kit and built-in booster heater.
2. Full display touchscreen control.
3. Prewired 15 KW Electric tank heat.
4. Booster Heater built-in 18KW.
5. Programmable, automatic dosing, pumped delime system.
6. Built-in Drain Water Tempering kit. Kit to be installed by Hobart Service.
7. Verify direction of dishmachine with drawings.
8. One (1) Year Extended warranty - One (1) Year parts and labor.
9. One (1) Year Extended warranty on booster heater - One (1) Year parts and labor.
10. Interior Chamber height to be 4" taller than standard.
11. CONNECTIONS: *CHOOSE WHICH YOU REQUIRE*
12. Unit comes with single point connection from factory. Div. 26 to use manufacturer provided wiring schematic to separate into a dual point connection, One (1) connection for the motors, controllers and tank heaters and One (1) connection for the boosters. Div. 26 to provide S/S disconnect switches located as per plans interconnected to dishmachine and booster heater.
13. Two (2) vent cowls with 4 x 16 vent and damper. Provide 18 gauge stainless steel seamless duct risers 6" above finish ceiling for final connection. The duct: trimmed at ceiling with 16 gauge stainless steel flange with all corners welded.

14. One (1) table limit switch with stainless steel cover to conceal back. Provided by Manufacturer / Installed by Div. 26.
15. Four (4) 20"x20" Peg racks.
16. Four (4) 20" x 20" sheet pan racks.
17. Two (2) 20" x 20" combination racks.
18. Vent fan controls.
19. Peak Rate of drain flow = 38 gpm. Division 22 to provide and install backflow preventor between booster heater and filter. Final connection by Division 22. Coordinate location of electrical disconnects on free wall.

ITEM NO. 254 SOILED & CLEAN DISHTABLE

QUANTITY 1

Manufacturer:	Custom Fabricated
Model:	---
Size and Shape:	Refer to drawings
Alternate:	---

1. Top: 14 gauge type 304 S/S 3" high 1-1/2" rolled rim at free sides. 10" high splash at walls.
2. 14 gauge S/S recessed deposit shelf. Extend shelf through opening to be flush with wall at deposit side. Turn shelf down 2" at front with ¾" return at bottom (either scribed into partition or forming reveal). Shelf: integral with dishtable. Provide Component Hardware E32-4900 drain - extend drain line to floor sink.
3. **18 gauge butt joint wall panel from splash to underside of shelf.**
4. Install Disposer as shown. Notch and punch splash turn back for vacuum breaker. 12 gauge S/S bracket mounted below counter top and polished to match top for disposer control panel.
5. Provide One (1) T&S model no. B-0133-EE pre-rinse, B-0108-C spray head, two (2) B-0109-04 18" long wall bracket (dealer to cut to correct length), one (1) additional spray face model no. 108SFRK with ceramic cartridges.
6. One (1) Chicago model no. 305-VBRCF hose bibb and rack mounted on 12 gauge S/S bracket ground and polished to match top. Hose and spray rinse by owner.
7. One (1) 18" disposer cone.
8. #18 gauge stainless steel perforated removable basket on 1/2" O.D. stainless steel rod legs 1" high and 3/8" O.D. stainless steel rod handles.
9. Provide ½" slope in top towards dishmachine per the general specifications.
10. S/S corner filler at backsplash; slope to dishtable.
11. S/S cover to conceal table limit switch.
12. 2 1/2" backsplash at dishmachine portion, single thickness of s/s will not be accepted.
13. Anchor flanged feet to floor with non-corrosive bolts. Secure wall mounted equipment / components to in wall grounds or anchor plates. Coordinate installation with the general contractor.

ITEM NO. 255 MOBILE DRYING RACK

QUANTITY 2

Manufacturer:	Metro
Model:	PR48VX3
Size and Shape:	Refer to drawings
Alternate:	---

1. Four (4) tier, includes two (2) drop-ins and (1) cutting board/tray drying rack, built in Microban antimicrobial product protection.
2. Two (2) no. 5MPX casters per unit.
3. Two (2) no. 5MPBX locking casters per unit.

ITEM NO. 260 HAND SINK - WALL MTD

QUANTITY 7

Manufacturer:	Advance Tabco
Model:	7-PS-50
Size and Shape:	Refer to drawings
Alternate:	---

1. 20 gauge stainless steel construction.
2. Basket drain and wall bracket.
3. Gooseneck faucet with wrist handles.
4. Soap and towel dispensers by Owner.
5. P-Trap assembly, delete open/close drain valve.
6. Custom fabricated removable end splashes on sides as required by code. Height same as rear splash.
7. Trade contractor to provide temperature adjustment valves as required.

ITEM NO. 268 REFRIGERATED GRAB & GO MERCHANDISER

QUANTITY 2

Manufacturer:	RPI Vienna
Model:	VIAS3-34-R-SQ-SC-INS
Size and Shape:	Refer to drawings
Alternate:	---

1. Slide-in, self contained refrigerated Grab & Go Merchandiser, sized per plan.
2. Bottom of front opening to be 34” AFF with stainless steel adjustable legs to align with counter height.
3. Stainless steel interior.
4. Stainless steel exterior.
5. Fully insulated glass to reduce condensation.
6. Qty of three (3) tempered glass shelves with lights.
7. Two (2) bi-parting doors on rear.
8. Five (5) year compressor warranty.
9. Drain to floor sink. Floor sink to be located below Air Screen.

10. KEC to verify unit is 5-6’ away from air vents. Coordinate in field.
11. Rear air ventilation kit.
12. Cord and plug assembly.
13. Stainless steel trim as required to seal gaps at counters.
14. Provide submittal shop drawing for review by Consultant.
15. **Special Instruction:**Start-up and calibration of unit must be by factory authorized service agency, prior to customer demonstration. K.E.C. to coordinate 18” height clearance at top of unit.

ITEM NO. 614 FILL FAUCET

QUANTITY 2

Manufacturer:	T & S
Model:	B-0610
Size and Shape:	Refer to drawings
Alternate:	---

1. Pot Filler Faucet, splash-mounted, 8" centers, vacuum breaker, flexible S/S hose, 68" long, hooked nozzle with self-closing valve, ½" IPS female inlets, built-in check valves.
2. 12" square 14 ga. S/S wall plate with hose rack with radius corners.
3. Install at 48" A.F.F. by Division 22. Coordinate height of backflow preventor with highest water level of associated equipment.

ITEM NO. 632 SIX BURNER RANGE - GAS

QUANTITY 1

Manufacturer:	Vulcan
Model:	36S-6B
Size and Shape:	Refer to drawings
Alternate:	---

1. Standard oven with two (2) oven racks.
2. Stainless steel front, sides.
3. 3/4" rear gas connection.
4. 10" high stainless steel backguard.
5. Manual rotary ignitor with flame safety device.
6. Heavy duty casters, two (2) with brakes.
7. Provide quantities and sizes required: Dormont Model #VER-KIT-2S-48” Gas Conn. Kit, 48” long, Moveable Gas Connector Kit, covered with stainless steel braid, coated with blue antimicrobial PVC, SnapFast® Quick Disconnect, Swivel MAX®, full port valve, coiled restraining cable with hardware, limited lifetime warranty.
8. Provide Eagle model CC-S, Stainless Steel Caster Cradle Stabilizing Device for all mobile production equipment under the exhaust hoods. Coordinate locations with the Owner prior to installation. Quantity One (1) equals One (1) lot. Alternate: Regency Stainless Steel Caster Placement System, model #600Safetyset.

ITEM NO. 800 BUILT-IN REFRIGERATED MERCHANDISER

QUANTITY 1

Manufacturer:	STRUCTURAL CONCEPTS
Model:	OASIS C43R-UC
Size and Shape:	Refer to drawings
Alternate:	

1. Front discharge.
2. Coordinate with serving counters.
3. 6’ cord and plug.
4. Condensate pan.

END OF KITCHEN

SECTION 11 43 55

ICE MACHINES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Self-contained ice machine with built-in storage bin

B. Related Work Described Elsewhere: Utility hook-up to equipment is described in Plumbing and Electrical Sections of these Specifications; cooperate as necessary with all other trades to ensure proper and adequate provision for the required utility sizing and locations.

1.02 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is an authorized representative of the ice machine manufacturer for both installation and maintenance of appliances required for this Project.

B. Product Options: Drawings indicate sizes, profiles, and dimensional requirements of residential appliances and are based on the specific types and models indicated. Other manufacturers' appliances with equal performance characteristics may be considered. Refer to Division 1 Section "Substitutions."

C. Electrical Appliances: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

D. UL and NEMA Compliance: Provide electrical components required as part of residential appliances that are listed and labeled by UL and that comply with applicable NEMA standards.

E. AGA and ANSI Standards: Provide gas-burning appliances that carry the design certification seal of AGA and that comply with ANSI Z21-Series standards.

F. AHAM Standards: Provide appliances that comply with the following AHAM standards:
   1. Refrigerators and Freezers: Total volume and shelf area ratings certified according to ANSI/AHAM HRF-1.

G. Energy Ratings: Provide residential appliances that carry labels indicating energy-cost analysis (estimated annual operating costs) and efficiency information as required by the Federal Trade Commission.

1.03 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: For each ice machine, indicating product specifications and options

C. Operation and Maintenance Instructions: For each ice machine.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Deliver appliances only after utility rough-in is complete and construction in the spaces to receive appliances is substantially complete and ready for installation.

C. Protect ice machines before, during, and after installation, including the installed work and materials of all other trades.

D. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

1.05 WARRANTY

A. Section 01 70 00 - Execution and Closeout requirements: Product warranties and product bonds.

B. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

PART 2 PRODUCTS

2.01 ICE MACHINES

A. Manufacturers:
   1. Hoshizaki Ice Machines; www.hoshizakiamerica.com.
   2. Substitutions: Not allowed.

2.02 SELF-CONTAINED UNIT

A. Type: Model F-330BAJ air-cooled self-contained Flaker unit manufactured by Hoshizaki America, Inc.
   1. Production: 322 lbs/day @ 45-1000 F ambient air temperature and 900 F and 450 F water-in temperature.
   2. Storage: Up to 80 lbs capacity.
   3. Cabinet Finish: Stainless steel.
   4. Ice Shape: Flake style.
   5. Dimensions: Nominal 24” W x 26” D x 39” H with 6” legs.
   6. Electrical Characteristics: 115V, single phase, 6.9 Amps.
   7. Stainless steel evaporator.
   8. Provide and install with in-line Arctic Pure water filter with changeable cartridge.
   9. Removable air filter.
   10. Manufacturer’s Warranty
      a. 3-years parts and labor on entire machine.
      b. 5-years parts and labor on evaporator.
      c. 5 years parts on compressor and air-cooled condenser coil.

PART 3 EXECUTION

3.01 PREPARATION

A. Review manufacturer’s installation instructions and notify Architect in the event of discrepancies; do not proceed with installation until all such discrepancies have been resolved.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions and with requirements of authorities having jurisdiction.

B. Anchor equipment securely in place in accordance with manufacturer’s instructions.

C. Sequence installation to accommodate required utility connections.

3.03 ADJUSTING

A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.

B. Test each appliance to verify proper operation. Make necessary adjustments.

C. Verify that accessories required have been furnished and installed.

3.04 CLEANING

A. Section 01 71 00 - Execution and Closeout Requirements: Final cleaning.

B. Remove packing material from ice machines and leave units in clean condition, ready for operation.

END OF SECTION

SECTION 11 52 13

MANUAL PROJECTION SCREENS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Front-projection screens.
   1. Ceiling-mounted pull-down projection screens where indicated.

B. Related Sections:
   1. Section 09 51 13 - Lay-In Acoustical Ceilings: Additional ceiling-support wiring at screen locations.

1.02 DEFINITIONS

A. Gain: Ratio of light reflected from or refracted by screen material to that reflected perpendicularly from a magnesium carbonate surface as determined per FS GG-S-00172D(1).

B. Half-Gain Angle: The angle, measured from the axis of the screen surface, to the most central position on perpendicular plane through the horizontal centerline of the screen where the gain is half of the peak gain.

1.03 SUBMITTALS

A. Product Data: For each type of screen specified.

B. Shop Drawings: Show layout and types of projection screens. Include the following:
   1. Connections to suspension systems for pendant- and recess-mounted screens.
   2. Anchorage details.
   3. Details of juncture of exposed surfaces with adjacent finishes.
   4. Accessories.

1.04 QUALITY ASSURANCE

A. Source Limitations: Obtain projection screens through one source from a single manufacturer. Obtain each screen as a complete unit, including necessary mounting hardware and accessories.

B. Coordination of Work: Coordinate layout and installation of projection screens with other construction supported by, or penetrating through, ceilings, including light fixtures, HVAC equipment, fire-suppression system, and partitions.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver projection screens until building is enclosed, other construction within spaces where screens will be installed is substantially complete, and installation of screens is ready to begin.

PART 2 PRODUCTS

2.01 FRONT-PROJECTION SCREENS

A. Material and Viewing Surface of Front-Projection Screens: Provide screens manufactured from mildew- and flame-resistant fabric of type indicated for each type of screen specified and complying with the following requirements:
   1. Matte-white viewing surface with gain characteristics complying with FS GG-S-00172D(1) for Type A screen surface.
   2. Material: Vinyl-coated glass-fiber fabric.
   3. Mildew Resistance: Provide mildew-resistant screen fabrics as determined by FS 191A/5760.
   4. Fire-Test-Response Characteristics: Provide projection-screen fabrics identical to materials that have been tested for flame resistance according to both small- and large-scale tests of NFPA 701.
   5. Seamless Construction: Provide screens in sizes indicated without seams.
   6. Provide extra drop length of dimension indicated to comply with the following requirements for fabric color and location of drop length:
      a. Color: Same as viewing surface.
      b. Location: At top of screen.
   7. Size of Viewing Surface: As indicated.

B. Manually Operated Screens: Provide manufacturer's standard spring-roller-operated units designed and fabricated for wall or ceiling installation and consisting of case, screen, mounting accessories, and other components necessary for a complete installation.
   1. Screen Case: Fabricated in 1 piece from steel sheet not less than 0.0299 inch (0.76 mm), with flat back design and vinyl covering or baked-enamel finish. Provide end caps with integral roller brackets and universal mounting brackets, finished to match end caps, for wall or ceiling mounting.
   2. Screen Mounting: Top edge securely anchored to a 3-inch diameter, rigid steel spring roller; bottom edge formed into a pocket holding a tubular metal slat, with ends of slat protected by plastic caps, and saddle and pull attached to slat by screws.

C. Size(s): 70” x 70” unless indicated otherwise in the drawings.

D. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   1. Manually Operated Front-Projection Screens:
      1) Model C; Da-Lite Screen Co., Inc.; www.da-lite.com
      2) Luma 2; Draper Shade & Screen Co., Inc; www.draperinc.com
      3) Communicator; Stewart Filmscreen Corp.; www.stewartfilm.com

PART 3 EXECUTION

3.01 INSTALLATION

A. General: Install projection screens at locations indicated to comply with screen manufacturer's written instructions.

B. Install front-projection screens with screen cases in position and relationship to adjoining construction indicated. Securely anchor to supporting substrate in a manner that produces a smoothly operating screen with vertical edges plumb and viewing surface flat when screen is lowered.
   1. Manually operated units:
      a. At installations with suspended acoustical panel ceilings at 9'-0"- a.f.f. or less, suspend units from ceiling suspension system with manufacturer's standard scissor clips. Do not exceed carrying capacity of clips or ceiling suspension system.
      b. At installations with suspended acoustical panel ceilings at greater than 9'-0" a.f.f., or with other ceiling types, suspend units from wall with manufacturer's wall brackets with standard or extended arm as required to clear adjacent wall-mounted fixtures or equipment.

3.02 PROTECTING AND CLEANING

A. Protect projection screens after installation from damage during construction. If damage occurs despite such protection, remove and replace damaged components or entire unit as required to provide units in their original, undamaged condition.

END OF SECTION

SECTION 11 52 15

ELECTRIC PROJECTION SCREENS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Front-projection screens.
   1. Wall-mounted electric operation with factory-finished exposed case.

B. Related Sections:
   1. Section 06 10 53 - Miscellaneous Rough Carpentry: Wood backing for recessed screen installation.
   2. Division 26 Sections for electrical wiring, connections, and installation of remote-control switches for electrically operated projection screens.

1.02 DEFINITIONS

A. Gain: Ratio of light reflected from or refracted by screen material to that reflected perpendicularly from a magnesium carbonate surface as determined per FS GG-S-00172D(1).

B. Half-Gain Angle: The angle, measured from the axis of the screen surface, to the most central position on perpendicular plane through the horizontal centerline of the screen where the gain is half of the peak gain.

1.03 SUBMITTALS

A. Product Data: For each type of screen specified.

B. Shop Drawings: Show layout and types of projection screens. Include the following:
   1. Location of screen centerline relative to ends of screen case.
   2. Location of wiring connections.
   3. Location of seams in viewing surfaces.
   4. Anchorage details.
   5. Details of juncture of exposed surfaces with adjacent finishes.
   6. Accessories.
   7. Wiring Diagrams: For electrically operated units.

1.04 QUALITY ASSURANCE

A. Source Limitations: Obtain projection screens through one source from a single manufacturer. Obtain each screen as a complete unit, including necessary mounting hardware and accessories.

B. Coordination of Work: Coordinate layout and installation of projection screens with other construction supported by, or penetrating through walls, including light fixtures, scoreboards, HVAC equipment, fire-suppression system, and partitions.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver projection screens until building is enclosed, other construction within spaces where screens will be installed is substantially complete, and installation of screens is ready to begin.

PART 2 - PRODUCTS

2.01 FRONT-PROJECTION SCREENS

A. Material and Viewing Surface of Front-Projection Screens: Provide screens manufactured from mildew- and flame-resistant fabric of type indicated for each type of screen specified and complying with the following requirements:
   1. Matte-white viewing surface with gain characteristics complying with FS GG-S-00172D (1) for Type A screen surface.
   2. Material: Vinyl-coated glass-fiber fabric.
   3. Mildew Resistance: Provide mildew-resistant screen fabrics as determined by FS 191A/5760.
   4. Fire-Test-Response Characteristics: Provide projection-screen fabrics identical to materials that have been tested for flame resistance according to both small- and large-scale tests of NFPA 701.
   5. Seamless Construction: Provide screens in sizes indicated without seams.
   6. Edge Treatment: Black masking borders.
   7. Provide extra drop length of dimension indicated to comply with the following requirements for fabric color and location of drop length:
      a. Color: Same as viewing surface.
      b. Location: At top of screen.
   8. Size of Viewing Surface: As indicated.

B. Electrically Operated Screens, General: Provide manufacturer's standard UL-labeled units consisting of case, screen, motor, controls, mounting accessories, and other components necessary for a complete installation. Remotely control operation of each screen to comply with the following:
   1. Single-Station Control: 3-position control switch with metal device box and cover plate for flush wall mounting and for connection to 120-V, ac power supply.
      a. Provide key-operated switch.
         1) Manufacturer’s keyed controls shall be prepared to receive interchangeable core as scheduled in the hardware section. Core shall be coordinated with Owner’s master keying and hardware standards.
   2. End-Mounted Motor: Instant-reversing, gear-drive motor of size and capacity recommended by screen manufacturer with permanently lubricated ball bearings, automatic thermal-overload protection, preset limit switches to automatically stop screen in up and down positions, and positive-stop action to prevent coasting. Locate motor in its own compartment as follows:
      a. On right end of screen, unless otherwise indicated.
      b. Provide with twist-lock electrical plug for secure connection.
   3. Screen Mounting: Top edge securely anchored to rigid metal roller and bottom edge formed into a pocket holding a 3/8-inch diameter, metal rod with ends of rod protected by plastic caps.
      a. Roller for end-mounted motor supported by self-aligning bearings in brackets.

4. Cabinet Enclosure: Constructed plywood or MDF board construction, factory painted in color as selected by the Architect.
    a. Cabinet shall have sloping top at minimum 30-degree angle to protect against collection of debris or game balls.
    b. Cabinet construction shall be sufficient to withstand impact of thrown basketballs.

C. Size(s): As indicated on the drawings.

D. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
1. Matte-White Viewing Surfaces:
    a. Matte White; Bretford Manufacturing, Inc. www.bretford.com
    b. Matte White; Da-Lite Screen Co., Inc. www.da-lite.com
    c. Fiberglass Matte White; Draper Shade & Screen Co., Inc. www.draperinc.com
2. Electrically Operated Matt White Screens with Protective Cabinet and End-Mounted Motor:
    a. Executive Electrol; Da-Lite ScreenCo., Inc., www.da-lite.com.
    b. Ambassador; Draper Shade & Screen Co., Inc., www.draperinc.com

PART 3 - EXECUTION

3.01 INSTALLATION

A. General: Install projection screens at locations indicated to comply with screen manufacturer's written instructions.

B. Install front-projection screens with screen cases in position and relationship to adjoining construction indicated. Securely anchor to supporting substrate in a manner that produces a smoothly operating screen with vertical edges plumb and viewing surface flat when screen is lowered.
1. Anchorage:
    a. Ensure that wall construction is sufficient to accept full weight of screen system, including case and motor.
    b. For screens mounted on drywall, ensure that solid wood blocking is installed between studs for screw-fastening.
    c. For screens mounted on hollow CMU walls, utilize toggle bolts rather than expansion anchors or masonry screws for secure anchoring.
2. Coordinate with the Contractor for final electrical connections and installation of keyed cylinder into switch body.

3.02 TESTING

A. Test electrically operated units to verify that screen, controls, limit switches, closure, and other operating components are in optimum functioning condition.

3.03 PROTECTING AND CLEANING

A. Protect projection screens after installation from damage during construction.
1. Provide matching paint touch-up to factory-finished cabinet where damaged due to shipping or construction operations.

2. Remove and replace damaged components or entire unit as required to provide units in their original, undamaged condition.

END OF SECTION

SECTION 11 61 43

STAGE CURTAINS AND TRACKS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes the following types of stage curtains:
   1. Front-setting curtains including house curtain and valance.
   2. Rear curtain.
   3. Black Box curtains.

B. Related Sections:
   1. Section 05 50 00 - Metal Fabrications: Supplementary members supporting stage curtain systems to structure.

1.02 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2022.

C. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2023, with Errata.

1.03 SUBMITTALS

A. Product Data: Include types, styles, materials, operating instructions, and maintenance recommendations.
   1. Setting Drawings, and templates for built-in or embedded anchor devices.

B. Shop Drawings: Include plans, elevations, and detail sections of typical track and rigging elements. Show anchors, hardware, operating equipment, and other components not included in manufacturer's Product Data. Include the following:
   1. Locations for blocking to be provided by others.
   2. Extent of required operating clearances.
   3. Calculations: Calculate requirements for supporting curtains, track, and equipment and verify capacity of each curtain, track, and rigging component to support loads.

C. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors, textures, and patterns available, together with 12-inch- square sample (any color) of each type fabric.

D. Samples for Verification: Not less than 36 inches (914.4 mm) square of each fabric from dye lot to be used for the Work, with specified treatments applied, and showing complete pattern repeat, if any. Mark top and face of fabric.

E. Product Certificates: Signed by manufacturers of stage curtains certifying that products furnished comply with requirements. Give name of flame-retardant chemical used, identification of applicator, treatment method, application date, allowable life span for treatment, and details of any restrictions and limitations.

F. 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.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed installation of stage curtains 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. Fire-Test-Response Characteristics: Provide stage curtains with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or a testing and inspecting agency acceptable to authorities having jurisdiction. Permanently attach label to each fabric of curtain assembly indicating that fabric is inherently and permanently flame resistant.
   1. Flame-Resistance Ratings: Passes NFPA 701.

C. PRE-INSTALLATION MEETING

D. Section 01 31 19 – Project Meetings: Schedule and coordinate pre-installation meeting that includes the trade(s) for the work of this Section and other trades that whose work is related to the work of this Section.
   1. Convene minimum one week prior to commencing work of this Section.

1.05 PROJECT CONDITIONS

A. Field Measurements: Verify stage curtain openings and dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
   1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening and construction dimensions and proceed with fabricating stage curtains without field measurements. Coordinate construction to ensure that actual opening and construction dimensions correspond to established dimensions.

PART 2 PRODUCTS

2.01 CURTAIN FABRICS

A. General: Provide fabrics inherently and permanently flame resistant (IFR). Provide fabrics from the same dye lot.

B. Colors, Textures, and Patterns: Match Architect's samples.

C. Products: Subject to compliance with requirements, provide the following:
   1. Woven Polyester Velour:
      a. Prestige (IFR); KM Fabrics, Inc.; kmfabrics.com

b. Plateau (IFR); KM Fabrics, Inc.; kmfabrics.com

2.02 FRONT-SETTING CURTAIN FABRIC

A. Woven Polyester Velour: Napped fabric of 100 percent polyester; 54-inch minimum width; and other characteristics as follows:
   1. K-M Prestige (IFR): Fabric weighing 26 oz./linear yard nominal, with pile height not less than 101 mils (2.56541 mm), with not less than 48 picks per inch; inherently and permanently flame resistant.

2.03 REAR SETTING CURTAIN FABRIC

A. Woven Polyester Velour: Napped fabric of 100 percent polyester; 54-inch minimum width; and other characteristics as follows:
   1. K-M Plateau(IFR): Fabric weighing 13 oz./linear yard nominal, with pile height not less than 110 mils (2.79401 mm), with not less than 105 picks per inch; inherently and permanently flame resistant

2.04 METAL PRODUCTS

A. Steel Pipe: ASTM A 53, Grade A, standard weight (Schedule 40), black, 1-1/2-inch nominal diameter, unless otherwise indicated.

B. Galvanized Steel Sheet: Commercial-quality, zinc-coated, carbon-steel sheet; complying with ASTM A653/A653M, G60 (Z180) coating designation.

C. Supports, Clamps, and Anchors: Sheet steel in manufacturer's standard thicknesses, galvanized after fabrication according to ASTM A153/A153M, Class B.

D. Trim and Support Cable: 1/4-inch- diameter, 7x19 galvanized steel aircraft cable with a breaking strength of 7000 lb. Provide fittings complying with cable manufacturer's written recommendations for size, number, and method of installation, including a drop-forged galvanized turnbuckle to allow for leveling.

E. Inserts, Bolts, Rivets, and Fasteners: Manufacturer's standard corrosion-resistant units.

2.05 CURTAIN FABRICATION

A. General: Affix permanent label, stating compliance with requirements of authorities having jurisdiction, in accessible location on curtain not visible to audience. Provide vertical seams, unless otherwise indicated. Arrange vertical seams so they do not fall on faces of pleats. Do not use fabric cuts less than half width.
   1. Vertical Hems: Provide vertical hems not less than 2 inches (50.8 mm) wide, with not less than a 1-inch tuck, and machine-sewn with no selvage material visible from front of curtain. Sew open ends of hems closed.
   2. Leading Edge Turnbacks: Provide turnbacks formed by folding not less than 12 inches (304.8 mm) of face fabric back, with not less than a 1-inch tuck, and secured by sewing turnback vertically.
   3. Top Hems: Reinforce top hems by double-stitching 3-1/2-inch-wide, heavy-duty synthetic polyester webbing to top edge with not less than 2 inches (50.8 mm) of face fabric turned under.

4. Pleats: Provide 75% added fullness in curtains, exclusive of turnbacks and hems, by sewing additional material into 6-inch double-stitched box pleats spaced at 6 inches (304.8 mm) o.c. along top hem reinforcement.
5. Grommets: Brass, centered on box pleats and 1 inch (25.4 mm) from corner of curtain, for snaps or S-hooks.
    a. Provide not less than No. 2 grommets except, for velour curtains, provide not less than No. 3 grommets.
6. Bottom Hems: For curtains that do not hang to the floor, provide hems not less than 3 inches (76.2 mm) deep with 3/4-inch weight tape. For floor-length curtains, provide hems not less than 6 inches (152.4 mm) deep with 1-inch weight tape. Sew open ends of hems closed.
7. Velour Curtains: Fabricate with the fabric nap down.

B. Curtain Battens: Fabricate battens from steel pipe with a minimum number of joints. As necessary for required lengths, connect pipe with a drive-fit pipe sleeve not less than 18 inches (457.2 mm) long and secure with four flush rivets, plug welds, threaded couplings, or another equally secure method. Shop-paint completed pipe battens with black paint with 1-inch-wide yellow stripe at the center of each batten.

C. Snap Hooks: Track manufacturer's heavy-duty hooks.

D. Tie Lines: Braided, flame-resistant synthetic tie lines (e.g., polyester or nylon)., black or white to best match curtain; not less than 5/8-inch-wide by 36 inches (914.4 mm) long.

2.06 STRAIGHT CURTAIN TRACK FABRICATION

A. Steel-Track Channels: Fabricate of roll-formed galvanized steel sheet, with continuous bottom slot, and with each half of track in one continuous piece.
1. Minimum Base-Metal Thickness: Not less than 0.0677 inch (1.72 mm).

B. Heavy-Duty Track System: Equip track with heavy-duty, live-end, double-wheel pulley; heavy-duty, dead-end, single-wheel pulley; and adjustable, heavy-duty floor block; each with not less than 5-inch molded-nylon- or glass-filled-nylon-tired ball-bearing wheels, enclosed in steel housings. Provide single curtain carriers of molded nylon with a pair of neoprene-tired ball-bearing wheels riveted parallel to body. Provide one master carrier, for each leading curtain edge, of plated steel with two pairs of nylon-tired ball-bearing wheels and with two-line guides per carrier. Equip carriers with neoprene or rubber bumper to reduce noise, and heavy-duty, plated-steel swivel eye and manufacturer's standard trim chain for attaching curtain snap or S-hook. Provide end stops for track. Design adjustable floor block to maintain proper tension on operating line.
1. Operating Line: Manufacturer's standard 3/8-inch stretch-resistant operating cord consisting of braided synthetic-fiber jacket over solid, synthetic-fiber, linear, center filaments.
2. Track Lap Clamp: Metal to match track channel for attaching double-sectioned track at center overlap.
3. Curtain Carriers: For track spaced at 12 inches (304.8 mm) o.c.
4. Fold Guide: Equip carriers with rear-fold or backpack guide and rubber spacers to permit offstage curtain folding, sized for use with operating line, if any.

C. Products: Subject to compliance with requirements, provide one of the following:
1. Silent Steel Model No. 281 with No. 2863, No. 2864, and No. 2866 pulleys; Automatic Devices Company; www.adctracks.com

2. Atlas Silk Model No. 418S; H & H Specialties, Inc.; www.hhspecialties.com
3. Tru-Roll Model No. 1000; Tru-Roll, Inc.; www.truroll.com
4. Substitutions: Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for supporting members, blocking, installation tolerances, clearances, and other conditions affecting performance of stage curtain work. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Examine inserts, clips, blocking, or other supports required to be installed by others to support tracks and battens. Proceed with installation only after unsatisfactory conditions have been corrected.

3.03 INSTALLATION, GENERAL

A. Install stage curtain system according to track manufacturer's and curtain fabricator's written instructions.

3.04 BATTEN INSTALLATION

A. Install battens by suspending at heights indicated with steel cables spaced to support load, but do not exceed 10 feet (304.8 cm) o.c. between cables.

B. Secure cables either directly to structures or to inserts, eye screws, or other devices that are secure and appropriate to substrate and that will not deteriorate or fail with age or elevated temperatures. Attach other cable end to pipe clamps with turnbuckles, moused or fixed with nuts after adjustment, to prevent loosening.

3.05 TRACK INSTALLATION

A. Batten-Hung Tracks: Install track by suspending from pipe batten with manufacturer's track clamp hangers attached to batten pipe clamps at spacing, according to manufacturer's written instructions.
   1. Heavy-Duty Track: Do not exceed 72 inches (1828.8 mm) between supports.

B. Install track for center-parting curtains with not less than 24-inch overlap of track sections at center, supported by special lap clamps.

3.06 CURTAIN INSTALLATION

A. Track Hung: Secure curtains to track carriers with track manufacturer's special heavy-duty S-hooks or snap hooks.

B. Batten Hung: Secure curtains to pipe battens with tie lines.

3.07 DEMONSTRATION

A. Engage a factory-authorized service representative to test system and to train Owner's personnel to rig, adjust, operate, and maintain stage curtains, tracks, and draw-curtain machines.
   1. Schedule training with Owner, through Architect, with at least seven days' advance notice.

END OF SECTION

SECTION 11 66 00

ATHLETIC EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: The following types of athletic equipment as shown on the Drawings:
   1. Protective wall padding.
   2. Volleyball Equipment.
   3. Basketball/Volleyball scoreboards.

B. Related Sections:
   1. Division 26 sections - for power, conduit, boxes, conductors, and connections for scoreboards.

1.02 QUALITY ASSURANCE

A. For installation use only personnel who are skilled in the work required.

1.03 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product data on physical characteristics and durability characteristics for each type of gymnasium equipment and accessory specified.

C. Installation Methods: Submit two copies of manufacturer's recommended installation method showing all requirements for blocking and bracing.

D. Shop drawings showing location and extent of athletic equipment and accessories. Include plans, elevations, large-scale details of anchorages, and accessory items.
   1. Indicate unit conditions at openings, typical and special details, and location and installation requirements for hardware and operators.
   2. Provide dimensioned locations of volleyball floor inserts to General Contractor for locating thickened slab areas.

E. Template drawings prepared by manufacturer showing location of items supported or anchored by permanent construction.

1.04 PRODUCT HANDLING

A. Protection: Protect equipment before, during and after installation. Protect installed work of other trades.

B. Replacements: In event of damage, make necessary replacements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Athletic Equipment:
1. Bison IPI; www.bisoninc.com
2. Porter Athletic; www.porterathletic.com
3. Aalco Manufacturing Co.; www.aalcomfg.com
4. ADP Lemco, Inc.; www.adplemco.com
5. Arizona Courtlines; www.arizonacourtlines.com
6. Douglas Industries, Inc.; www.douglas-sports.com
7. Performance Sport Systems; www.perfsports.com
8. Sports Imports; www.sportsimports.com
9. Substitutions: Section 01 60 00 - Product Requirements.

B. Scoreboards:
1. Daktronics; www.daktronics.com
2. Nevco; www.nevco.com
3. Spectrum Scoreboards; www.spectrumscoreboards.com
4. Substitutions: Section 01 60 00 - Product Requirements.

2.02 MATERIALS:

A. Protective Wall Padding:
1. Basis-of-Design: Porter Equipment Co. wall wainscot padding No. 90350-326
2. Provide protective wainscot wall padding, 2' x 6' x 1-1/2" thick 6 lbs density urethane foam filled panels, covered with nylon reinforced vinyl fabric, fire retardant, color to be selected by Architect. Backing to be 7/16" thick plywood or OSB. Ends to be finished, no lip. Work to include special shaped column covers and cut outs for other trades.
3. Provide all related accessories required for installation. Mechanically anchor Wall Padding to walls concealing anchors. No lip shall be exposed beyond the edge of the padding. Use separate top pad, velcro attached to anchor strip to conceal anchors. Locate bottom of pads 8" above finish floor.
4. Fasteners: At hollow masonry walls use toggle bolt fasteners to anchor manufacturer’s hanger track.

B. Volleyball Equipment:
1. Inserts: 3 inch I.D. steel sleeve with screw-down flange pre-drilled to receive cast brass, flush mounted floor plate with hinged access door.
a. Model: Bison VB22.
2. Designed for mounting in cored concrete sub-slab with wood flooring.
a. Volleyball System: Steel pin-lock uprights, net, ratchet, pads, and antenna.
b. Basis-of-Design: Bison Centerline VB2000T System.
c. Uprights: Steel pin-lock uprights to fit inserts.
d. Safety Pads: Provide Bison VB21P safety pads for each upright.
e. Net Ratchet: Provide Bison VB1250K winch with removable crank.
f. Net: 1 meter wide Technora net (Bison VB1200T) with non-kinking top cable, sideline markers, and wooden dowels.

g. Antenna: Adjustable antenna with molded cable clamps (Bison VB1300).

3. International Official Stand: Adjustable-height steel official stand with platform and safety pads.
   a. Model: Bison VB76.
4. Wall Racks: Wall-mounted storage rack for 1 pair uprights.
   a. Model: Bison VB26.

C. Basketball/Volleyball Scoreboard:
1. Basketball/Volleyball Scoreboard:
   a. Basis-of-Design: Daktronics model BB-2101.
2. Size: 8'-0" wide x 4'-0" high x 6" deep.
3. Cabinet Color: To be selected by Architect from manufacturer's standard colors.
4. Features:
   a. 13-inch high-intensity LED digits for clock and scores.
   b. 10-inch high-intensity LED digit for period.
   c. Displays period time up to 99:59; shows 1/10th of a second during the final minute.
   d. Team scores display from 0-199.
   e. Digital period display from 0-9.
   f. Possession and Bonus/Double Bonus indicators.
   g. Built-in horn, synchronized with clock.
5. Construction and Certifications:
   a. All-aluminum cabinet construction designed to withstand impacts from sports balls without requiring a protective screen.
   b. Certifications: ETL Listed, tested to CSA standards.
6. Controller:
   a. Daktronics All Sport® 5000 series console, capable of multi-sport operation (basketball, volleyball, wrestling) with sport-specific keyboard inserts.
   b. Provide with wireless control functionality and durable carrying case.
   c. Power Requirements: 120V, 1.3 Amps, 60Hz. (Note: Power draw increases with options).
7. Customization:
   a. Provide with custom vinyl team name caption reading "CROSBY" in place of the standard "HOME" caption.
   b. Provide two Electronic Team Name Message Centers (TNMCs) in place of standard HOME and GUEST captions to allow for programmable team names.

PART 3 EXECUTION

3.01 INSPECTION

A. Inspection: Inspect installed work of other trades and verify that such work is complete to a point where this work may commence. Verify that installation may be made in accordance with approved shop drawings and manufacturer's instructions.
1. Discrepancies: In event of discrepancy, notify Architect. Do not proceed with installation until discrepancies have been resolved.

3.02 INSTALLATION

A. Install where indicated, anchoring all components firmly in place in complete accordance with approved shop drawings and the manufacturer's recommendations.

3.03 SCOREBOARDS

A. Inspection: Inspect installed work of other trades and verify that such work is complete to a point where the work of this Section may commence. Verify that installation may be made in accordance with approved shop drawings and manufacturer's instructions.
   1. Discrepancies: In event of discrepancy, notify Architect. Do not proceed with installation until discrepancies have been resolved.

B. After delivery but prior to installation, system manufacturer’s technician shall field-test all equipment for proper operation. Correct any deficiencies prior to installation.
   1. Install all equipment in accordance with manufacturer's instructions and reviewed submittal drawings and specifications.

C. Install where indicated, anchoring all components firmly in place in complete accordance with approved shop drawings and the manufacturer's recommendations.

D. Provide and install all control cabling, and make all required power connections.

E. Conduits, power, and transformer provided and installed under Division 26 Sections.

3.04 CONSULTATION, TRANING AND SERVICES

A. Starting, Adjusting, And Demonstrating: Provide demonstration and training session for Owner's representative(s) covering operation and maintenance of all equipment provides under this Section.

B. Manufacturer shall coordinate corrective action required by Substantial Completion checklist.

C. During installation and testing manufacturer’s technician shall provide coordination, testing, maintenance, and training. Technician shall be onsite during first two events where equipment is utilized.

D. Provide two sets of operating manuals, and two sets of mechanical drawings and electrical diagrams to the Owner.

E. Manufacturer shall provide toll-free telephone technical support during the warranty period.

END OF SECTION

SECTION 11 66 24

BASKETBALL BACKSTOPS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Indoor basketball backstops, backboards, goals and nets.

B. Related Sections:
   1. Section 05 50 00 - Metal Fabrications: Supplementary framing.
   2. Section 11 66 00 - Athletic Equipment: Exterior basketball goals.

1.02 REFERENCES

A. National Electrical Manufacturers Association:
   1. NEMA MG 1 - Motors and Generators.

B. National Federation of State High School Associations:
   1. NFHS - Basketball Rules Book.

C. Underwriters Laboratories Inc.:
   1. UL - Electrical Construction Equipment Directory.

1.03 SYSTEM DESCRIPTION

A. Indoor Backstops: Forward-folding, ceiling-mounted backstops with rectangular glass backboards at main court and cross courts.

1.04 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings:
   1. Indicate size and location of backstops, mounting details, accessory anchoring members. Include wiring diagrams for electric operators and controls.

C. Product Data:
   1. Submit data indicating materials of construction, thicknesses, colors available.

1.05 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

B. Operation and Maintenance Data: Include the following.
   1. Parts catalog with complete list of replacement parts.
   2. Schematic wiring diagrams of installed electrical equipment.

1.06 QUALITY ASSURANCE

A. Products Requiring Electrical Connection: Listed and classified by UL or another testing firm acceptable to authority having jurisdiction.

1.07 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience.

B. Installer: Company specializing in performing work of this section with minimum three years' experience and approved by manufacturer.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Accept backstops on site in manufacturer's original packaging. Inspect for damage.

C. Store backstops indoors, protected from weather and contamination until installed.

1.09 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.10 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.

B. Furnish manufacturer's standard 25-year warranty for structural components and 1-year for electrical components.

PART 2 PRODUCTS

2.01 BACKSTOPS

A. MANUFACTURERS:
1. Bison IPI; www.bisoninc.com
2. Porter Athletic; www.porterathletic.com
3. Aalco Manufacturing; www.aalcomfg.com
4. ADP Lemco, Inc.; www.adplemco.com
5. Draper, Inc.; www.draperinc.com
6. Institutional Products, Inc.; www.instprod.com
7. Substitutions: Section 01 60 00 - Product Requirements.

2.02 INDOOR BACKSTOPS

A. Center strut design, retractable, front folding, suspended from overhead building structural frame to support. Bison *Model No. BA48SF* or equal. Height adjustable. Electrical/Key and Manual operation, refer to Drawings.
   1. Tubular steel center post mast, approx. 6-5/8-in dia., welded and bolted construction, designed to minimize sway and vibration during play; painted finish.
   2. Furnish manufacturer's standard hardware for backstop mounting.
   3. Furnish supplemental steel framing to span between building structural frame and support backstop at position indicated on Drawings.
   4. Steel framing factory painted in color as selected by the Architect.
   5. All switches for goal controls shall have a Sargent interchangeable core lock that is keyed to the gym entry key.

B. Backboards: Square Glass Backboard:
   1. Basis-of-Design: Bison *Model No. BA42XL*.
   2. Type: Rectangular, 72 inches wide by 42 inches high.
   3. Material: 1/2-inch thick, fully tempered glass.
   4. Frame: Heavy-duty extruded aluminum frame with a mill or clear anodized finish.
   5. Markings: Official rectangular white target and border, permanently fired-in to the glass.
   6. Goal Mounting: Factory drilled for standard 5-inch x 4-1/2-inch hole pattern to accommodate specified breakaway goal.

C. Backboard Padding:
   1. Basis-of-Design: Bison *Model No. BA68U* Bolt-On Backboard Padding.
   2. Material: High-density, molded polyurethane foam with an internal steel spine.
   3. Mounting: Bolt-on design securely attached to the bottom and lower sides of the backboard frame.
   4. Standards: Meet all NFHS requirements.
   5. Color: As selected by Architect from manufacturer's standard range.

D. Goals: Steel, removable type; fabricated from 5/8-inch rod; 18 Inches inside clear diameter; with no-tie style net hooks; painted finish.
   1. Breakaway Goal: Single rim, rigid play up to 230 lbs, flexible for forces greater than 230 lbs.
   2. Basis-of-Design: Bison *Model No. BA35E Ultimate Breakaway Goal*.

E. Net: Woven, size and style to fit goal; 15 to 18 inches (457.2 mm) long.
   1. Chord Net: Nylon. Basis-of-Design: Bison *Model BA39N.*

2.03 WINCHES

A. Electric Winch: Geared drive and cables designed to hold backstop at any position.
   1. Basis-of-Design: Bison *Model No. BA980 "Posilok" Electric Hoist.*
   2. Motor and belt drive operated sized to suit application with adjustable upper and lower limit switches.
   3. Motor: NEMA MG 1; 1 hp, 115 volts, single phase, 60 Hz; continuous duty rated, with adjustable limit switches.
   4. Controls: Furnish one 3-position, momentary-contact, wall-mounted key switch for each hoist. Switches shall be ganged together in a single lockable steel control box with a common cover plate.

B. Manual Winch:
   1. Basis-of-Design: Bison *Model No. BA975W Manual Winch*.
   2. Operation: Worm-gear construction for positive locking and load holding.
   3. Controls: Provide one removable operating handle for each winch.

2.04 ACCESSORIES

A. Safety Lock: Furnish Bison *Model No. BA990S "SafeStrap"* backstop safety lock at each folding backstop.

2.05 FABRICATION

A. Fabricate components in largest practical sizes for delivery.

B. Grind exposed welded joints flush and smooth with adjacent finish surface.

C. Provide fittings and hardware to accommodate site assembly and installation.

D. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.06 SHOP FINISHING

A. Painted Metal Finishes:
   1. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
   2. Do not paint surfaces in direct contact with concrete or where field welding is required.
   3. Shop Painting:
      a. Indoor Backstops: Manufacturer's standard enamel coating; black color.

PART 3 EXECUTION

3.01 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify walls are ready to receive backstops.

C. Verify electrical power is available with correct characteristics.

D. Verify finishing operations, including painting, are complete before installing backstops.

3.02 INSTALLATION

A. Install backstops in accordance with NFHS requirements.

B. Assemble components furnished loose for field assembly.

C. Install backboards plumb, level, and parallel to basketball court end line.

D. Install goals level and at elevation indicated.

E. Touch up damaged finishes to match shop finish.

3.03 ADJUSTING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for starting and adjusting.

B. Adjust limit switches to prevent damage to equipment.

3.04 DEMONSTRATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.

B. Demonstrate operation and maintenance of folding backstops.

END OF SECTION

SECTION 12 24 13

ROLLER SHADES

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes electrically operated roller shades.

B. Related Sections:
1. Section 06 10 53 - Miscellaneous Rough Carpentry: Blocking for attachment of roller shades.
2. Section 09 21 16 - Gypsum Board Assemblies: Suspension framing for attachment of roller shade housings.
3. Section 09 51 13 - Acoustical Panel Ceilings: Additional ceiling hanger wires at roller shade locations.
4. Division 26 Sections - Electrical power and final connections.

1.02 REFERENCES

A. WCMA - Window Covering Manufacturer's Association.

1.03 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal requirements.

B. Shop Drawings: Indicate opening sizes, tolerances required, method of attachment, clearances, and operation.
1. Include wiring diagrams, showing power, system, and control wiring.

C. Product Data: Submit data indicating physical and dimensional characteristics, fabric(s), and finishes.

D. Samples:
1. Submit two samples, 12 x 12 inches (304.8 mm) in size, of shade material.
a. Submit 24” square section of shade material with full scale section of custom graphics made from master art provided by Architect.

E. Manufacturer's Installation Instructions: Submit special procedures, and perimeter conditions requiring special attention.

1.04 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Provide roller shade band materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
1. Flame-Resistance Ratings: Passes NFPA 701.

B. Product Standard: Provide roller shades complying with WCMA A100.1.

1.05 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience.

B. Installer: Company specializing in installing products specified in this section with minimum three years' experience and approved by manufacturer.

1.06 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.07 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Coordinate the Work with window installation and placement of concealed blocking to support blinds.

1.08 WARRANTIES

A. Installer's Warranty: Provide written warranty against defects in materials and workmanship for a period of 1-year after date of Substantial Completion of the Project.

B. Manufacturer's Warranty: Provide manufacturer's written 25-year warranty covering brackets, rollers, and shades.

PART 1 PRODUCTS

2.01 MANUFACTURERS

A. BTX Window Automation, Inc. www.btxinc.com.

B. Draper Shade & Screen Co., Inc. 800-238-7999 www.draperinc.com

C. Hunter Douglas Contract. 800-727-8953 www.hunterdouglascontract.com

D. Lutron Shading Solutions by VIMCO www.lutron.com/shadingsolutions.

E. MechoShade Systems, Inc. www.mechoshade.com.

F. SWF Contract, www.swfcontract.com

G. Sol-R-Veil www.solrveil.com.

H. Substitutions: Section 01 60 00 - Product Requirements

2.02 COMPONENTS

A. Shade Band Material: Vinyl-coated polyester.

1. General:
    a. Material Width: As required to eliminate or minimize vertical seams.
    b. Bottom Hem: Straight.
    c. Characteristics: Durable, washable, mold and mildew resistant. Non-fading and 100% UV resistant.
2. Decorative:
    a. Material Openness Factor: Nominal 3%.
    b. Material Color: As selected from manufacturer’s standard colors/patterns.
3. Blackout: Not applicable.
4. Rollers: Electrogalvanized or epoxy primed steel or extruded-aluminum tube of diameter and wall thickness required to support and fit internal components of operating system and the weight and width of shade band material without sagging; designed to be easily removable from support brackets; with manufacturer's standard method for attaching shade material. Provide capacity for one roller shade band per roller, unless otherwise indicated on Drawings.
5. Direction of Roll: Regular, from back of roller.

B. Mounting Brackets:
1. End Brackets: Fabricated from steel finished to match fascia or headbox.
2. Pocket with Ceiling Slot Opening: Six-sided box units for recessed installation; fabricated from formed-steel sheet, extruded aluminum, or wood; with a bottom consisting of slot opening of minimum dimension to allow lowering and raising of shade and a removable or an openable, continuous metal access panel concealing rollers, brackets, and operating hardware and operators within.

C. Mounting: Recessed in ceiling pocket mounting permitting easy removal and replacement without damaging roller shade or adjacent surfaces and finishes.

D. Bottom Bar: Steel or extruded aluminum, with plastic or metal capped ends. Provide exposed-to-view, external-type bottom bar with concealed weight bar as required for smooth, properly balanced shade operation.

2.03 FABRICATION

A. Product Description: Roller shade consisting of a roller, a means of supporting the roller, a flexible sheet or band of material carried by the roller, a means of attaching the material to the roller, a bottom bar, and an operating mechanism that lifts and lowers the shade.

B. Concealed Components: Non-corrodible or corrosion-resistant-coated materials.
1. Lifting Mechanism: With permanently lubricated moving parts.

C. Unit Sizes: Obtain units fabricated in sizes to fill window and other openings as follows, measured at 74 degrees Fahrenheit (23.33 degrees Celsius):
1. Adjacent shades: Make open gaps between adjacent shades as close as possible, but no closer than 1/4”.
2. Shade Units Installed between (Inside) Jambs: Edge of shade not more than 1/4 inch (6.35 mm) from face of jamb. Length equal to head to sill dimension of opening in which each shade is installed.

D. Installation Brackets: Designed for easy removal and reinstallation of shade, for supporting fascia, roller, and operating hardware and for hardware position and shade mounting method indicated.

E. Installation Fasteners: Not fewer than two fasteners per bracket, fabricated from metal noncorrosive to shade hardware and adjoining construction; type designed for securing to supporting substrate; and supporting shades and accessories under conditions of normal use.

F. Color-Coated Finish: For metal components exposed to view, apply manufacturer's standard baked finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.

G. Colors of Metal and Plastic Components Exposed to View: As indicated by manufacturer's designations, unless otherwise indicated.

2.04 MOTORIZED ROLLER SHADE OPERATORS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Manufacturer of roller shade.
   2. Elero USA Inc.
   3. SIMU US, Inc.
   4. SOMFY Systems.

B. General: Provide factory-assembled motorized shade operation systems designed for lifting shades of type, size, weight, construction, use, and operation frequency indicated. Provide operation systems of size and capacity and with features, characteristics, and accessories suitable for Project conditions and recommended by shade manufacturer, complete with electric motors and factory-prewired motor controls, remote-control stations, remote-control devices, power disconnect switches, enclosures protecting controls and all 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 the building electrical system.

C. Comply with NFPA 70.

D. Control Equipment: Comply with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6.

E. Electric Motors: UL-approved or -recognized, totally enclosed, insulated motor, complying with NEMA MG 1, with thermal-overload protection, brake, permanently lubricated bearings, and limit switches; sized by shade manufacturer to start and operate size and weight of shade considering service factor or considering Project's service conditions without exceeding nameplate ratings.
   1. Service Factor: According to NEMA MG 1, unless otherwise indicated.
   2. Motor Characteristics: Single phase, 110 V, 60 Hz.

F. Controls: Electric controls with NEMA ICS 6, Type 1 enclosure for recessed or flush mounting. Provide the following devices for remote-control activation of shades:
   1. Remote Group Control Stations: Keyed, momentary-contact, three-position, switch-operated control station with open, close, and off functions for single switch group control of all shade units.
   2. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop shade at fully raised and fully lowered positions.

PART 3 EXECUTION

3.01 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify openings are ready to receive work.

C. Verify structural blocking and supports are correctly placed.

3.02 INSTALLATION

A. Install roller shades level, plumb, square, and true according to manufacturer's written instructions.

3.03 ERECTION TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Maximum Offset from Level: 1/8 inch (3.18 mm).

3.04 CLEANING AND ADJUSTING

A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.

B. Adjust blinds for smooth operation.
   1. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer that ensures roller shades are without damage or deterioration at time of Substantial Completion.
   2. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.
   3. Clean roller shade surfaces after installation and just prior to occupancy, according to manufacturer's written instructions.

3.05 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain roller shades.

END OF SECTION

SECTION 12 32 16

MANUFACTURED PLASTIC LAMINATE CLAD CASEWORK

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Plastic laminate-clad cabinets and countertops assembled from stock components.
   2. Custom chemical-resistant plastic laminate-clad cabinets with epoxy resin countertops and integral epoxy resin sinks at science classrooms/labs and preparation rooms.
   3. Coordinate work between section 06 20 24 Interior Finish Carpentry and Millwork and this section for consistency in design intent, material compatibility, and installation sequencing.

B. Related Sections:
   1. Section 06 10 53 - Miscellaneous Rough Carpentry: Miscellaneous grounds and support framing.
   2. Section 06 20 23 - Interior Finish Carpentry and Millwork: For miscellaneous items of custom millwork not provided under this Section.
   3. Section 07 90 00 – Joint Protection: For requirements of sealant used at interface of casework and other materials.
   4. Section 08 80 00 - Glazing: Requirements for any casework glazing.
   5. Division 22 Plumbing – Fittings and stainless steel sinks.
   6. Division 22 Plumbing – Fittings for epoxy sinks at science casework.
   7. Division 26 Electrical – Outlets mounted on science casework.

1.02 REFERENCES

A. American National Standards Institute:
   1. ANSI A208.1 - Mat-Formed Wood Particleboard.

B. Architectural Woodwork Institute:
   1. AWI - Quality Standards Illustrated.

C. Federal Specification Unit:
   1. FS A-A-1936 - Adhesive, Contact, Neoprene Rubber.

D. National Electrical Manufacturers Association:
   1. NEMA LD 3 - High Pressure Decorative Laminates.

1.03 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate materials, component profiles and elevations, assembly methods, joint details, fastening methods, accessory listings, hardware location and schedule of finishes.

C. Product Data: Submit data for each type of casework unit and hardware accessory.

D. Samples:
   1. Submit two samples, 6 x 6 inches (152.4 mm) in size, of each selected laminate color/finish.
   2. Submit two samples, 6 x 6 inches (152.4 mm) in size, of epoxy resin countertop and sink material in specified color.
   3. Mockups: Refer to Mockup Diagram.
      a. Submit one full size sample of a typical base cabinet unit, complete with doors, drawers, and hardware, but without countertop.
      b. Submit one full size sample of a typical wall cabinet unit, complete with doors, shelves, and hardware.
      c. Approved samples may be incorporated into the Work. If not incorporated into the Work, retain approved samples in building until completion of the Work and remove when directed by Architect.

1.04 QUALITY ASSURANCE

A. Perform work in accordance with AWI (Architectural Woodwork Institute) Architectural Woodwork Quality Standards Illustrated, Custom Grade.

B. Single Source Responsibility: All casework, countertops, and accessories furnished under this Section shall be supplied by a single manufacturer.

1.05 MANUFACTURER'S WARRANTY

A. Provide fabricator's written warranty against defects in materials and workmanship for a period of five years after date of Substantial Completion for the Project.

1.06 QUALIFICATIONS

A. Fabricator: Company specializing in performing Work of this section with minimum three years' experience.

1.07 PRE-INSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Protect units from moisture damage.

1.09 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

B. During and after installation of Work of this section, maintain same temperature and humidity conditions in building spaces as will occur after occupancy.

1.10 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.01 PLASTIC LAMINATE-CLAD CASEWORK

A. Manufacturers:
1. A&M Casework, Inc.
2. Ameritek Design, Inc., www.ameritekdesign.com
3. Calmar Manufacturing Co. Inc.; Calmar, Iowa
4. Case Systems, Inc., www.casesystems.com
5. Global Casework Manufacturing, Inc., www.globalcasework.com
6. Imperial Mill & Fixtures, Inc.
7. JC Millwork, Inc., www.jccompany.org.
8. Jericho Woodworks, www.educationalcaseork.com
9. Jim R. Reynolds & Associates, Inc., www.jimreynolds.com
10. MGC, Inc., www.mgcinc.net.
11. South Texas Woodmill, Inc.
12. Stephens Industries Inc., www.stevensind.com
    a. Terrill Manufacturing, Company; San Angelo, Texas. www.terrillmfg.com
    b. TMI Systems Design Corp.; Dickinson, ND www.tmisystems.com
    c. Top Notch Cabinets and Installation, www.topnotch@aol.com
13. Victoria Cabinet Works; Victoria, Texas
14. Westmark Commercial Case Work, Houston, Texas www.westmarkproducts.com
15. Substitutions: Section 01 60 00 - Product Requirements.

B. Definitions: The following definitions apply to plastic laminate-clad casework:
1. Exposed portions of casework (Finish Surfaces) include surfaces visible when doors and drawers are closed. Bottoms of cases more than 4'-0" above floor, tops of cases less than 6′-6″ above floor, and visible members in open cases or behind glass doors shall be considered exposed.
2. Semi-exposed portions of casework includes those members behind opaque doors, such as shelves, divisions, interior faces of ends, case back, drawer sides, backs and bottoms, and back face of doors. Tops of cases 6'-6" or more above floor shall be considered semi-exposed.
3. Concealed portions of casework include sleepers, web frames, dust panels, and other surfaces not usually visible after installation.

2.02 COMPONENTS

A. Solid Lumber: AWI Custom Grade; maximum moisture content of 6-8 percent.

B. Plywood: AWI Grade B; wood veneer core; type of glue recommended for application.
   1. Furnish 7-ply veneer plywood for 3/4 inch (19.05 mm) thickness.
   2. Furnish 5-ply veneer plywood for 1/2 inch (12.7 mm) thickness.

C. Core Material: medium density fiberboard (MDF) average 54-lb. density manufactured from pre-consumer recycled wood and formaldehyde-free adhesive system; meeting requirements of ANSI A208.2-2009 and ASTM E84-09. Flame Spread rating of 25 or less, and Smoke Developed rating of 50 or less.

D. Particleboard: Not allowed.

E. High-Pressure Decorative Laminate: NEMA LD 3, GP50 for horizontal surfaces, GP28 for vertical surfaces, CL20 for cabinet liner surfaces, BK20 for undecorated backing sheets; color, pattern, and surface texture as indicated. Wilson-Art, Formica, Nevamar, or Pionite.
   1. Provide Wilson-Art Chemsurf or approved equivalent for all cabinet surfaces at science labs and prep rooms.

F. Epoxy Resin Countertops and Integral Sinks:
   1. Size: 1-inch thick x Maximum practicable lengths.
   2. Cast Epoxy Resin: Factory molded tops of modified epoxy resin chemical-resistant formulation, uniform mixture throughout full thickness. 14,000 psi compressive strength Color, non-glaring black.
   3. Basis of Design: Durcon as manufactured by Wilsonart, or approved equivalent.
   4. Sinks:
      a. Matching countertops in material and color. Molded in one piece with surfaces smooth, corners coved and bottom sloped to outlet. Minimum 1/2” thickness of same material as tops.
      b. Sizes: As indicated in the drawings.
      c. Outlets: 1-1/2 inch (12.7 mm) diameter, 6 inch (152.4 mm) length, fabricated of silicon iron, cast epoxy resin, or stainless steel.
      d. Overflows: Standard beehive or open top design and with separate strainer. Height 2-inches less than sink depth.
   5. Mechanical Service Fixtures: Provided under Div. 22

2.03 ACCESSORIES

A. Adhesive for High Pressure Decorative Laminates: FS A-A-1936 contact adhesive or white PVA glue.

B. PVC Edge Trim: Extruded rigid PVC; smooth finish, of width to match component thickness; standard or custom color as required to match plastic laminate;
   1. Minimum 1-mm thickness at doors and drawers.

C. Glass: Clear tempered double strength, as specified in Section 08 80 00.

D. Fasteners and Anchors:
   1. Fasteners: Hot dipped or Electro galvanized steel for high humidity and treated wood locations, unfinished steel elsewhere.
      a. Nails and Staples: ASTM F1667.

E. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application.

F. Concealed Joint Fasteners: Threaded steel.

G. Grommets: Metal, nylon, or high strength plastic material for cut-outs.

H. Hardware: Manufacturer's standard commercial-quality, heavy-duty hardware complying with requirements indicated, constructed with base materials and finishes as selected from manufacturer’s full range of standard materials and finishes.

1. Butt Hinges: Semi-concealed, 5-knuckle hinges complying with BHMA A156.9, Grade 1, constructed from minimum 0.095-inch tempered steel, with antifriction bearings and rounded tips. Provide minimum 170º door swing. Provide 2 hinges for doors less than 48 inches (1219.2 mm) high and 3 hinges for doors 48 inches or more high.
    a. No European style hinges.
2. Pulls: Solid metal, for drawers and swing doors, mounted with 2 screws fastened from back. For sliding doors, provide recessed flush pulls. Provide 2 pulls for drawers 30" wide and wider. 4” wire design pulls, brushed chrome finish.
3. Door Catches: Dual self-aligning permanent magnet type. Provide 2 catches on doors over 4 feet (121.92 cm) high.
4. Drawer Slides:
    a. Allow full extension for drawer slides.
    b. Light and Medium Duty Drawers, provide one of the following:
        1) Accuride 3832, KV 8400 or approved equivalent by Blum or Royal. Full extension all ball bearing 100 lbs. load rated with lever disconnect and positive outstop preventing inadvertent drawer removal.
        2) 100 pound load rated epoxy powder coated steel, bottom corner mounted with smooth, quiet nylon rollers. Positive stop in both directions and self-closing feature.
5. File Drawer and Wide Heavy Duty Drawers, provide one of the following:
    a. Accuride 4032, KV 8400 or approved equivalent equivalent by Blum or Fulterer. Full extension all ball bearing 150 lbs. load rated with rail mount, hold-in detent, progressive movement and positive outstop preventing inadvertent drawer removal.
    b. 150-pound load rated epoxy powder coated steel, bottom corner mounted with smooth, quiet nylon rollers. Positive stop in both directions and self-closing feature.
6. Label Holders: Provide where indicated, size to receive standard label cards approximately 1” x 2” nominal size, finished to match other exposed hardware.
7. Locks: 5-pin tumbler cam type of metal case construction. Provide locks only where indicated in the drawings.
    a. Provide with removable core and metal strike. All casework locks within a room keyed alike, each room keyed differently.
    b. Provide 2 keys per room for rooms with casework locks. Cylinder face and keys engraved with matching numbers.
    c. Brass body with dull chrome finish. Core removable and interchangeable with control key. Master key operates all locks
8. Sliding Door Hardware Sets: Manufacturer’s standard, to suit type and size of sliding door units.
9. Cabinet Base: Resilient base provided under Section 09 65 00 on exposed sides, fronts, and backs of floor-mounted cabinets.
10. Adjustable Shelf Supports: BHMA B84073, wrought steel, mortise mounted or Injection molded transparent polycarbonate friction fit into cabinet end panels and vertical dividers, adjustable on approximately 1.375-inch centers. Each shelf support to have two integral support pins, 5mm minimum diameter, to interface predrilled holes and to prevent rotation

of support. Provide four supports per shelf. The support automatically adapts to 3/4-inch or 1-inch thick shelving and provides non-tip feature for shelving. Supports shall be designed so that they may be field fixed if desired. Structural load to 1200 pounds without failure (300 pounds per support).

2.04 FABRICATION

A. General Cabinet Requirements:
   1. Cabinet bases shall be fabricated from solid lumber.
   2. Frames and structural parts of cabinets shall be fabricated from plywood or solid lumber.
   3. Face, side, and divider panels shall have cores fabricated from minimum 3/4 inch (19.05 mm) thick medium density fiberboard or plywood.
      a. Back panels shall be fabricated from 1/2-inch thick medium density fiberboard.
      b. or plywood.
   4. Doors, shelves, drawer fronts, and tall cabinet tops shall have cores fabricated from minimum 3/4 inch (19.05 mm) thick medium density fiberboard.
   5. 3/4” thick plywood when used for cabinet bodies and shelving.
   6. Drawer sides shall be fabricated from sealed hardwood lumber, and bottoms shall be fabricated from minimum 1/2-inch thick sealed medium density fiberboard.
   7. Multiple shelf cabinets 84” tall and greater than 36” wide to have fixed center shelf.

B. Laminate Cladding:
   1. Countertops and splashes: GP50 or PF42.
   2. Exposed surfaces other than countertops and splashes: GP28.
   3. Semi-exposed surfaces: CL20.
   4. Concealed faces of exposed and semi-exposed surfaces: CL20 or BK20; all laminated construction shall be balanced and edge banded.

C. Edge Banding:
   1. Countertops and splashes: PVC, 3-mm.
   2. Doors, shelves, drawer fronts, and face frames of open shelving units: PVC, 3-mm.
   3. Face frames other than open shelving units, and tops and bottoms of drawers: PVC, 0.04 inch (1 mm).

D. Countertop Construction:
   1. Size: Maximum practicable lengths.
   2. Thickness: Nominal 1-1/4 inch (6.35 mm); provide front and end overhang of 1-inch over base cabinets.
      a. Rounded Corners: Provide min. 1-inch radius at all outside corners.
   3. Plastic Laminate: Shop-bond with waterproof adhesive to 1-1/8 inch (29 mm) thick medium density fiberboard. At countertops with sinks or other plumbed fixtures, use only marine grade plywood full width of the sink plus 12″ to either side. Apply backing sheet to underside of countertop. Edge exposed edges of countertop and openings with same plastic laminate used for countertops.
      a. Splash: Construct splashes of 3/4 inch (19.05 mm) thick medium density fiberboard.
      b. Use marine-grade plywood for plastic laminate cores for countertops and splashes at sink cabinets.

4. At epoxy resin tops provide front and end overhang of 1 inch (25.4 mm) over base cabinets, formed with continuous drip groove on under surface 1/2 inch (12.7 mm) from edge. Cast surfaces very smooth, with factory cut-outs for sinks and drip grooves.
5. Shop-assemble casework for delivery to site in units easily handled and to permit passage through building openings.

E. Door and Drawer Fronts: Flush overlay style.

F. Fit exposed plastic laminate edges with PVC edging. Use one piece for full length only.

G. When necessary to cut and fit on site, fabricate materials with ample allowance for cutting. Furnish trim for scribing and site cutting.

H. Apply high pressure decorative laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners Locate counter butt joints minimum 2 feet (60.96 cm) from sink cut-outs.

I. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.

J. Provide all cutouts for plumbing fixtures, inserts, appliances, outlet boxes, and other fixtures and fittings. Verify locations of cutouts from on-site dimensions.

K. Shop glaze glass materials using Hafele plastic blead glazing insert or interior dry method specified in Section 08 80 00.

L. Clear seal or paint concealed (back and side) edges of shelving to match shelving laminate (instead of plastic laminate)

M. Hardwood bottoms only at drawers.

PART 3 EXECUTION

3.01 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify adequacy of backing and support framing.

C. Verify location and sizes of utility rough-in associated with work of this section.

3.02 INSTALLATION

A. Set and secure casework in place; rigid, plumb, and level.

B. Use concealed joint fasteners to align and secure adjoining cabinet units, counter tops, and splashes.

C. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch (0.79 mm). Do not use additional overlay trim for this purpose.

D. Base Cabinets:

1. Fasten each individual cabinet to floor at toe space, with fasteners spaced 24 inches (609.6 mm) o.c. Bolt continuous cabinets together. Secure individual cabinets with not less than 2 fasteners into floor, where they do not adjoin other cabinets.
2. Where required, assemble units into one integral unit with joints flush, tight, and uniform. Align similar adjoining doors and drawers to a tolerance of 1/16 inch (1.59 mm).

E. Wall Cabinets:
1. Securely fasten to solid supporting material, not plaster, lath, or wallboard. Anchor, adjust, and align wall cabinets as specified for base cabinets.
2. Reinforcement of stud walls to support wall-mounted cabinets will be performed during wall erection by trade involved, but responsibility for accurate location and sizing of reinforcement is part of this Work.

F. Adjust casework and hardware so that doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

G. Countertops:
1. Field Jointing: Where practicable, make in same manner as factory jointing using dowels, splines, adhesives, and fasteners recommended by manufacturer. Locate field joints as shown on accepted shop drawings, factory prepared so there is no job site processing of top and edge surfaces.
2. Fastenings: Use concealed clamping devices for field joints, located within 6 inches (152.4 mm) of front, at back edges and at intervals not exceeding 24-inches. Tighten in accordance with manufacturer's instructions to exert a constant, heavy clamping pressure at joints. Secure tops to cabinets with zee-type fasteners or equivalent, using 2 or more fasteners at each front, end, and back.
3. Workmanship: Abut top and edge surfaces in one true plane, with internal supports placed to prevent any deflection. Provide flush hairline joints in top units using clamping devices.
4. After installation, carefully dress joints smooth, remove any surface scratches, clean and polish entire surface.
5. Provide holes and cutouts as required for mechanical and electrical service fixtures.
6. Provide scribe moldings for closures at junctures of top, curb and splash with walls as recommended by manufacturer for materials involved. Use permanently elastic sealing compound recommended by manufacturer.
7. Seal space between countertop backsplash and wall with sealant as specified in Section 07 90 00.

H. Accessories: Install in accordance with manufacturer's directions. Turn screws to a flat seat; do not drive. Adjust moving parts to operate freely without excessive bind.

3.03 ADJUSTING

A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting and balancing.

B. Adjust moving or operating parts to function smoothly and correctly.

3.04 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION

SECTION 12 35 00

MANUFACTURED MUSICAL INSTRUMENT STORAGE CABINETS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Musical instrument storage cabinet systems.

B. Related Sections:
   1. Section 06 10 53 - Miscellaneous Rough Carpentry: Wood blocking for anchoring musical instrument storage cabinets.
   2. Section 09 21 16 - Gypsum Board Assemblies: Reinforcing in gypsum board partitions for anchoring musical instrument storage cabinets.

1.02 REFERENCES

A. American Laminators Assoc. Performance Standard ALA 1985.

B. ANSI - BHMA Standard A156.9, Grade 1.

1.03 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: For each type of product indicated.

C. Shop Drawings: Show fabrication and installation details for musical instrument storage cabinets. Include plans, elevations, sections, details, and attachments to other Work.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative of musical instrument storage cabinet manufacturer for installation and maintenance of units required for this Project.

B. Source Limitations: Obtain musical instrument storage cabinets through one source from a single manufacturer.

C. Product Designations: Drawings indicate sizes, configurations, and finish material of musical instrument storage cabinets by referencing designated manufacturer's catalog numbers. Other manufacturers' cabinets of similar sizes and door configurations, of same finish material, and complying with the Specifications may be considered.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Deliver musical instrument storage cabinets only after painting, utility roughing-in, and similar operations that could damage, soil, or deteriorate cabinets have been completed in installation areas. If cabinets must be stored in other than installation areas, store only in areas where environmental conditions meet requirements specified in "Project Conditions" Article.

C. Keep finished surfaces covered with polyethylene film or other protective covering during handling and installation.

1.06 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of institutional cabinets that fail 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.

C. Warranty Period: Three years from date of Substantial Completion.

D. Warranty Period for Cabinet Shelving: Ten years from date of Substantial Completion.

1.07 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install musical instrument storage cabinets 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 musical instrument storage cabinets are indicated to fit to other construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings.
   1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating musical instrument storage cabinets without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.08 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Coordinate layout and installation of metal framing and reinforcements in gypsum board assemblies for support of musical instrument storage cabinets.

1.09 SYSTEM DESCRIPTION

A. Design Requirements:

1. Provide one-piece high molecular polyethylene shelving with integral ventilation grooves, designed and engineered to withstand continuous use without surface or front edge breakdown.
2. Individual cabinets shall be manufactured with thermofused polyester laminated panels, finish both faces all components. All end panels to be factory jigged and drilled to accept unit-to-unit through-bolting: no conventional wood screws attaching units side-to-side will be permitted. Each cabinet will be furnished with an integral base and four (4) steel levelers accessible from within the unit but concealed in final installation.
    a. Provide wire grille hinged door panels as indicated the drawings. All hinges shall be structurally attached to vertical panels using engineered and tested through-bolt hardware that is welded to wire grille doors. Screw-mounted hinges not acceptable.

B. Manufacturer to Provide Documentation of Following Minimum Performance Requirements:
1. Molded plastic instrument storage shelf shall have a static load capacity of over 1,000 lbs.
2. Wire grille door hinge to be welded to door frame in five places, pull-tested to withstand 3,000 lbs.

PART 2 PRODUCTS

2.01 MUSICAL INSTRUMENT STORAGE CABINETS

1. Manufacturers:
    a. Melhart Music, www.melhart.com
    b. Stephens Industries Inc., www.stevensind.com
    c. TMI Systems Design Corp., www.tmisystems.com
    d. Wenger Corp., www.wengercorp.com
    e. Substitutions: Section 01 60 00 - Product Requirements.

2.02 MATERIALS

A. Cabinet Wall Panels:
1. 3/4-inch thick industrial (cabinet) grade particleboard, minimum 48 pcf with thermoset polyester (melamine not acceptable) laminate on both sides for totally finished construction. No backer sheets or unfinished surfaces may be used on unexposed sides. Color: As selected by Architect from manufacturer’s full line of standard and custom colors.
    a. Interior Composite Wood Products: Contain no added urea-formaldehyde resins.

B. Cabinet Shelving:
1. Cabinets up to 27 inches (685.8 mm) wide: One-piece high molecular blow-molded polyethylene with 1-3/- inch radius front edge. Mount to cabinet walls with one-piece molded rigid ST nylon clip. Shelf is replaceable without damage to adjacent surfaces. Doweled shelves will not be permitted.
2. Cabinets over 27 inches (685.8 mm) wide: One-piece high molecular formed polyethylene with radius front edge and 3/16" wall thickness. Ribbed for structural integrity. Supported by four structural tubular members 1-1/2" x 1" x 16-ga. wall thickness with 14-gauge welded end plates.

C. Doors:

1. Grille doors: Welded steel grille construction with powder coat finish, color as selected by Architect from manufacturer's full line of standard and custom colors. Welds at T-joints must be 360º.
    a. Hinges, 5-knuckle institutional type hinge, supplied by ISO 9002 vendor. Hinge will support 315 lbs. dynamic vertical load. Hinge pin shall be 2-3/4" long. Hinge welded to door frame in five places.
    b. Finish: Manufacturer's standard powder coat. Provide two hinges on compartment doors, four on full height doors.
2. Locking slide-bolt: All doors shall be provided with locking slide-bolt designed for padlocks, with formed steel strike plate through-bolt connected to cabinet end panel; 12-gauge steel. Provide clear plastic label holder for identification card insert. Finish: Manufacturer's standard powder coat.
3. Edging: Heat bonded 3mm beveled PVC edge-banding, machine applied using hot-melt adhesives, edges and corners machine profiled for safety, integral color to match door panels.

D. Finish Hardware:
1. Joinery Hardware: Two inch, 1/4-20 panel connectors with 0.59 inch (15 mm) head diameter, and steel thread inserts shall be utilized to join desired cabinets side-to-side; use factory jigged and drilled joinery holes.
2. Finish: Manufacturer's standard powder coat.
3. Cabinet levelers: Structural levelers each cabinet, accessible from within the unit when desired, concealed in complete installation; glides with minimum 3/8 inch (9.52 mm) diameter threaded rod mounted in steel corner brackets. Provide minimum four glides per cabinet, six glides for cabinets with divider panels.

E. Cabinet Back Panel: Standard cabinet back to be 1/4" thick prefinished hardboard, color: match interior of side and top panels.
1. Interior Composite Wood Products: Contain no added urea-formaldehyde resins.

F. Vertical Closure Kit: Provide visual closure between wall and cabinet. Constructed of 3/4" thick thermoset polyester composite wood to match cabinet side panels.
1. Interior Composite Wood Products: Contain no added urea-formaldehyde resins.

G. Horizontal Closure Kit: Provide visual closure between top of cabinet and soffit. Constructed of 3/4" thick thermoset polyester composite wood to match cabinet side panels.
1. Interior Composite Wood Products: Contain no added urea-formaldehyde resins.

H. Top Back Filler Kit: Provide visual closure between back wall and top panel of cabinet. Constructed of 3/4" thick thermoset polyester composite wood to match cabinet top panels.
1. Interior Composite Wood Products: Contain no added urea-formaldehyde resins.

I. Finished Back Panel: Provide panel to attach to cabinet back that is exposed. Constructed of 1/2" thick thermoset polyester composite wood to match cabinet.
1. Interior Composite Wood Products: Contain no added urea-formaldehyde resins.

J. Base Molding: ASTM F1861, Type TS (rubber, vulcanized thermoset), black, 4 inches (101.6 mm) high. Provide on fronts and exposed sides of floor-mounted cabinets.
1. Style: A, straight with no toe.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of reinforcements, and other conditions affecting performance of musical instrument storage cabinets.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 CABINETS INSTALLATION

A. Install plumb, level, and true; shim as required, using concealed shims. Where musical instrument storage cabinets abut other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.

B. Base Cabinets: Set cabinets straight, level, and plumb. Adjust subtops within 1/16 inch (1.59 mm) of a single plane. Fasten cabinets to partition framing, wood blocking, or reinforcements in partitions with fasteners spaced 24 inches (609.6 mm) o.c. Bolt adjacent cabinets together with joints flush, tight, and uniform. Align similar adjoining doors and drawers to a tolerance of 1/16 inch.
   1. Where base cabinets are not installed adjacent to walls, fasten to floor at toe space with fasteners spaced 24 inches (609.6 mm) o.c. Secure sides of cabinets to floor, where they do not adjoin other cabinets, with not less than two fasteners.

C. Wall Cabinets: Hang cabinets straight, level, and plumb. Adjust fronts and bottoms within 1/16 inch (1.59 mm) 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.
   1. Fasten through back, near top and bottom, at ends, and not more than 16 inches (406.4 mm) o.c. with No. 10 wafer-head screws sized for 1-inch penetration into wood framing, blocking, or hanging strips; No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish; or toggle bolts through metal backing or metal framing behind wall finish.

D. 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.
   1. Adjust cabinets and hardware so doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

3.03 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: Provide 6 mil (0.1524 mm) plastic or other suitable water-resistant covering over countertop surfaces. Tape to underside of countertop at a minimum of 48-inches o.c. Remove protection at Substantial Completion.

END OF SECTION

SECTION 12 56 51

MANUFACTURED LIBRARY FURNITURE

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Stationary wood shelving units with continuous plastic laminate tops.
   2. Mobile wood shelving units with individual plastic laminate tops.
   3. Plastic laminate custom library furnishings including circulation desk.

B. Related Sections:
   1. Section 06 10 53 - Interior Finish Carpentry and Millwork: For miscellaneous items of shop-fabricated millwork not included in this Section.
   2. Section 12 32 16 - Plastic Laminate-Clad Casework: For miscellaneous items of plastic laminate clad casework not included in this Section.

1.02 SUBMITTALS:

A. Product Data: Submit manufacturer's product literature for each type of library furniture item and installation accessory required.
   1. Submit written data on physical characteristics, load bearing capabilities and durability.

B. Maintenance Data: Include data in Maintenance Manual as specified in Division-1.

C. Maintenance Instructions: Submit manufacturer's printed instructions for maintenance of installed work, including methods and frequency recommended for maintaining optimum condition of wood and painted metal surfaces under anticipated use conditions. Include precautions against materials and methods which may be detrimental to finishes and performance.

D. Shop Drawings: Submit installation drawings showing location extent of library furniture. Indicate location and extent of wiring for manufacturer provided electrical components.

E. Samples for Initial Selection Purposes: Submit manufacturer's standard size samples of library furniture finishes, but not less than 3" X 3", including wood, plastic laminate, and painted surfaces. Provide samples showing full range of colors, textures and patterns available for each type of component required.

F. Samples for Verification Purposes: Submit 12" square samples of each wood, plastic laminate, and paint finish required, prepared from same material to be used for the work.

1.03 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firm (material producer) with not less than 3 years of production experience, whose published literature clearly indicates general compliance of products with requirements of this section.

B. Installer's Qualifications: Firm specializing in furniture installation with not less than 2 years of experience in installation similar to those required for this project.

C. Single Source Responsibility: Provide material produced by a single manufacturer for all free-standing library furniture.

1.04 PRE-INSTALLATION MEETING

A. Section 01 31 19 – Project Meetings: Schedule and coordinate pre-installation meeting that includes the trade(s) for the work of this Section and other trades that whose work is related to the work of this Section.
   1. Convene minimum one week prior to commencing work of this Section.

1.05 DELIVERY, STORAGE AND HANDLING:

A. Deliver materials to project site in original factory wrappings and containers, clearly labeled with identification of manufacturer, brand name, and lot number. Store materials in original undamaged packages and containers, inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity; laid flat, blocked off ground to prevent sagging and warping.

B. Comply with instructions and recommendations of manufacturer for special delivery, storage, and handling requirements.

1.06 SEQUENCING AND SCHEDULING:

A. Sequence library furniture installation with other work to minimize possibility of damage and soiling during remainder of construction period.

1.07 WARRANTY:

A. Special Project Warranty: Submit a written warranty, executed by the Contractor, Installer and the Manufacturer, agreeing to repair or replace units which fail in materials or workmanship within the specified warranty period.
   1. This warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents.
      a. Control Manufacturer’s Warranty: Minimum 5-years after the date of Substantial Completion for the Project, including all parts and labor. Life of elevator system software updates.

1.08 MAINTENANCE:

A. Replacement Materials: Furnish accessory components as required. Furnish replacement materials from same production run as materials installed. Package replacement materials with protective covering, identified with appropriate labels.
   1. At Project close-out provide direct to the Owner an additional six (6) book shelves, packaged and labeled for storage, for each unique shelf size installed. Obtain receipt.

PART 2 PRODUCTS

2.01 MANUFACTURERS:

A. Manufacturers: Subject to compliance with requirements, provide products of one of the following:
   1. Brodart Company; www.brodart.com
   2. Buckstaff Company; www.buckstaff.com
   3. Library Bureau www.librarybureau.com
   4. Russwood Library Furniture, www.russwood.net
   5. TEC Educational Furniture; www.tecedfurniture.com
   6. Tesco Industries; www.tesco-ind.com
   7. Worden Co.; www.wordencompany.com

2.02 MATERIALS:

A. Solid Wood: Plain sliced select Red or White Oak, free from imperfections, thoroughly air seasoned, kiln dried.

B. Lumber Core Stock: Free from imperfections, thoroughly air seasoned stock, kiln-dried to moisture content of 5-7%, sealed top, bottom and exposed edges.
   1. Exposed material to match solid wood species, color and finish.

C. Plywood: Constructed with odd number of plies, all interior plies except core of center ply, occurring in pairs. Plies of each interior pair of same species, thickness and grain direction, placed on opposite sides of core. Grain direction of each ply at right angles to grain of adjacent plies, and edges of panels. All plies free of blisters, wrinkles, laps or other defects.
   1. Finish face ply to match solid wood species, color and finish.

D. Particleboard Core Stock: Medium density, complying with ANSI A208.1, 45 lbs./cu. ft. minimum average modulus of rupture of 2400 psi (16547.42 kPa), minimum average modulus of elasticity of 400,000 psi (2757904.00 kPa).

E. High Pressure Laminate: 0.050" thick, backing sheet not less than 0.020" thick, complying with NEMA LD 3 Standard.

F. Glue: Water-resistant resin adhesive which retains strength when subjected to thorough wetting and drying.

G. Exposed Veneers: Plain-sliced, AWI standard A grade, uniform even grain.

2.03 MANUFACTURED UNITS:

A. Provide library furniture items with the following details, in sizes, quantities and configurations as scheduled.
   1. Unit Tops: Minimum 1" thick, 5-ply Veneer Core Plywood construction, with 1" x 3" solid hardwood banding, face veneer on exposed surface, plain veneer on underside.
   2. Continuous Tops: All side-by-side units shall have continuous finished tops. Minimum 1" thick, 5-ply Veneer Core Plywood construction, with 1" x 3" solid hardwood banding, face

veneer on exposed surface, plain veneer on underside. Make finished tops as long as practicable without joints.

3. End Panels and Back Panel: Same construction as worksurface top; height and width for sizes scheduled.
4. Box Drawers: 1/2" solid hardwood sides, dovetailed and glued. 1/4" five ply hardwood bottom, fitted into dado, glued and blocked into place. Equipped with full extension drawer glides and stops to prevent accidental removal.
5. Letter File Drawers: 1/2" solid hardwood sides, dovetailed and glued. 1/2" five ply hardwood bottom- fitted into dado, glued and blocked into place. Equipped with full extension file drawer slides, 150 lb. load capability.
6. Kickbase: 4" rubber base to match rubber wall base specified in Section 09 65 00 - Resilient Flooring.
7. Sliders: Install non-marking nylon sliders on stationary casework bottoms for ease of relocation.

B. Mobile Shelving Units: Provide minimum 2” diameter hard rubber wheeled casters at 4-corners of each unit. Casters shall be locking type with foot lever.

C. Provide custom circulation desk as indicated in the drawings in finishes matching the library furniture
1. Include built-in book-return unit with depressible platform and rolling casters.

2.04 FINISHES:

A. Wood Finishes: Provide library furniture with wood finish as specified.
1. Wood finish as selected by Architect from manufacturer's standard finishes.

B. Metal Finishes: Provide metal finish complying with ANSI A156.18, as scheduled
1. Chrome: Mirror Polished.
2. Stainless Steel: Polished.

C. Plastic Laminate Finish: As selected by Architect from selected laminate manufacturer's full range of available color and finishes.

PART 3 EXECUTION

3.01 PREPARATION:

A. Verify that all library furniture components, including size and finish, are those specified before installing.

B. Verify that all required electrical hook-up provisions are in place prior to installing.

3.02 INSTALLATION:

A. Install furniture and accessories after finishing operations, including painting, have been completed.

B. Install furniture to comply with final layout drawings in strict compliance with manufacturer's printed instructions. Position units level, plumb; at proper location relative to adjoining units and related work. Adjust accessories to provide visually acceptable installation.

3.03 FIELD QUALITY CONTROL:

A. Remove and replace components which are chipped, scratched or otherwise damaged, or do not operate smoothly and which do not match adjoining work. Provide new matching units, installed as specified and in manner to eliminate evidence of replacement.

3.04 CLEANING:

A. Immediately upon completion of furniture installation, clean components and surfaces.

B. Remove surplus materials, rubbish and debris resulting from installation, upon completion of work and leave areas of installation in neat clean condition.

3.05 PROTECTION:

A. Protect furniture against damage during remainder of construction period. Advise Owner of additional protection needed to ensure that furniture will be without damage or deterioration at time of substantial completion.

END OF SECTION

SECTION 12 66 00

TELESCOPING STANDS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Wall-attached telescoping stands.
   2. Molded plastic bench seating modules.
   3. Delegated-design of the complete telescoping stand system, including all platforms, understructure, seating, and anchorage to the building structure.

B. Related Sections:
   1. Division 26 Sections: Power outlets for power-assistance unit.

1.02 DEFINITIONS

A. Operable systems of multiple-tiered bench seating on interconnected folding platforms that close, without being dismantled, into a nested vertical stack for storing or moving.

1.03 PERFORMANCE REQUIREMENTS

A. Structural Performance Characteristics: Engineer, fabricate, and install telescoping stands to withstand the design loads specified in NFPA 102, "Standard for Assembly Seating, Tents, and Membrane Structures," Chapter 5, "Folding and Telescopic Seating," without exceeding the allowable design working stresses of the materials involved, including anchors and connections. Apply each load to produce the maximum stress in each respective component of each telescoping stand unit.

1.04 PRODUCT-SPECIFIC SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Delegated-Design Submittal: Submit a comprehensive package for the telescoping stands, signed and sealed by the qualified professional engineer specified in the "Quality Assurance" article. The submittal shall include:
   1. Shop Drawings: Show plans, elevations, sections, fabrication details, anchorage details, and all attachments to building structure.
   2. Structural Calculations: Provide a comprehensive structural analysis demonstrating compliance with NFPA 102 and all other specified performance requirements and design loads.

C. Product Data for each type of telescoping stand specified, including details of construction relative to materials, dimensions of individual components, profiles, and finishes.

D. Shop Drawings showing fabrication and installation of telescoping stands including plans, elevations, sections, details of components, and attachments to other units of Work.

1. For installed products indicated to comply with certain design loadings, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

E. Samples for initial selection in the form of manufacturer's color charts consisting of actual units or sections of units showing the full range of colors, textures, and patterns available for each exposed material involving color selection.

F. Samples for verification of the following items, in the size indicated below. Prepare Samples from the same material to be used for the Work. Where finishes involve normal color and texture variations, include Sample sets showing the full range of variations expected.
1. Plywood: 12 inch (304.8 mm) square samples of finished material.
a. Painted Steel: 6-inch square sample of painted steel sheet.
b. Colors for Plastic Benches: Manufacturer’s chain of plastic samples in full range of available colors.
c. Molded-Plastic Benches: (2) 6”x6” plastic sample panels per each color selected.

G. Qualification data for firms and persons specified in the "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.

H. Maintenance data for telescoping stands, including detailed instructions for operation and annual inspection requirements of authorities having jurisdiction, to include in the operation and maintenance manual specified in Division 1.

1.05 QUALITY ASSURANCE

A. NFPA Standard: Comply with requirements of NFPA 102, "Standard for Assembly Seating, Tents, and Membrane Structures," Chapter 5, "Folding and Telescopic Seating," except where more stringent requirements are indicated or imposed by authorities having jurisdiction.

B. Installer Qualifications: Engage an experienced Installer to perform work of this Section who has specialized in installing types of telescoping stands similar to those required for this Project and who is acceptable to, or certified by, manufacturer of telescoping stands.

C. Professional Engineer Qualifications: A professional engineer who is legally authorized to practice in the 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 telescoping stands that are similar to that indicated for this Project in material, design, and extent.

D. Welding Standards: Comply with applicable provisions of AWS D1.1 "Structural Welding Code--Steel" and AWS D1.3 "Structural Welding Code - Sheet Steel."
1. Engage certified welders that have satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, have undergone recertification.

1.06 PROJECT CONDITIONS

A. Field Measurements: Check actual dimensions of construction affecting telescoping stands by accurate field measurements before fabrication and show recorded measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.07 ADDITIONAL MATERIALS

A. Provide to Owner boxed and sealed ten (10) additional plastic seat tops matcing those installed in the Project.

PART 2 PRODUCTS

2.01 TELESCOPING STANDS

A. Manufacturers
   1. Basis-of-Design: Sheridan Seating, Inc.; www.sheridanseating.com
   2. Hussey Seating Co.; www.husseyseating.com
   3. Interkal Inc.; www.interkal.com
   4. Irwin Seating Company; Folding Bleacher Company Subsidiary; www.foldingbleacher.com
   5. Substitutions: Section 01 60 00 - Product Requirements.

2.02 MATERIALS

A. Plywood: Softwood plywood panels, 5/- inch nominal thickness, 5-ply construction with grade designation American Plywood Association (APA) A-C Exterior, with solid cross bands, Group 1 veneer species for plies, and exterior glue, APA grade trademarked, complying with DOC PS 1 requirements, unless otherwise noted.

B. Structural Steel Shapes, Plates, and Bars: ASTM A-6, except where higher strength steel is indicated or standard with manufacturer.

C. Commercial-Quality Uncoated Steel Sheet: ASTM A366 cold-rolled steel sheet, or ASTM A569 hot-rolled steel sheet, stretcher leveled.

D. Structural-Quality Uncoated Steel Sheet: ASTM A570 hot-rolled steel sheet, or ASTM A 611 cold-rolled steel sheet, stretcher leveled.

E. High-Strength Uncoated Steel Sheet: ASTM A-607 hot or cold-rolled steel sheet, stretcher leveled.

F. Galvanized Steel Sheet: ASTM A 653, G60 coating designation, phosphatized, stretcher leveled.

G. Steel Tubing: ASTM A-500, cold formed; or ASTM A-501, hot formed.

H. Extruded Aluminum: ASTM B221, alloy as standard for manufacturer.

I. Polyethylene Plastic: ASTM D1248, Type III, Class B; molded, color-pigmented, textured, impact-resistant, structural formulation.

J. Fasteners: Vibration proof, of size and material standard with manufacturer.

2.03 COMPONENTS

A. General: Provide manufacturer's standard telescoping stands fabricated to comply with requirements indicated. Smoothly round corners, edges, and exposed fasteners to eliminate

snagging and pinching hazards. Form exposed sheet metal with flat, flush surfaces, true to line and level, and without cracking and grain separation. Perform welding by operators and processes complying with AWS requirements.

B. Bench Seats and Skirts: Bench Seats and Skirts: Provide seats with a uniform height of manufacturer's standard 17 to 18 inches (432 to 457 mm), complying with NFPA 102.
   1. Material: Polyethylene plastic in color selected by Architect from manufacturer's full range of colors.
   2. Profile: Contoured Seat Module, as standard with Basis of Design manufacturer.
   3. Depth: Nominal 10-inches unless otherwise indicated.

C. Cutouts for wheelchair accessible seating at first tier locations indicated. Provide front rails attached to front of second tier at rear of wheelchair accessible seating area. Provide full-width front closure panel at cutout that matches decking construction and finish and extends from underside of second tier to 1-1/2 inches (38 mm) from finished floor.

D. Footrests: Fabricate fully cosed footrests from plywood, with finish selected by Architect.

E. Understructure: Fabricate understructure from structural steel members of size, spacing, and form required to support design loads.

F. Cantilever bench seat supports to produce toe space uninterrupted by vertical bracing.

G. Support Column Wheels: Provide manufacturer's non-marring, soft, rubber-face wheel assembly under each support column. Include wheels of size, number, and design required to support stands and to achieve smooth operation without damage to flooring surface, but not less than 4 per column or less than 3-1/2 inches (89 mm) in diameter and 1 inch (25.4 mm) wide.

H. Aisles: Fabricate stands with the following aisle configuration, at locations and of widths indicated:
   1. Footrest-Level Configuration: Interrupt seats to provide aisle walking surfaces at footrest level.

I. Row-Spacing: Fabricate units with row spacing of manufacturer's standard nominal [26 inches (660 mm).

J. Row-Rise: Fabricate units with row rise of manufacturer's standard nominal 9-5/8 to 10-1/2 inches (244 to 267 mm).

K. Operation: Provide telescoping stands incorporating manufacturer's standard system of seating and understructure members that permit opening and closing of adjacent rows, allow individual and collective rows to be locked open for use, and close with vertical faces of upper skirts in the same vertical plane.
   1. Manual Operation: Provide manufacturer's standard pair of operating handles to attach under the first-row kick board for manual operation.
      a. Provide manufacturer’s portable electric tractor system (“mule”) for stand-up power-assist for opening and closing of seating sections.

L. Types of Telescoping Stands: Provide assemblies of the following types, fabricated in lengths and number of rows indicated:
   1. Wall-Attached Type: Construct stands to provide for permanent attachment of rear of understructure to wall construction.

2. Manual-rotate end and aisle railings.

M. Accessories: Provide the following accessories of manufacturer's standard design and construction at locations indicated or required to comply with referenced code standard:
1. Nonslip abrasive tread surfaces at vertical aisles.
2. Intermediate aisle steps, fully enclosed, at each vertical aisle.
3. Hinged front steps, fully enclosed, at each vertical aisle, that flip up on hinges and store between first and second row of seating.
4. Non-removable folding aisle handrails located at centerline of each vertical aisle and discontinuous with gaps or breaks at intervals not exceeding 5 rows.
5. End railings of non-removable, self-storing type.

2.04 STEEL FINISHES

A. Surface Preparation: Solvent-clean surfaces to comply with SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel complying with SSPC-SP 5 (White Metal Blast Cleaning) or SSPC-SP 8 (Pickling).

B. Rust-Inhibitive Finish: Immediately after cleaning and pretreating, apply manufacturer's standard rust-inhibitive finish to exposed and concealed metal surfaces including understructure, except where other types of finishes are indicated.
1. Powder-Coat Finish: Immediately after cleaning and pretreating, apply a factory-applied, thermoset powder-coat finish to all exposed and concealed metal surfaces of the understructure. Color as selected by Architect from manufacturer's standard range.

2.05 WOOD FINISHES

A. Transparent Finish: Prepare surfaces by machine sanding, supplemented by hand sanding where required, followed by application of sealer coats and transparent topcoats of type, in number, and by process standard with manufacturer. Apply to wood surfaces, except where otherwise indicated.

B. Painted Plywood: Manufacturer's standard wear-resistant finish in manufacturer's standard color.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas where telescoping stands are to be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of telescoping stands. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install telescoping stands to comply with manufacturer's instructions and Shop Drawings. Provide accessories indicated and anchors, fasteners, inserts, and other items required for installing and attaching units to adjoining construction.

3.03 ADJUSTING AND CLEANING

A. On completion of installation, including work of other trades, lubricate, test, and adjust each telescoping stand unit to operate easily and to comply with manufacturer's specifications.

B. Clean installed telescoping stands on exposed and semi-exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

3.04 DEMONSTRATION

A. Engage a factory-authorized service representative to demonstrate and train Owner's maintenance personnel as specified below.
   1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
   2. Train Owner's maintenance personnel on procedures and schedules related to operation, troubleshooting, servicing, inspection, and maintenance.

B. Review data in the operation and maintenance manuals. Refer to Division 1 Section "Contract Closeout."

C. Schedule training with Owner, through Architect, with at least 7 days' advance notice.

3.05 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure telescoping stands are without damage or deterioration at the time of Substantial Completion.

END OF SECTION

SECTION 12 93 00

SITE FURNISHINGS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Bicycle racks.

1.02 SUBMITTALS

A. Product data for each type of outdoor furnishings specified, with installation instructions for each unit built-in or connected to other construction. Include methods of installation for each type of substrate.

B. Shop drawings showing installation details of accessories permanently affixed to construction, including full scale installation details of special conditions.

C. Samples for initial selection purposes consisting of manufacturer's standard size samples showing full range of colors, textures, and patterns available for each type of accessory required.

D. Samples for verification purposes in full size units of each type of building accessory indicated.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firm (material producer) with not less than 3 years of production experience, who’s published literature clearly indicates general compliance of products with requirements of this section.

B. Single Source Responsibility: Provide material produced by a single manufacturer for each outdoor furnishing type.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to project site in original factory wrappings and containers, clearly labeled with identification of manufacturer, brand name, and lot number. Store materials in original undamaged packages and containers, inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity. Store materials laid flat and blocked off from the ground or slab to prevent sagging and warping.

B. Comply with instructions and recommendations of manufacturer for special delivery, storage, and handling requirements.

1.05 SEQUENCE AND SCHEDULING

A. Sequence outdoor furnishing installation with other work to minimize possibility of damage and soiling during remainder of construction period.

1.06 MAINTENANCE

A. Maintenance Instructions: Submit manufacturer's printed instructions for maintenance of installed work, including methods and frequency recommended for maintaining optimum condition under anticipated use conditions. Include precautions against materials and method which may be detrimental to finishes and performance.

B. Deliver extra materials to Owner. Furnish replacement materials described below from same production run as materials installed. Package replacement materials with protective covering, identified with appropriate labels.
   1. For each item indicated, furnish quantity of units equal to 5 percent of amount installed.

PART 2 PRODUCTS

2.01 COMPONENTS

A. Bicycle Racks:
   1. Formed steel pipe, nominal 2 inch (50.8 mm) diameter Sched.40, seamless, embedded in concrete footings at each end; capacity of 13 bikes; galvanized finish.
      a. Furnish 1/2-inch diameter lock bar welded to each vertical member.
   2. Basis-of-Design: Bike Security Racks Co., www.bikeracks.com, Model BS-12-AE.

2.02 FABRICATION

A. Provide accessory items, both free standing and permanently installed, equipped with functions as specified. Fabricate units with tight seams and joints, exposed metal edges rolled. Manufacturer or product identification on exposed surfaces is unacceptable. Provide products with smooth welds, consistent finish with no evidence of wrinkling, chipping, uneven coloration, dents, or other imperfections.

PART 3 EXECUTION

3.01 INSTALLATION

A. Verify that materials are those specified before installing.

B. Install outdoor furnishings after other finishing operations, including painting, have been completed.

C. Site Furnishing Units: Install accessories complying with manufacturer's printed instruction, using fasteners as recommended by manufacturer as appropriate to substrate.

D. Adjust site furnishing items for proper operation. Clean and polish exposed surfaces, using materials and methods recommended by the manufacturer.

3.02 PROTECTION

A. Protect site furnishings against damage during remainder of construction period, complying with manufacturer's directions.

END OF SECTION

SECTION 14 24 23

MRL HYDRAULIC PASSENGER ELEVATORS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Hydraulic passenger elevators as shown and specified. Elevator work includes:
   1. Type: Standard capacity pre-engineered hydraulic passenger elevators with finished cab interiors.
   2. Elevator car enclosures, hoistway entrances, and signal equipment, 2 or 3-stage jacks.
   3. Equipment, machines, controls, systems and devices as needed for safely operating the specified elevators at their rated speed and capacity.
   4. Accessibility provisions for physically disabled persons.
   5. Materials and accessories as required to complete the elevator installation.
   6. Emergency Communication System: Integrated emergency telephone system as manufactured by Honeywell or Bosch, coordinated with the elevator control system.

B. Related Sections:
   1. Section 03 30 00 - Cast-In-Place Concrete: Installing inserts, sleeves, and anchors in concrete. Concrete for foundation and pit.
   2. Division 5 Sections - Structural Steel and Metals:
      a. Providing hoist beams, pit ladders, steel framing, auxiliary support steel and divider beams for supporting guide-rail brackets.
      b. Providing steel angle sill supports and grouting hoistway entrance sills and frames.
   3. Section 07 13 00 - Sheet Waterproofing: Waterproofing of elevator pits.
   4. Division 08 - Access Control System: Elevator manufacturer to provide and install hall control stations coordinated with Owner’s key control system for elevator access.
   5. Division 9 Sections - Finishes:
      a. Providing elevator car finish flooring and field painting of unfinished primed ferrous materials.
      b. Gypsum Board Assemblies: Rated shaft walls where indicated.
   6. Division 22 Sections - Plumbing:
      a. Sump pump and oil interceptor.
   7. Division 26 Sections - Electrical:
      a. Providing electrical service to elevators, including fused disconnect switches.
      b. Emergency power supply, transfer switch and auxiliary contacts.
      c. Heat and smoke sensing devices.
      d. Convenience outlets and illumination in hoistway and pit.
      e. CAT5E and coax cabling in travelway for camera and telephone.

C. Other Related Work Not Included in This Section: The following work is provided by other trades in accordance with the requirements of the Model Building Code and ANSI A17.1 Code.
   1. Elevator hoist beam to be provided at top of elevator shaft. Beam to accommodate proper loads and clearances for elevator installation and maintenance.

a. Include all inserts, anchors, bearing plates, brackets, supports, and bracing including all setting templates and diagrams for placement

2. Hoistway walls with a minimum two-hour fire rating. Hoistway shall be clear and plumb with variations not to exceed 1/2” at any point.
3. Elevator hoistways to have temporary barricades as required.
4. Install bevel guard at 75 degrees on all recesses, projections or setbacks over 2” (4” for A17.1 2000 areas) except for loading or unloading.
5. Provide rail bracket supports at pit, each floor and roof. For guide rail bracket supports, provide divider beams between hoistway at each floor and roof.
6. Pit floor shall be level and free of debris. Reinforce dry pit to sustain normal vertical forces from rails and buffers.
7. Where pit access is by means of the lowest hoistway entrance, a vertical ladder of non-combustible material extending 42” minimum (48” minimum for A17.1-2000 areas) shall be provided at the same height above sill of access door or handgrips.
8. Access to the machinery space must be in accordance with the governing authority or code.
9. Provide cutouts as required for oil line and wiring duct, coordinated with elevator contractor at the building site. Final sealing of all penetrations.
10. All wire and conduit shall run remote from the hoistway. Final sealing of all penetrations in hoistway.
11. When heat, smoke, or combustion sensing devices are required contacts on the sensors shall be sized for 120 volt D.C.
12. Install and furnish finished flooring in elevator cab.
13. Finished floors and entrance walls shall not be constructed until after sills and door frames are in place. Coordinate rough opening size with elevator contractor. When drywall construction is used, provide cold-form metal framing as required to maintain fire resistance rating.
14. Where drywall construction is used for front walls, it shall be of sufficient strength to maintain the doors in true lateral alignment. Coordinate with elevator contractor.
15. Before erection of rough walls and doors, erect hoistway sills, headers, and frames. After rough walls are finished, erect fascias and toe guards. Set sill level and slightly above finished floor at landings.
16. To maintain legal fire rating in masonry construction, door frames shall be anchored to walls and properly grouted in place.
17. The elevator wall shall interface with the hoistway entrance assembly and be coordinated with the elevator contractor’s requirements.
18. Fill and grout around entrances as required.
19. Elevator sill supports shall be provided at each opening.
20. All walls and sill supports must be plumb where openings occur.
21. Jack Hole: Not applicable.
22. Locate a light fixture and convenience outlet in pit with switch located adjacent to the access door.
23. A light switch and fused disconnect switch for each elevator shall be located per the National Electrical Code (NFPA No. 70).
24. Provide a light outlet for each elevator in center of hoistway. Coordinate location with elevator contractor.
25. For signal systems and power operated door provide ground and branch wiring circuits, including main line switch. For car light and fan provide a feeder and branch wiring circuits, including main line switch.

26. Adjust wall thicknesses shown with actual fixture requirements. Coordinate with elevator contractor.
27. Provide supports, patching and recesses to accommodate hall button boxes, signal fixtures, etc.
28. Locate telephone and convenience outlets on control panel.
29. Controller landing wall thickness must be a minimum of 8 1/2 inches thick. This is due to the controller being mounted on the second floor landing in the door frame on the return side of the door. For center opening doors, the controller is located on the right hand frame (from inside the elevator cab looking out). These requirements must be coordinated between the general contractor and the elevator contractor.

1.02 REFERENCE STANDARDS

A. ANSI - Power Operated Pedestrian Doors; 2005.

B. ASME A17.1 - Safety Code for Elevators and Escalators Includes Requirements for Elevators, Escalators, Dumbwaiters, Moving Walks, Material Lifts, and Dumbwaiters with Automatic Transfer Devices; 2019, with Errata (2021).

C. ASME A17.2 - Guide for Inspection of Elevators, Escalators, and Moving Walks Includes Inspection Procedures for Electric Traction and Winding Drum Elevators, Hydraulic Elevators, Inclined Elevators, Limited-Use/Limited-Application Elevators, Private Residence Elevators, Escalators, Moving Walks, Dumbwaiters, and Material Lifts; 2023.

D. ASTM A 666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar; 2023.

E. ISO 9001 - Quality Management Systems — Requirements; 2015, with Amendment (2024).

F. ISO 14001 - Environmental Management Systems — Requirements with Guidance for Use; 2015, with Amendment (2024).

G. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

I. NFPA 72 - National Fire Alarm and Signaling Code; Most Recent Edition Cited by Referring Code or Reference Standard.

J. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.

1.03 PRE-INSTALLATION SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal requirements.

B. Shop Drawings:
1. Show equipment arrangement in the control space, pit, and hoistway. Provide plans, elevations, sections and details of assembly, election, anchorage, and equipment location.
2. Indicate elevator system capacities, sizes, weights, performances, safety features, finishes and other pertinent information.

3. Show floors served, travel distances, maximum loads imposed on the building structure at points of support and all similar considerations for the elevator work.
4. Indicate electrical power requirements and branch circuit protection device recommendations.
5. Submit details and information regarding:
    a. Location and means for disconnect.
    b. Motor and hydraulic pump, valves, piping, controller, selector, and other component locations.
    c. Car, guide rails, buffers, and other components in hoistway.
    d. Rail bracket spacing; maximum loads imposed on guide rails requiring load transfer to building structural framing.
    e. Clearances and over-travel of car.
    f. Locations in hoistway of connections for car light and telephone.
    g. Location and sizes of access doors, doors, and frames.
    h. Interface with building security system.
    i. Visible and audible signal operation.

C. Powder Coat Paint Selection: Submit manufacturer's standard selection charts for exposed finishes and materials.

D. Plastic Laminate Selection: Submit manufacturer's standard selection charts for exposed finishes and materials.

E. Metal Finishes: Provide samples for specified metal finishes.

1.04 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

B. Operation and Maintenance Data:
1. Owner's Manual and Wiring Diagrams.
2. Parts list, with recommended parts inventory.
3. Include parts catalog with complete list of equipment replacement parts; identify each entry with equipment description and identifying code.
4. Include technical information for servicing operating equipment.
5. Include legible schematic of hydraulic piping and wiring diagrams of installed electrical equipment and changes made in the Work. List symbols corresponding to identity or markings on hoistway apparatus.
6. Include one copy of master electric and hydraulic schematic and one copy of lubrication chart.
7. Provide 2 sets of all keys required for operation and maintenance.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: An approved manufacturer with minimum fifteen years' experience in manufacturing, installing, and servicing elevators of the type required for the project.
1. Elevator manufacturer shall be the manufacture of the power unit, controller, signal fixtures, door operators, cab entrances, and all other primary parts of the elevator operating equipment.

a. The major parts of the elevator equipment shall be manufactured in the United States and not be an assembled system.

B. Installer Qualifications: The manufacturer or an authorized agent of the manufacturer with not less than fifteen years of satisfactory experience installing elevators equal in character and performance to the Project elevators.

C. Regulatory Requirements
1. ASME/ANSI A17.1 Safety Code for Elevators and Escalators, latest edition or as required by the local building code. ASME A17.2.2 - Inspector's Manual for Hydraulic Elevators.
2. International Building Code.
3. NFPA 70, National Electrical Code.
4. NFPA 80, Fire Doors and Windows
5. Americans With Disabilities Act Accessibility Guidelines (ADAAG).
6. Texas Accessibility Standards (TAS).

D. Fire Rated Entrance Assemblies: Opening protective assemblies Including frames, hardware and operation shall comply with ASTM E2074, UL10(B), and NFPA 80. Provide entrance assembly units bearing Class B or 1-1/2 hour label by a Nationally Recognized Testing Laboratory.
1. Attach label from agency approved by authority having jurisdiction to identify each fire rated door.

E. Inspection and Testing: Elevator contractor shall obtain and pay for all required inspections, tests, permits and fees for elevator installation.
1. Arrange for inspections and make required tests.
2. Deliver to the Owner upon completion and acceptance of elevator work.

1.06 PRE-INSTALLATION MEETINGS

A. Section 01 31 19 – Project Meetings: Schedule and coordinate pre-installation meeting that includes the trade(s) for the work of this Section and other trades that whose work is related to the work of this Section.

B. Convene minimum one week prior to commencing work of this section.

C. Require attendance of persons directly involved with Work of this section.

D. Review schedule of installation, installation procedures and conditions, and coordination with related work.
1. Review temporary use of elevator for construction purposes, hours of use, scheduling of its use, cleanliness of cab, employment of operator, and maintenance of system.

1.07 DELIVERY STORAGE AND HANDLING

A. Manufacturer shall deliver elevator materials, components and equipment to location of safe and secure storage at the Project site.

1.08 PROJECT USAGE

A. Obtain approval from elevator contractor for temporary usage of installed elevator during any period prior to Substantial Completion of Project and inspection and acceptance of the elevator installation.

1.09 WARRANTY

A. Reference Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Issue to Owner the elevator manufacturer’s standard written warranty agreeing to repair, restore, or replace defects in in elevator materials or workmanship unless due to ordinary wear and tear or improper use or care for a minimum of 12-months after Date of Substantial Completion of the Project, and inspection and completion of the elevator installation.

1.10 MAINTENANCE

A. Furnish maintenance and call-back service beginning at date of Substantial Completion for the Project. Provide a minimum of 12-months' full maintenance service by skilled employees of the elevator contractor. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. Provide parts and supplies as used in the manufacture and installation of original equipment.

B. Initial Maintenance Service:
   1. Perform maintenance, including emergency callback service, during normal working hours.
      a. Include 24-hour-per-day, 7-day-per-week emergency callback service.
      b. Response Time: Two hours or less
   2. Manufacturer shall have a service office and full time service personnel within a 50-mile radius of the Project.

C. Continuing Maintenance Proposal: Provide a continuing maintenance proposal from Installer to Owner, in the form of a standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.
   1. Include with proposal assisting building maintenance personnel with yearly cleaning of cab and hoistway glazing.

D. Maintain locally, near Place of the Work, adequate stock of parts for replacement or emergency purposes. Have personnel available to ensure fulfillment of this maintenance service, without unreasonable loss of time.

E. Do not assign or transfer maintenance service to agent or subcontractor without prior written consent of Owner.

PART 2 PRODUCTS

2.01 HYDRAULIC PASSENGER ELEVATORS

A. Manufacturers:
   1. Thyssenkrupp; www.tkelevator.com/us-en
   2. Otis Elevator Co.; www.otis.com

3. Substitutions: Section 01 60 00 - Product Requirements.

B. Emergency Communication System:
1. Honeywell International Inc.; www.honeywell.com
2. Bosch Security Systems; www.boschsecurity.com
3. Substitutions: Under provisions of Section 01 60 00.

2.02 SYSTEM DESIGN

A. Basis of Design: *Endura MRL* with components, materials, operation, and system requirements as manufactured and determined by Thyssenkrupp or approved equivalent by specified manufacturer.

2.03 MATERIALS, GENERAL

A. Colors, Patterns, and Finishes: As selected by the Architect from manufacturer's standard colors, patterns, and finish charts.

B. Carbon Steel:
1. Shapes and Bars: Carbon.
2. Sheet: Cold-rolled steel sheet, commercial quality, Class 1, matte finish.
3. Finish for Exposed Metals: Factory-applied baked enamel.

C. Stainless Steel:
1. ASTM A 666 - Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
2. Provide Type 304 with #4 satin polished finish for front return panel, recessed base, cab and hoistway doors and frames, control panel faces, hand railing, pad hooks, certificate frames, and other items as may be specifically indicated as stainless steel in these specifications.

D. Plastic Laminate: Decorative high-pressure type, complying with NEMA LD 3, Type GP-50 General Purpose Grade, nominal 0.050" thickness.

E. Finish Flooring: Provided under Division 9 Section, not to exceed 3/8" installed thickness.

F. Sills: Mill finish extruded aluminum.

2.04 HOISTWAY EQUIPMENT

A. Platform: Fabricated frame of formed or structural steel shapes, gusseted and rigidly welded with a wood stiffener. Underside of the platform shall be fireproofed. The car platform shall be designed and fabricated to support one-piece loads weighing up to 25% of the rated capacity.

B. Sling: Steel stiles affixed to a steel crosshead and bolstered with bracing members to remove strain from the car enclosure.

C. Guide Rails: Steel, omega shaped, fastened to the building structure with steel brackets.

D. Guide Shoes: Slide guides shall be mounted on top and bottom of the car.

E. Buffers: Provide substantial buffers in the elevator pit. Mount buffers on a steel template that is fastened to the pit floor or continuous channels fastened to the elevator guide rail and securely anchored to the pit floor. Provide extensions if required by project conditions.

F. Jacks:
   1. Jack units shall be of sufficient size to lift the gross load to the height specified. Factory test jacks to ensure adequate strength and freedom from leakage.
   2. Brittle material, such as gray cast iron, is prohibited in the jack construction.
   3. Provide the following jack type: Twin post holeless telescopic 2 or 3-stage as required for the particular travel dimension. Two jacks piped together, mounted one on each side of the car with each having two telescopic sections designed to extend in a synchronized manner when oil is pumped Into the Assembly.
   4. Each jack section shall be guided from within the casing or the plunger assembly used to house the section. Each plunger shall have a high-pressure sealing system which will not allow for seal movement or displacement during the course of operation.
   5. Each Jack Assembly shall have a check valve built into the assembly to allow for automatically re-syncing the two plunger sections by moving the jack to its fully contracted position.
   6. The jack shall be designed to be mounted on the pit floor or in a recess in the pit floor.
   7. Each jack section shall have a bleeder valve to discharge any air trapped in the section.

G. Automatic Self-Leveling: Provide each elevator car with a self-leveling feature to automatically bring the car to the landings and correct for overtravel or undertravel. Self-leveling shall within its zone, be automatic and independent of the operating device. The car shall be maintained approximately level with the landing irrespective of its load.

H. Wiring, Piping, and Oil: Provide all necessary hoistway wiring in accordance with the National Electrical Code. All necessary code-compliant pipe arid fittings shall be provided to connect the power unit to the jack unit. Provide proper grade readily biodegradable oil as specified by the manufacturer of the power unit. See Power Unit below for additional requirements.

2.05 POWER UNIT

A. Power Unit (Oil Pumping and Control Mechanism): A self-contained unit consisting of the following items:
   1. Oil reservoir with tank cover.
   2. An oil hydraulic pump.
   3. An electric motor.
   4. Oil control valve with the following components built into single housing; high pressure relief valve, check valve, automatic unloading up start valve, lowering and leveling valve, and electro-magnetic controlling solenoids.

B. Pump: Positive displacement type pump specifically manufactured for oil-hydraulic elevator service. Pump shall be designed for steady discharge with minimum pulsation to give smooth and quiet operation. Output of pump shall not vary more than 10-percent between no load and full load on the elevator car.

C. Motor: Standard manufacture motor specifically designed for oil-hydraulic elevator service. Duty rating shall be selected for specified speed and load.

D. Control System: Shall be microprocessor based and protected from environmental extremes and excessive vibrations in a NEMA 1 enclosure.

E. Oil Control Unit: The following components shalt be built into a single housing. Welded manifolds with separate valves to accomplish each function are not acceptable. Adjustments shall be accessible and be made without removing the assembly from the oil line.
   1. Relieve valve shall be externally adjustable and be capable of bypassing the total oil flow without increasing back pressure more than 10-percent above that required to barely open the valve.
   2. Up-start and stop valve shall be adjustable and designed to bypass oil flow during start and stop of motor pump assembly. Valve shall close slowly, gradually diverting oil to or from the jack unit, ensuring smooth up-starts arid up-stops.
   3. Check valve shall be designed to close quietly without permitting any perceptible reverse flow.
   4. Lowering valve and leveling valve shall be adjustable for down-start speed, lowering speed, leveling speed, and stopping speed to ensure smooth "down" starts and stops. The leveling valve shall be designed to level the car to the floor in the direction the car is traveling after slowdown is initiated.

F. Solid State Starting: Provide an electronic starter featuring adjustable starting currents.

G. Oil Type: USDA Certified bio-based product, ultra-low toxicity, readily biodegradable, energy efficient, high performing fluid made from canola oil with antioxidant, anti-corrosive, anti-foaming, and metal-passivating additives. Especially formulated for operating in environmentally sensitive areas. USDA certified bio-based product, >90% bio-based content, per ASTM D6855.

2.06 HOISTWAY ENTRANCES

A. Doors and Frames: Provide complete hollow sandwich panel hoistway entrances at each hoistway opening bolted/knock-down construction.
   1. Manufacturer’s standard entrance design consisting of hangers, doors, hanger supports, hanger covers, fascia plates, sight guards, and necessary hardware.
   2. Finish: Stainless steel, flush design, rolled profiles, rigid construction. Fabricate front return panels same as doors.

B. Interlocks: Equip each hoistway entrance with an approved type interlock tested as required by code. Provide door restriction devices as required by code.
   1. Door Hanger and Tracks: Provide sheave type two-point suspension hangers and tracks for each hoistway horizontal sliding door.
   2. Sheaves: Polyurethane tires with ball bearings properly sealed to retain grease.
   3. Hangers: Provide an adjustable device beneath the track to limit the up-thrust of the doors during operation.
   4. Tracks: Drawn steel shapes, smooth surfaced and shaped to conform to the hanger sheaves.

C. Hoistway Sills: Extruded metal, with grooves in top surface. Provide mill finish on aluminum.

2.07 CAR ENCLOSURE

A. Car Enclosure:
   1. Walls:
      a. Walls: Cab type TKLP, durable wood core finished on both sides with high pressure plastic laminate.

2. Canopy: Cold-rolled steel with hinged exit.
3. Ceiling: Suspended type, fluorescent lighting with translucent diffuser mounted in a metal frame.
4. Cab Fronts, Return, Transom, Soffit, and Strike: Provide panels faced with brushed stainless steel.
5. Doors: Horizontal sliding car doors reinforced with steel for panel rigidity. Hang doors on sheave type hangers with polyurethane tires that roll on a polished steel track and are guided at the bottom by non-metallic sliding guides.
6. Cab Doors: Stainless steel, of hollow sandwich panel construction, flush design, rolled profiles, rigid construction. Fabricate front return panels same as doors.
7. Cab Door Frames: Stainless steel, welded corner design with smooth invisible joints
8. Handrail: Provide 1.5” diameter cylindrical stainless steel railing on rear wall. Handrail shall have a No. 4 brushed finish.
9. Base: Stainless steel, recessed.
10. Pad Hooks: Stainless steel.
11. Protective Pads: One set per each cab, full-height canvas cover, padded with sponge fill material, sewn with piping edges; factory installed stainless steel grommets for mounting to pad hooks. Pads fabricated to cover rear wall, both side walls, and front return; provide cut-out for control panel.

B. Car Top Inspection: Provide a car top inspection station with an "Auto-Inspection” switch, an “Emergency Stop" switch, and constant pressure "up and down" direction and safety buttons to make the normal operating devices inoperative. The station shall give the inspector complete control of the elevator. Car top inspection station shall be mounted in the door operator assembly.

2.08 DOOR OPERATION

A. Door Operation: Provide a direct current motor-driven heavy duty operator designed to operate the car and hoistway doors simultaneously. Door movements shall be electrically cushioned at both limits of travel, and the door operating mechanism shall be arranged for manual operation in event of power failure. Doors shad automatically open when the car arrives at the landing arid automatically dose after an adjustable time interval or when the car is dispatched to another landing. Closed-loop, microprocessor controlled motor-driven linear' door operator with adjustable torque limits are also acceptable. AC controlled units with oil checks or other deviations are not acceptable.
   1. No Unnecessary Door Operation: The car door shall open only if the car is stopping for a car or hall call, answering a car or hall call at the present position, or selected as a dispatch car.
   2. Door Open Time Saver: if a car is stopping in response to a car call assignment only (no Coincident hall call), the current door hold open time is changed to a shorter field programmable time when the electronic door protection device is activated.
   3. Double Door Operation: When a car stops at a landing with concurrent up and down hall calls, no car calls, and no other hall call assignments, the car door opens to answer the hall call in the direction of the car's current travel. If an onward car call is riot registered before the door closes to within 6-inches of fully dosed, the travel will reverse and the door will reopen to answer the other call.
   4. Nudging Operation: The doors shall remain open as long as the electronic detector senses the presence of a passenger or object in the door opening. If door closing is prevented for a field programmable time, a buzzer will sound. When the obstruction is removed, the door will begin to close at reduced speed. If the infra-red door protection

system detects a person or object while closing on nudging, the doors will stop and resume closing only after the obstruction has been removed.

5. Limited Door Reversal: If the doors are closing and the infra-red beam is interrupted, the doors will reverse and reopen partially. After the obstruction is cleared, the doors will begin to close.
6. Door Open Watchdog: If the doors are opening but do not fully open after a field-adjustable time, the doors will recycle closed and then attempt to open six times to try and correct the fault.
7. Door Close Watchdog: If the doors are closing, but do not fully close after a field adjustable time, the doors will recycle open and then attempt to close six times to try and correct the fault.
8. Door Close Assist: When the doors have failed to fully close and are in the recycle mode, the door drive motor shall have increased torque applied to possibly overcome mechanical resistance or differential air pressure and allow the door to close.

B. Door Protection Devices: Provide a door protection system using 150 or more microprocessor-controlled infra-red light beams. The beams shall project across the car opening detecting the presence of a passenger or object. If door movement is obstructed, the doors shall immediately reopen.

2.09 CAR OPERATING STATION

A. Car Operating Station, General: The main car control in each car shall contain the devices required for specific operation mounted in an integral swing return panel requiring no applied faceplate. Swing return and main car operating panel shall have a satin or brushed stainless steel finish. The main car operating panel shall be mounted in the return and comply with TAS handicap requirements. Pushbuttons that illuminate blue using long lasting LED's shall be included for each floor served, and emergency buttons and switches shall be provided per code. Switches for car light and accessories shall be provided.

B. Emergency Communications System: Integral phone system provided.

C. Auxiliary Operating Panel: Not required.

D. Column-Mounted Car Riding Lantern: A car riding Lantern shall be installed in the elevator cab and located in the entrance jamb. The lantern, when illuminated, shall indicate the intended direction of travel. The lantern shall illuminate and a signal will sound when the car arrives at a floor where it will stop. The lantern shall remain illuminated until the door(s) begin to close.

E. Special Equipment: Card-key access operation in each hall station, coordinated with Owner’s master card-key system.

1. Hall Call Lock-out: Incorporate card-operated switch that when activated permits hall call registration for that landing only.
2. “Security control” operation shall not override or affect emergency firefighters' standard keyed access and operation.

F. Fire Department Communication System: Telephone jack or other device in compliance with local requirements, with conductors in traveling cable.

G. Emergency Communication System: Provide system that complies with ASME A17.1, local and state governing authorities, and the Texas Department of Licensing and Regulation’s (TDLR), Texas Accessibility Standards (TAS).

1. System Basis of Design: Provide Honeywell (Viking/Specialty equivalents) or Bosch emergency phone modules designed for flush-mounting within the car operating station.
2. Operation: Upon activation, the system shall automatically dial a preprogrammed 24-hour monitoring station.
3. Visual Indicators: System shall provide "Call Placed" and "Call Received" LED indicators in accordance with ASME A17.1 Section 2.27.1.1.3.
4. Interface: Provide necessary VoIP or Analog interface modules as required to connect the car's emergency phone to the building's central security backbone.

2.10 CONTROL SYSTEMS

A. Controller: The elevator control system shall be microprocessor-based and software oriented. Control of the elevator shall be automatic in operation by means of push buttons in the car numbered to correspond to floors served, for registering car stops, and by "up-down" push buttons at each intermediate landing, and “call" push buttons at terminal landings.

B. Automatic Light and Fan Shut-Down: The control system shall evaluate the system activity and automatically turn off the cab lighting and ventilation fan during periods of inactivity. The setting shall be field-programmable.

C. Shunt Trip: Provide means installed in accordance with NFPA 72 to automatically disconnect power supply to elevator prior to activating automatic sprinkler within elevator hoistway room.

2.11 HALL STATIONS

A. Hall Stations – General: Provide buttons with blue-illuminating LED halos to indicate that a call has been registered at that floor for the indicated direction. Provide one set of pushbutton risers. Provide one pushbutton riser with faceplates having a satin stainless steel finish.
   1. Phase 1 firefighter’s service key switch complete with instructions, shall be incorporated into the hall station at the designated level.

B. Floor Identification Pads: Provide door jamb pads at each floor. Jamb pads shall comply with TAS and ADA requirements.

C. Visible and Audible Signals: Signals shall meet requirements of ADA, TAS, local code requirements, and these specifications:
   1. At Each Hoistway Entrance: Indicators as specified below are required regardless of number of building floors or number of hoistways.
   2. Visible indicator shall indicate a car’s arrival, which car is answering a call (for multiple cars), and the car’s direction of travel.
      a. Audible indicator shall verbally announce a car’s arrival, which car is answering a call (for multiple cars), and the car’s direction of travel. Announcement shall be in English language that can be heard and understood from any position within 10 feet (304.8 cm) of hoistway.
   3. At Each Cab Interior:
      a. Visible indicator shall indicate the floor level when arriving at each stop. Panel buttons shall indicate which floors have been selected for a stop.
      b. Audible indicator shall verbally announce the floor level when arriving at each stop. Announcement shall be in English language that can be heard and understood from any position within the cab.

2.12 MISCELLANEOUS ELEVATOR COMPONENTS

A. Oil Hydraulic Silencer: Install an oil hydraulic silencer (muffler device) at the power unit location. The silencer shall contain pulsation-absorbing material inserted in a blowout-proof housing arranged for inspecting interior parts without removing unit from oil line.

B. Oil Viscosity Control: Provide a means to maintain constant oil viscosity when the elevator is not in use.

2.13 ELECTRICAL COMPONENTS

A. Motors: NEMA MG 1.

B. Disconnect Switch: Factory mount disconnect switch in control panel on equipment.

C. Boxes, Conduit, Wiring, and Devices.

D. Fittings: Steel compression type for electrical metallic tubing. Fittings with set screws are acceptable only when separate grounding conductor is also installed across joint.

E. Spare Conductors: Include 10 percent extra conductors and two pairs of shielded audio cables in traveling cables. Do not parallel conductors to increase electric current capacity unless individually fused.

F. Do not use armored flexible metal conduit as grounding conductor.

G. Include wiring and connections to elevator devices remote from hoistway.

H. Furnish CAT5E and coax cable in travelway for camera and telephone.

2.14 MISCELLANEOUS FACTORY FINISHING

A. Structural Metal Surfaces: Clean surfaces of rust, oil or grease; wipe clean with solvent, prime two coats.

B. Galvanized Surfaces: Clean with neutralizing solvent, prime one coat.

C. Wood Surfaces Not Exposed to Public View: One coat primer; one coat enamel.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Before starting elevator installation, inspect hoistway, hoistway openings, pits control space as constructed and verify all critical dimensions, examine supporting structures and all other conditions under which elevator work is to be installed. Do not proceed with elevator installation until unsatisfactory conditions have been corrected. Beginning elevator installation indicates acceptance of construction by other trades.

B. Verify electrical power is available and of correct characteristics.

C. Beginning elevator installation operations indicates acceptance of existing conditions and responsibility for satisfactory performance.

3.02 INSTALLATION

A. Install elevator system components and coordinate installation of hoistway wall construction.
   1. Work shall be performed by competent elevator installation personnel in accordance with ASME A17.1, manufacturer's printed installation instructions, and approved shop drawings.
   2. Comply with National Electrical Code for electrical work required during installation.
   3. Coordinate installation of hoistway wall construction.
   4. Install system components. Connect equipment to building utilities. Install piping between hoistway plunger and pump unit.
   5. Mount motor and pump unit on vibration and acoustic isolators. Securely fasten to building supports. Prevent lateral displacement.
   6. Field Welds: Chip and clean away oxidation and residue, wire brush; spot prime with two coats.
   7. Install hoistway door sills, frames, and headers in hoistway walls. Set entrances in vertical alignment with car openings and aligned with plumb hoistway lines.

B. Coordination: Coordinate elevator work with the work of other trades for proper time and sequence to avoid construction delays. Use benchmarks, lines, and levels designated by the Contractor to ensure dimensional coordination of the Work.

C. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with cars. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum safe, workable dimensions at each landing.
   1. Install guide rails using threaded bolts and lock washers under nuts. Compensate for expansion and contraction movement of guide rails. Accurately align guide rails. Form smooth joints with machined splice plates. Bolt or weld brackets directly to structural steel hoistway framing. Make rails plumb and parallel to each other within 1/16 inch (1.59 mm).

D. Lubricate operating parts of system where recommended by manufacturer.

E. Emergency Communication System:
   1. Install the Honeywell or Bosch communication module within the car operating station return panel using tamper-resistant fasteners.
   2. Coordinate with Division 26 for the termination of CAT5E/Audio cabling at the elevator controller and the transition to the building's communication network.
   3. Ensure the microphone and speaker apertures are not obstructed by car interior finishes or pad hooks.

3.03 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Acceptance Testing: Upon completion of the elevator installation and before permitting use of elevator, perform acceptance tests as required by A17.1 Code and local authorities having jurisdiction. Perform other tests as may be required by governing regulations or agencies. Perform tests required by ASME A17.2.2.
   1. Test the emergency communication system for clarity of two-way voice communication.
   2. Verify the "Location Identification" signal correctly reports the building address and elevator number (e.g., "Elevator No. 1 - Crosby 6th Grade Center") to the monitoring station.

3. Test the battery backup to ensure functionality for a minimum of 4 hours during a primary power failure.

C. Arrange for final inspection by state elevator inspector, and provide copies of inspection report to Owner, Contractor, and Architect.

D. Advise Owner, Contractor, Architect, and governing authorities in advance of dates and times tests are to be performed on the elevator.

3.04 ADJUSTING

A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting and balancing.

B. Make necessary adjustments of operating devices and equipment to ensure elevator operates smoothly and accurately.

C. Adjust equipment for smooth and quiet operation, with no objectionable lateral or oscillating movement or vibration. Adjust for smooth acceleration and deceleration of car so not to cause passenger discomfort.

D. Adjust automatic floor leveling feature at each floor to provide stopping zone of 1/4 inch (6.35 mm).

E. Lubricate operating parts of system as recommended by manufacturer.

3.05 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Remove protective coverings from finished surfaces and clean surfaces and components ready for inspection.

C. Before final acceptance, remove protection from finished surfaces and clean and polish surfaces in accordance with manufacturer’s recommendations for type of material and finish provided. Stainless steel shall be cleaned with soap and water and dried with a non-abrasive surface. Do not use bleach-based cleansers.

D. At completion of elevator work remove tools, equipment, and surplus materials from site. Clean equipment areas and hoistways. Remove trash and debris and leave area broom clean.

3.06 PROTECTION

A. Section 01 70 00 - Execution and Closeout Requirements: Protecting installed construction.

B. During construction and after completion of elevator work, provide suitable protective coverings, barriers, devices, signs, or similar methods or procedures to protect elevator work from damage or deterioration. Maintain protective measures until Substantial Completion of the Project.

C. Do not permit construction traffic within cab after final cleaning.

3.07 DEMONSTRATION

A. Instruct Owner's personnel in proper use, operation, and daily maintenance of elevators. Review emergency provisions, including emergency access and procedures to be followed at time of failure in operation and other building emergencies. Train owner's personnel in normal procedures to be followed in checking for sources of operational failures or malfunctions.

B. Make a final check of each elevator operation with Owner's personnel immediately before date of Substantial Completion of the Project. Determine that control systems and operating devices are functioning properly.

3.08 SCHEDULE

A. Standard Capacity Passenger Elevator:
   1. Elevator Type: Above-ground, 2 or 3 stage dual jacks.
   2. Machine Room: None required.
   3. Rated Capacity: 4000 lbs.
   4. Rated Speed: 125 feet (3810 cm)/minute DOWN.
   5. Travel Distance: As indicated.
   6. Landings: 2 total.
   7. Openings:
      a. Front: 2.
      b. Rear: 0
   8. Clear Car Inside: Nominal 7'-8" wide x 5'-5" deep.
   9. Cab Ceiling Height: 7'-9".
   10. Door Opening Entrance Size: 3'-6" wide x 7'-0" high.
   11. Door Type: Single-speed, bi-parting.
   12. Power Characteristics: 460 volts, 3-phase, 60-Hz.
   13. Seismic Requirements: Zone 1.
   14. Fixture and Button Style: Signa4 signal fixtures.
   15. Special Operations: Limited Access, key operated.

END OF SECTION

Project Manual

January 26, 2026

STANTEC Project No. 21400 1329

Crosby Sixth Grade Center

Crosby Independent School District

Crosby, Texas



01.26.2026

Issue for Permit and Proposal

Volume 2 of 2

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SECTION 00 01 01 – PROJECT TITLE PAGE

TITLE AND LOCATION OF THE WORK:

CROSBY SIXTH GRADE CAMPUS
Red Summit Dr.
Crosby, TX 77532



01.26.2026

NAME AND ADDRESS OF THE OWNER:

CROSBY INDEPENDENT SCHOOL DISTRICT
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281-664-1900

TITLE OF DOCUMENTS BOUND HEREWITH:

TITLE PAGE
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END OF MASTER TOC - VOLUME 1

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Note: Sections marked by asterisk (*****) below are provided by the Owner, Construction Manager (where applies), or consultants to the Architect or Owner, and are not covered by the Architect's seal. Refer to attached supporting Tables of Contents to identify Consultant responsible for a particular section.

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*21 05 10	Fire Protection Contract Quality Control
*21 05 12	Fire Protection Shop Dwgs, Coord Dwgs & Product Data
*21 05 13	Electrical Provisions of Fire Protection Work
*21 10 00	Fire Sprinkler System

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*22 01 00	Plumbing Operating & Maintenance Manuals
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*22 05 15	Plumbing Earthwork
*22 05 16	Excavating, Backfilling an Compacting for Utilities Outside Building Slab
*22 05 17	Plumbing Access Doors
*22 05 19	Pressure and Temperature Instrument for Plumbing Piping
*22 05 23	Valves, Strainers and Vents
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*22 11 16	Domestic Water Piping and Appurtenances
*22 11 19	Piping and Piping Appurtenances for Cold Water Makeup
*22 11 23	Domestic Water Pumps (Includes HW Circ. Pumps & Sump Pumps)
*22 11 25	Domestic Water Booster Pump
*22 13 16	Soil, Waste and Sanitary Drain Piping, Vent Piping and Appurtenances
*22 14 13	Roof Drainage Piping and Appurtenances
*22 20 00	Plumbing Pipe and Pipe Fittings- General
*22 33 33	Electric Water Heater (Commercial ASME)
*22 34 32	Gas Domestic Water Heater (Cyclone
*22 40 00	Plumbing Fixtures and Fixture Carriers
*22 60 01	Acid Waste Piping and Appurtenances
*22 63 11	Gas Piping and Appurtenances

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*23 05 00	Mechanical General Provisions
*23 05 10	HVAC Contract Quality Control
*23 05 12	HVAC Shop Drawings, Coordination Drawings and Product Data
*23 05 13	Electrical Provisions of HVAC Work



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*23 05 18 Variable Frequency Inverter
*23 05 19 Pressure and Temperature Instruments for HVAC
*23 05 23 HVAC Valves, Strainers and Vents
*23 05 33 HVAC Pipe Heat Tracing
*23 05 48 Vibration Isolation
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*23 09 33 Building Management and Control System
*23 20 00 Mechanical Pipe and Fittings – General
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*23 21 23 HVAC Pumps
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*26 01 05 Electrical Operation and Maintenance Manuals
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22 11 23 Domestic Water Pumps (Includes HW Circ. Pumps & Sump Pumps)
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23 52 35 Gas Modulating Hot Water Boiler Condensing
23 65 28 Air-Cooled Variable Speed Rotary Screw Chiller
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23 82 18 Ductless Mini Splits
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26 26 00 Elevator Power Module Panel
26 27 73 Line Voltage Wiring Devices
26 32 02 Dual Purpose Manual Transfer Switches with Integrated Load Bank and Generator Quick Connects
26 32 13 Natural Gas Standby Generator Sets and Transfer Switch
26 43 00 Surge Protective Devices
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32 92 00	Turf and Grasses
33 10 00	Water Distribution
33 30 00	Sanitary Sewer
33 40 00	Storm Drainage



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Texas Engineering Firm No. 20740

END OF CIVIL TOC

SECTION 21 01 00 - 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 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. Complete electronic manuals will be delivered to the Owner.

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.
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.
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

SECTION 21 05 00 - FIRE PROTECTION GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Except as modified in this Section, General Conditions and 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.

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 reproducibles 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 (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.

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.

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.

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.

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.

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

SECTION 21 05 10 - 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.

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

SECTION 21 05 12 - 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: ¼” = 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

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.

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
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.

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

SECTION 21 05 13 - 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.

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.

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

SECTION 21 10 00 - FIRE SPRINKLER SYSTEMS

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.

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.

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. Schedule. 40, black steel pipe joined with rolled grooved fittings.

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 with 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

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-n 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.

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.

2.09 GASKETS

A. Use 1/16-inch-thick preformed synthetic rubber bonded.

2.10 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.

2.11 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.
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.

2.12 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.

2.13 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 ¼ 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.

F. Manufactured by:
1. Trerice Model No. 4500 Series
2. Ashcroft
3. Marsh
4. Weksler

2.14 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.

2.15 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.

2.16 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.

2.17 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.

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 through 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 ¾ inch rods and properly anchor and support.

D. Use grooved mechanical couplings and mechanical fasteners only in accessible locations.

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.

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.

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 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.

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.

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

SECTION 22 01 00 - 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 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. Complete electronic manuals will be delivered to the Owner.

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.
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.
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

SECTION 22 05 00 - 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 three systems of comparable size and type that has served their Owners satisfactorily for not less than three 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.

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 three sets of blue-line prints of each drawing, regardless of whether corrections were necessary and include in the transmittal (two 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 AutoCad 2012 / 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 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.

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.

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 one 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.

1.13 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.

1.14 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 three 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 three 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 subcontractor 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.

C. Concrete pads:
1. 4 inch 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 two 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, 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.

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 ½ inch 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

SECTION 22 05 10 - 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.

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

SECTION 22 05 12 - 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

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.

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
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.

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

SECTION 22 05 13 - 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.

F. Refer to Division 26 sections for motor starters and controls not furnished integrally with plumbing equipment.

G. 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.

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 ¾ hp and larger, and provide capacitor-start single-phase motors for ½ hp and smaller, except 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.

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

SECTION 22 05 15 - 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

SECTION 22 05 16 - EXCAVATING, BACKFILLING AND COMPACTING FOR UTILITIES OUTSIDE BUILDING SLAB

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 apply to this section.

B. Refer to Instructions to Bidders for substitution of materials and products.

C. Addenda issued during the bidding period that affect this section of the specifications.

1.2 WORK INCLUDED

A. Coordinating all excavating and backfilling for the underground storm sewer, sanitary sewer, water distribution lines, and all related appurtenances.

B. The extent of lines, excavation, and backfill shall be in conformance with the locations, lines, elevations and grades shown on the drawings prepared by the MEP Engineer.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. Earthwork

B. Water Distribution

C. Sanitary Sewer

D. Plumbing

1.4 REFERENCES

A. American Society for Testing and Materials (ASTM) Use current edition.
   1. ASTM D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3)
   2. ASTM D1556, Standard Test method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
   3. ASTM D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
   4. ASTM D4254, Standard Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density

B. City Standards

C. Local Governing Agencies

D. Texas Health and Safety Code, Chapter 161, Subchapter Q, as amended by House Bill No. 1927.

1.5 WARRANTY

A. Provide written warranty against defects in the material and workmanship for the work of this Section for a period of one year from the Date of Substantial Completion of the Project. Refer to Division 1 for Warranty form.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Cement-Stabilized Sand: Clean, local sand mixed with not less than 1-1/2 sacks of Portland cement per ton; mix in a mill-type mixer.

B. Sand: Clean, local sand

C. Earth Backfill: Clean local material consistent with the surrounding earth material and free of large clods, roots, rocks or other debris.

PART 3 – EXECUTION

3.1 EXCAVATION

A. General:
1. All utility trenches shall be constructed in conformance with OSHA trench safety standards.
2. Sheeting and shoring shall be accomplished to the extent necessary to maintain the sides of the trench in a vertical position throughout the construction period for trenches five feet in depth or deeper. Where approved, trench sides may be laid back in lieu of shoring to meet OSHA safety standards.
3. Utilities shall not be constructed or laid in a trench in the presence of water. All water shall be sufficiently removed from the trench prior to the line placing operation to ensure a dry, firm bed on which to place the utility line.

B. Storm and Sanitary Sewer Trenches:
1. For pipe sizes less than 42 inches in diameter, the minimum trench width shall be outside diameter of pipe plus 18 inches.
2. Trenches shall be excavated to a depth of at least 6 inches below the barrel of pipe.

C. Appurtenances:
1. Any overdepth excavation below appurtenances shall be refilled with cement-stabilized sand.

D. Water Line Trenches:
1. Water lines shall be at least two feet in depth from the top of proposed grade to the top of pipe.
2. Trench width for water lines shall be a minimum of the outside pipe diameter plus 18 inches.
3. Trenches shall be excavated to a depth of at least 6 inches below the barrel of pipe.

3.2 PIPE BEDDING AND BACKFILL

A. Storm and Sanitary Sewer Trenches:
1. The cement-stabilized sand bedding shall not extend from a point 6 inches below the bottom of the pipe to the level of the spring line. This material shall not be used after it loses its moisture content.
2. The cement-stabilized sand shall be thoroughly rodded after being placed in the trench.
3. Bedding, sewer pipe, and initial backfill over the pipe must be placed in a single day for any given portion of pipe. Initial backfill shall be placed to one foot above

the top of pipe for earth backfill and 6 inches over the top of pipe for cement-stabilized sand backfill.

4. Remainder of trench backfill shall be placed the next day or later in 8 inch lifts.
5. Backfill shall be placed in uniform layers not to exceed 8 inches loose depth, and compacted to a minimum of 95 percent of Standard Maximum Density (ASTM D698).
6. Backfill, under pavement and to one foot from outer edge, shall b e cement-stabilized sand, up to one foot below subgrade elevation. Remainder of backfill to subgrade to be as specified in paragraph 5 above and stabilized where required.

B. Water Line Trenches:
1. Pipe bedding shall consist of 6 inches of clean sand placed before the pipe is laid.
2. After laying pipe and ensuring that the pipe is properly placed and supported by the sand bedding, clean sand backfill shall be placed to 6 inches above the top of pipe. The sand backfill shall be thoroughly rodded and tamped for compaction.
3. For water lines to be beneath the building and pavement and to one foot from the outer edge of pavement, the remainder of the trench backfill shall be clean sand placed in 6 inch lifts and compacted to 95 percent Standard Proctor.
4. For water lines not beneath the building and pavement or within one foot from the outer edge of pavement the remainder of the trench backfill shall be earth fill placed in uniform layers not to exceed 8 inch loose depth. Each lift shall be compacted to a minimum of 90 percent of Standard Density (ASTM D698) at the proper moisture content specified in the soils report for this project. All earth backfill shall be placed the next day or later after the pipe is laid.

C. Natural Gas Trenches:
1. Natural gas lines shall not be installed under slabs on grade unless pipes are sleeved and vented as per Section 22 63 11.
2. Natural gas lines shall not be installed in trenches with other utilities.

D. Utility Locators:
1. Provide metallic locator over all underground utilities, including irrigation piping, plumbing, control wiring, conduit, data, etc. Locator tape shall be a maximum of 12 inches below grade and centered over the utility(s).

END OF SECTION

SECTION 22 05 17 - 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

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

SECTION 22 05 19 - 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. Trerice

B. Taylor

C. Marsh

D. Weksler

E. Marshalltown

F. Weiss

G. Miljoco

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.

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.

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.

END OF SECTION

SECTION 22 05 23 - 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. 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.
3. Service rating:
   a. 150 psi saturated steam.
   b. 600 psi WOG.
4. All valves for domestic use must be lead free.

D. 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.

E. 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.

F. 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. Jomar

G. 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).
3. Acceptable Manufacturers (All listed must be lead free):
a. Apollo
b. Keystone
c. Kitz
d. Milwaukee
e. Mission Duochek
f. Nibco

H. 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.
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.

I. Provide valves of same manufacturer throughout where possible.

J. Provide valves with manufacturer's name and manufacturing location, duty and pressure rating clearly marked on outside of body.

K. Where valves are installed in insulated piping, provide with extended neck so

valve operator and stop plate clears the full thickness insulation.

L. Provide valve, seat and trim materials suitable for the intended service.

M. Provide memory stops for all valves used for throttling service. Valves for throttling service shall be butterfly, plug, globe or ball type.

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.

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 SUCTION DIFFUSER

A. For each pump as shown on the drawing, provide an angle type suction diffuser. Body to fit both the pump inlet and suction pipe size.

B. Components:
1. Inlet straightening vanes.
2. Removable end cap.
3. Gauge ports.
4. Threaded strainer blow down port.
5. Adjustable support foot.
6. Removable magnetic insert.

C. The screen shall be as specified for pipe system strainers.

D. Provide an additional fine mesh disposable strainer for use during start up operations.
   1. Remove after 30 days operation and all flushing is complete.
   2. Attach to piping for owners review.

E. 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.

F. 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.

2.4 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
   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
   3. 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)

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. 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.

E. Provide isolation valves in domestic water lines to isolate all equipment, restrooms, hose bibbs, and where shown on the drawings.

F. 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.

G. Provide clearance for installation of insulation and access to valves.

H. Provide access where valves are not exposed.

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 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.

END OF SECTION

SECTION 22 05 24 -UTILITY CONTROLLER (Science Rooms) (Lab Automation Control Systems By E&I)

PART 1 – GENERAL

1.1 WORK INCLUDED

A. Utility Controller

B. Solenoid Enclosure

1.2 RELATED WORK

A. Division 22 – Plumbing

B. Division 26 – Electrical

C. Division 23 - Mechanical

1.3 SUBMITTALS

A. Submit applicable manufacturer's specifications sheets, installation instruction, wiring diagrams and performance data for all components required.

B. Submit floor plans indicating location of all devices.

C. Provide a complete written item-by-item, line-by-line specification review stating compliance or deviation in full description. Any deviations to this specification must be clearly stated in writing. It is the contractor's responsibility to provide submittals that meet or exceed the specifications herein prior to commencement of work.

1.4 SCOPE

A. Contractor shall furnish and install a Utility control system complete and operable as described in the specifications herein.

B. Work included: All labor, materials, appliances, tools, equipment necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete, as shown on the drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
   1. Examine all other specification sections and drawings for related work required to be included as work under Division 22.
   2. General provisions and requirements for electrical work.
   3. Refer to Wiring Devices for wall switch cover plates.

1.5 WARRANTY

A. Provide two-year parts and labor warranty from date of substantial completion.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Lab Automation Control Systems (LACS by E&I)

B. Isimet

2.2 MATERIALS AND COMPONENTS

A. General: Except as otherwise indicated, provide motor control center manufacturer's standard materials and components as indicated by published product information, designed and constructed as recommended by the manufacturer, and as required for a complete installation.

2.2 UTILITY CONTROLLER

A. Panel shall be NEMA 1 flush mounted, white powder coated with concealed wall box.

01. The utility control panel shall allow for independent activation or emergency deactivation for individual classrooms as detailed on drawings.
02. Panel shall also consist of RED open pilot lights (hot water / cold water / gas), GREEN closed pilot lights (hot water / cold water / gas).
03. Three position keyed selector switch (enable / off / purge enable), one system power supply 120VAC 24 VDC 5A with circuit protection, Power ON Selector; switch located in an internal junction box with removable cover.
04. System Controller 24 VDC, discrete inputs, relay outputs, terminal blocks with ground terminal block.
05. Locate as shown on drawings. Utility controller shall be UL 508A. Wiring to the input power terminals shall be per the drawings.
06. Pre-wired and pretested.

B. Panel shall have integral micro controller with Siemens logic device to provide 24VDC output circuits to activate utilities as shown on drawings. Activation of output circuits shall be enabled only by switch ON and then enabling the momentary key switch.

C. The panel shall be equipped with a service switch for each output circuit and a momentary enabling key switch. Deactivation of output circuits shall not require engagement of enabling key. Panel shall be provided with N/O momentary panic button assembly to deactivate output circuits in case of emergency. Reset after panic shall occur by re-keying.

E. Each utility controller is intended for use in conjunction with a solenoid valve enclosure, specified below and indicated on plans.

F. Provide inface from the BMCS to disable all utilities when the Fire Alarm System is enabled and or time of day schedule. Science Room Utility Controllers will be interlock with the BMCS and with related air-handling unit through software.

2.3 SOLENOID ENCLOSURE WITH VALVES

A. Solenoid Control Panel
01. NEMA 1 powder coated white, flush mounted or recessed concealed wall box as indicated.
02. Normally closed general service solenoid valves at each hot and cold domestic water utility service, refer to drawings for line sizes.
03. UL rated solenoid gas valve for the natural gas system; refer to drawings for line

size.

04. Solenoid coil shall be 120 VAC. Solenoids shall be UL listed.
05. Provide ball valve upstream from solenoid valves and wye strainer upstream of all water fluid delivery systems.
06. Solenoids shall close upon loss of operating power and require re-keying for reactivation of service. Solenoids shall not be mechanically latched.
07. Pre-wired and pretested.

PART 3 - EXECUTION

3.1 INSTALLATION OF UTILITY CONTROLS

A. Manufacturer shall provide instruction and operating manual along with a complete set of details including plumbing and electrical schematics as required for each panel.
B. Each panel shall also be provided with a bill of materials including manufacturer and part numbers. Coordination between trades is required for installation.
C. Each panel will be supplied with (2) sets of keys.
D. Prior to construction of utility controller, an Engineer approved submittal must be provided.
E. Panels to be Installed as indicted on plans.
F. Each utility controller is to be provided by the Division 22 Contractor and installed and wired to the solenoid valve box by the Division 26 Contractor. Refer to electrical panel schedules for lab receptacle shut-off requirements. Coordinate final location and height with Architect / Owner.

3.2 FACTORY START-UP

A. Factory authorized start-up will be included for each panel.

B. Factory operational and maintenance training.

3.3 SOLENOID VALVE ENCLOSURE

A. Each enclosure shall be furnished and installed by the Division 22 Contractor and is intended for use on conjunction with a utility controller specified above and indicated on the plans.
B. Thoroughly flush piping system prior to placing into service.
C. Final electrical connection to control panel is by the electrical contractor.
D. Refer to plans for sizes of utilities. Recessed mounted enclosure will vary in size depending on valve size(s). Coordinate final location and height with Architect / Owner.

3.3 BMCS INTERFACE

A. Science Room Utility Controllers will be interlock with the BMCS and with related air-handling unit through software. Provide interface terminals for the BMCS to disable all utilities when the Fire Alarm System is enabled and or time of day schedule.

END OF SECTION

SECTION 22 07 19 - 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.

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).

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 ¾" 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 ¾" 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 ½" 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.

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

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 ½” 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.

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-Skrim-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

INSULATED UNIT	THICKNESS (Inches)
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

SECTION 22 11 16 - 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 one-piece stainless steel IBR (in building riser), Watts or Ames.
   4. 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.

E. Unions. Provide 150 lb. standard unions with ground joint and bronze seat. Flange joints 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.

F. Alternate Method of Joining Copper Pipe and Tubing: Press Fittings: Copper press fitting shall conform to the material and sizing requirements of ASME B16.51. O-rings for copper

press fittings shall be EPDM. 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.

2.2 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.

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.

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

SECTION 22 11 19 - PIPING AND PIPING APPURTENANCES FOR COLD WATER MAKEUP

PART 1 - WORK INCLUDED

1.1 SCOPE

A. Furnish and install piping and piping appurtenances for cold water makeup piping.

1.2 RELATED WORK

A. Division 22 Plumbing
1. Valves, Strainers and Vents
2. Plumbing Pipe and Pipe Fittings
3. Plumbing Piping Insulation

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. Provide seamless, hard-drawn, Type L, copper water tube conforming to ASTM B88, and wrought copper fittings.

2.2 BACKFLOW PREVENTER

A. Watts Series 909 reduced pressure principal backflow preventer.

B. Factory assembled components as follows:
1. Isolating, shutoff, full port ball valves.
2. Incoming bronze strainer.
3. Test cocks.
4. Fixed air gap assembly.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install according to manufacturer's instructions.

3.2 BACKFLOW PREVENTERS

A. Provide backflow preventers at the following locations.
1. HVAC Systems cold water make-up including chilled water, hot water and condenser water.
2. Pumping systems including water utility service and water softening equipment.
3. Where required by Code.

B. Installation according to manufacturer's recommendations.
1. Connect drain with fixed air gap assembly.
a. Pipe full size discharge from relief valve of RPZ to nearest floor drain or floor sink of proper size. Reference manufacturer’s suggested sizing of drains.
2. Provide pipe unions on inlet, outlet and discharge connection of the assembly for complete removal.
3. Provide isolation valve upstream of backflow assembly to allow complete removal of listed assembly.
4. Install backflow preventer assembly horizontally in an accessible location for

testing and maintenance at a height not to exceed 60" above finished floor and no lower than 12" from finished floor to air gap outlet.

C. Provide certified testing of all backflow preventers.
1. Include certificates in O&M Manuals.

END OF SECTION

SECTION 22 11 23 - 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.

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 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. Build in differential pressure sensor
7. Programmable

B. Acceptable manufacturers:
1. Grundfos
2. Armstrong
3. Wilo

2.2 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

2.3 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

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 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.
3. Submit readings for approval.
4. Include the approved readings in the Owner's Maintenance Manual.

3.3 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.

3.4 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

SECTION 22 11 25 - DOMESTIC WATER BOOSTER PUMP (In-Line Vertical Multi-Stage w/VFD)

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.

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)	
Optional materials for the suction/discharge base and pump head shall be cast 316 stainless steel (ASTM CF-8M resulting in all wetted parts of stainless steel.	

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.

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

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 17,00 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)

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

SECTION 22 13 16 - 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
      b. Clamp-All Hi Torq 125
   2. No-Hub Clamps - Vents
      a. Husky SD – 2000
      b. Mission Rubber Co., LLC Heavy Weight Couplings
      c. Clamp-All Hi-TorQ 80 or approved equal

B. Provide Anaco-Husky shielded couplings Series 4200 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 4200.

C. Cast Iron Soil Pipe and Fittings:
   1. AB&I
   2. Charlotte Pipe and Foundry Co.
   3. Tyler Pipe / Soil Division

2.2 DRAIN PIPE AND FITTINGS

A. Above Slab Pipe:
   1. No-hub cast iron soil pipe and fittings shall conform to CISPI 301 and ASTM

A888.
2. Pipe shall conform to ASTM A74.
3. No-hub couplings shall meet or exceed the latest specification standard CISPI 310 or ASTM C-1540 and conform to FM 1640. CISPI 310 Couplings shall be listed by NSF International.
4. Rubber Gaskets for cast iron soil pipe and fittings shall conform to ASTM C564
5. 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 Piping:
1. Schedule 40 PVC plastic pipe and DWV fittings.
2. Solvent welded DWV joints shall conform to IAPMO Installation Standard IS-9.
3. Pipe and fittings shall conform to ASTM D 1784, ASTM D 1785, ASTM D 2665, ASTM D 3311 and NPS Standard 14 & 61.

C. Below Slab on Grade Piping for Grease Waste:
1. Schedule 40 CPVC pipe and fittings
2. Solvent welded DWV joints shall conform to ASTM D3311 and be produced to dimensions specified in ASTM F 2618, NSF International, UPC, IAPMO IGS 210 and International Plumbing Code.
3. Solvent Cement, Heavy Body; mustard yellow color, as tested by ASTM F 2618 / ASTM F493
4. Manufacturer: Spears (only)

2.3 VENT PIPE AND FITTINGS

A. Above Slab Pipe:
1. No-hub cast iron soil pipe and fittings shall conform to CISPI 301 and ASTM A888.
2. Pipe shall conform to ASTM A74.
3. No-hub couplings shall conform to CISPI 310 and shall be listed by NSF International
4. Rubber gaskets for cast iron soil pipe and fittings shall conform to ASTM C564

B. Below Slab on Grade Piping:
1. Provide Schedule 40 PVC with DWV fittings with solvent welded joints. Pipe and fittings shall conform to ASTM D1784-82.

C. Above Slab Pipe.
1. Drainage-waste-vent copper pipe and fittings for waste stub-outs for all fixture locations and equipment discharge.

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.

3.2 GRADE

A. Give horizontal pipe grade of ¼-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-, eights-, 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.

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 for1 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.

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.

END OF SECTION

SECTION 22 14 13 - 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

2.0 ACCEPTABLE MANUFACTURERS

A. Cast Iron Soil Pipe and Fittings
   1. AB&I
   2. Charlotte Pipe and Foundry Co.
   3. Tyler Pipe / Soil Division

2.1 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 Schedule 40 PVC plastic pipe and DWV fittings with solvent welded joints. Pipe and fittings shall conform to ASTM D 1784-82.

C. Provide Anaco-Husky shielded couplings, Series 4200 with one-piece neoprene gasket for cast iron pipe transitions to Schedule 40 DWV pipe penetrations through slabs. Sizes 2” through 8” use Series 4200.

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 or hubless type). 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 for1 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.

3.4 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

SECTION 22 20 00 - 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.
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. 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.

H. 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 D3219 joints, gaskets ASTM F477.

I. 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 manufactured, 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.

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.

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

Pipe Size	Copper & Steel Max. Support Spacing, Feet	Cast Iron Max. Support Spacing, Ft.	Minimum Rod Diameter, Inches
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.

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 air tight. Seal annular space between pipes and sleeves with mastic compound to make the space water and air tight.

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.

3.10 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.

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

SECTION 22 33 33 - 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. Bradford White

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.

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

SECTION 22 34 32 - GAS-FIRED DOMESTIC WATER HEATER (Cyclone)

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 ANSZ21.10 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. Rheem

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.

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 Polypropylene Pipe (UL 1738) air intake pipe and 4” diameter Polypropylene Pipe (UL 1738 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.

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.

END OF SECTION

SECTION 22 40 00 - 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. Sloan
   3. Toto
   4. Zurn

B. Plumbing Faucets:
   1. American Standard.
   2. Chicago.
   3. T&S Brass.
   4. Zurn.

C. Supports and Carriers:
   1. Wade
   2. Zurn
   3. J.R. Smith.
   4. Josam.
   5. Watts
   6. MIFAB

D. Flush Valves:
   1. Sloan
   2. Zurn
   3. American Standard

E. Supplies, Stops and Chrome Plated Tubular Brass:
   1. McGuire
   2. Chicago
   3. Zurn

F. Water Closet Seats:
   1. Beneke
   2. Church
   3. Olsonite
   4. Bemis
   5. Centoco

G. Electric Drinking Fountains:
   1. Halsey Taylor
   2. Elkay
   3. Oasis
   4. Haws

H. Floor Drains:
   1. Wade
   2. J.R. Smith
   3. Josam
   4. Zurn
   5. Watts
   6. MIFAB

I. Cleanouts:
   1. Wade
   2. J.R. Smith
   3. Josam
   4. Zurn
   5. Watts
   6. MIFAB

J. Stainless Steel Sinks:
   1. Elkay
   2. Just
   3. Griffin
   4. Acorn

K. Mop Sinks:
   1. Crane Fiat
   2. Stern Williams
   3. Acorn
   4. CECO

L. Roof Drains:
   1. Wade
   2. J.R. Smith
   3. Josam
   4. Zurn
   5. Watts
   6. MIFAB

M. Thermostatic Mixing Valves
   1. Lawler
   2. Symmons
   3. Leonard
   4. Powers
   5. Bradley

N. Emergency Safety Equipment
1. Speakman
2. Bradley
3. Encon
4. Guardian
5. Haws

O. Shock Arrestors:
1. Precision Products
2. Sioux Chief

P. Backflow Preventors
1. Watts
2. Febco
3. Wilkins
4. Beeco

Q. Hose Bibbs
1. Wade
2. Chicago
3. Josam
4. Woodford
5. Zurn
6. J.R. Smith
7. MIFAB

R. Wall Hydrants
1. Wade
2. Woodford
3. Zurn
4. J.R. Smith
5. Josam
6. MIFAB

S. 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.

G. Coordinate with the Contractor for locations and service required for each plumbing fixture.

H. All floor drains and floor sinks shall have Pro-Set “Trap Guard” for trap seal protection.

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

SECTION 22 60 01 - ACID WASTE PIPING AND APPURTENANCES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Acid waste and vent piping.

B. Acid neutralization basin.

1.2 RELATED WORK

A. Piping and fittings.

B. Piping hangers.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Pipe and Pipe Fittings: For all locations below grade or below slab, above slab in fire rated concealed areas, and exposed below casework (not in return plenum). For all locations above slab in fire rated concealed areas (in return air plenum).
   1. CPVC Schedule 40 pipe and DWV fittings for chemical waste drain applications, with solvent welded joints.
      a. Charlotte Pipe “Chemdrain”
      b. Spears

PART 3 - EXECUTION

3.1 ACID WASTE AND VENT PIPING

A. Pipe and Pipe Fittings: For all locations below grade or below slab, above slab, for all areas in return air plenum and not in return air plenums:
   1. All pipe, fittings and solvent cement shall be manufactured as a system, to be the product of one manufacturer and manufactured in the United States. All pipe and fittings shall conform to (NSF) 14.
   2. Special drainage systems for corrosive chemical or acid waste shall be manufactured from CPVC Type IV, Grade I, ASTM Cell Class 23447. All system components shall be certified by NSF International for use in chemical waste drain systems and bear the mark NSF-cw. All system piping shall be Schedule 40 CPVC produced to the dimensional requirements of ASTM F 2618 and the manufacturer’s specifications. All pipe fittings shall be CPVC drainage patterns meeting the requirements of ASTM F 2618 and the manufacturer’s specifications.
   3. Installation shall comply with the latest installation instructions published by manufacturer and shall conform to all local plumbing, fire and building code requirements. Buried pipe shall be installed in accordance with ASTM D2321 and ASTM F 1668. Solvent welded joints shall be made with ChemDrain One-Step solvent cement conforming to ASTM F493.
   4. Referenced Standards:

ASTM D 1784	Rigid CPVC Vinyl Compounds
ASTM D2321	Underground Installation of Thermoplastic Pipe (non-pressure applications)
ASTM F493	Solvent Cements for CPVC Pipe and Fitting
ASTM F 1668	Procedures for Buried Plastic Pipe
ASTM F 2618	Standard for Chlorinated Poly (Vinyl Chloride)

Chemical Waste Drainage Systems
NSF Standard 14 Plastic Piping Components and Related Materials

3.2 ACID WASTE CLEANOUTS

A. Floor Cleanouts: Provide cleanout plug below floor level with the same material as acid waste pipe. Install floor access housing similar to George Fischer Model #5277 15A. Install cleanouts where acid waste lines change direction.

B. Wall Cleanouts: Provide cleanout plug (of the same material as piping system, in wall cavity. Install square access cover and frame similar to Mifab C1460-S-3-6.

3.3 ACID WASTE AND VENT PIPING

A. Install at minimum slope 1/8 inch per foot.

B. Follow manufacturer's recommendations for support and burial.

C. Flush, fill with water and let stand for 24 hours. Repair leaks and repeat procedure until leak free.

END OF SECTION

SECTION 22 63 11 - 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 inch:
   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.

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 in accordance with ANSI (American National Standard) Z21.80 and CSA (Canadian Standards Association Standard) 6.22.

C. Where a line pressure regulator has an inlet pressure over 2 psi and serves an appliance rated for ½ psi (14” of water column) or less, a downstream overpressure devices (OPD must be installed in accordance with ANZI Z21.80.

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.

E. Do not install gas piping exposed to view inside public area, or occupied spaces, without prior written approval.

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. Headers with various installed devices can cause regulator malfunction.
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. Adhere to all applicable codes and regulations.

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.

B. Test joints with a soap solution while lines are under pressure.

C. Repair leaks.

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

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 top coat of Yellow Alkyd Flat Enamel.

END OF SECTION

SECTION 23 01 00 - 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 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. Electronic copies of complete Manuals will be delivered to the Owner.

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.
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. 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.
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

SECTION 23 05 00 - 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.

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 AutoCad 2014 / 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.

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.

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.

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.

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 40 hours dedicated instructor time.
   2. 8 hours on each of 5 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.

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.

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

SECTION 23 05 10 - 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.

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 FAN/COIL UNITS (WATER SOURCE HEAT PUMPS)

A. Mock-up a fan/coil unit (water source heat pump) completely installed, including:
   1. Primary, secondary and auxiliary drain pans.
   2. Piping connections; including all piping appurtenances.
   3. Pipe insulation.
   4. Condensate drain piping.
   5. Electrical connections.
   6. Duct connection beyond first transition.
   7. Block valves, balancing valves, and control valves.
   8. Cabinet/internal vibration isolation.
   9. Suspension system.

B. Tests: Air flow at scheduled static pressure.

C. Demonstrate:
   1. Filter accessibility.
   2. Accessibility to drain and components for service.
   3. Controls sequence.

3.2 AIR HANDLING UNIT

A. Mock-up an air handling unit, completely installed, including:
   1. Piping connections; including thermowells, test stations, test wells and other piping appurtenances.
   2. Pipe insulation.
   3. Condensate drain piping.
   4. Electrical connections.
   5. Ductwork beyond the first transition.
   6. Control valves and bypass.
   7. Cabinet/internal vibration isolation.

8. Block valves and balancing valves.
9. Duct insulation.
10. Instrumentation.

B. Tests: Air flow at scheduled static pressure.

C. Demonstrate:
1. Filter accessibility.
2. Accessibility to drain and components for service.
3. Controls sequence.

3.3 CONSTANT VOLUME TERMINAL BOX

A. Mock-up a Constant Volume Terminal Box completely installed, including:
1. Piping connections, including all piping appurtenances.
2. Pipe insulation.
3. Electrical connections.
4. Duct connection beyond first transition.
5. Block valves, balancing valves, and control valves.
6. Cabinet/internal vibration isolation.
7. Suspension system.

B. Tests: Air flow at scheduled static pressure.

C. Demonstrate:
1. Control Sequence.
2. Accessibility to components for service.

3.4 HOT AND CHILLED WATER CIRCULATING PUMPS

A. Mock-up one each system pump, completely installed including:
1. Pump mounted on housekeeping pad.
2. Auxiliary drain pan. (Chilled water only)
3. Piping to a point beyond the complete valve and instrumentation assemblies.
4. Strainers with blowdown.
5. Flexible piping connection.
6. Pipe supports.
7. Pipe insulation.
8. Pump painting.
9. Electrical connections.

3.5 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

SECTION 23 05 12 - HVAC 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: ¼” = 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

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.

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
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.

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

SECTION 23 05 13 - 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. Wiring of oil pump, vibration and oil level limit switches for cooling towers.
7. Refrigerant monitor/sensor/alarming and field installed visual/audible display alarms.
8. Pipe heat tracing.
9. Cooling tower vibration switch/interlock/reset.
10. Field interlock wiring from chiller: flow switches, pump aux. Contacts, pump start/stop.
11. Power supply 120 VAC and control signal from chiller control panel to condenser water flow control valve installed in piping leaving chiller.
12. Wiring of all related circulating water system chemical treatment devices.
    a. Low voltage electric contacting water meter
    b. Solenoid valve/blow-down assembly
13. Radiant heater timer switches and/or thermostats
14. Low Voltage thermostat wiring

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.

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.

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. Motors over 100 HP shall be provided with an insulated bearing on the non-drive end and a shaft grounding ring on the drive end of the motor with the exception of line contact bearings in the drive end of the machine. In this instance the line contact bearing must be electrically insulated and the AEGIS Bearing Protection Ring installed on the opposite drive end of the motor. 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

SECTION 23 05 14 - 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. Fan/Coil Units
   3. Air Handling Units
   4. Chilled Water Pumps
   5. Air Compressor Storage Tanks
   6. Equipment Drain Pans
   7. Heat Pump Units

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

SECTION 23 05 17 - 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. Flush screwdriver cam lock & cylinder lock for Owner selection

E. Automatic closing and latching mechanism

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 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

2.3 ACCEPTABLE MANUFACTURERS

A. Milcor

B. MIFAB

C. Acudor

D. Elmdor

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

SECTION 23 05 18 - VARIABLE FREQUENCY INVERTER

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install a variable frequency inverter for the following equipment items.
   1. Air Handling Units.
   2. Pumps.
   3. Cooling Towers.

1.2 RELATED WORK

A. Division 23 Mechanical
   1. Electrical Provisions of Mechanical Work.
   2. Air Handling Units
   3. Pumps
   4. Cooling Towers
   5. 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.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. ABB

B. Danfoss Graham

C. Siemens

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 inventor.
   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.

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 of 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.
      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.

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.

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

SECTION 23 05 19 - HVAC 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 23, Mechanical
1. 23 05 00 - Mechanical General Provisions
2. 23 20 00 - Pipe and Pipe Fittings, General
3. 23 05 23 - Valves, Strainers and Vents
4. 23 21 13 - Hot Water and Chilled Water Piping, Valves and Appurtenances
5. - Steam and Condensate Piping and Valves

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - GAUGES AND THERMOMETERS

A. Trerice

B. Taylor

C. Marsh

D. Weksler

E. Marshalltown

F. Weiss

G. Miljoco

2.2 PRESSURE GAUGES

A. Case and Ring: 4" 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% over operating range.

F. For pulsating service, provide impulse dampers.

G. Without flange for pipe mounting.

H. With flange for wall mounting.

I. Weiss Model: LF44S-1B or equal.

2.3 THERMOMETER WELLS

A. Brass or type 300 stainless steel. Machined bar stock, 1-piece construction.

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% into pipe.

2.4 THERMOMETERS IN PIPING SYSTEMS OR VESSELS

A. Die cast aluminum case with baked epoxy finish.

B. Adjustable angle 9" 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.

H Accuracy: +/- 1% of scale range.

I. Range:
1. Hot water lines: 30°F to 240°F.
2. Chilled water lines: 0°F to 100°F or 120°F
3. Condenser water: 0°F to 100°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.
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" OD probe.
2. Four 5" stem pocket testing thermometers.
a. Two with range 25°F to 125°F for chilled water and condenser water.
b. Two with range 0°F to 220°F for hot water.

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.

C. Locate gauges and thermometers to be easily readable from the floor at a 5'-6" eye level. Use adjustable angle or rigid stem as required. Install gauges in upright position.

D. Install gauges in the following locations: across pumps, chiller cooler and condenser, storage tanks, heat exchangers.

E. Test wells for automatic temperature controls shall be furnished by Building Management Control Section and installed by Mechanical Contractor.

F. Install thermometer in the following locations: Across chiller cooler and condenser, storage tanks, across heat exchangers, across boiler, leaving side of water heater, leaving water side of tempered water valves, common chilled and hot water lines.
   1. Hot water lines: 30°F to 240°F.
   2. Chilled water lines: 0°F to 100°F or 120°F
   3. Condenser water 0°F to 100°F.

END OF SECTION

SECTION 23 05 23 - HVAC VALVES, STRAINERS AND VENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. HVAC 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°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.

C. Balancing Valves
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" pipe size use threaded connections.
   b. For valves 2-1/2" 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" gauge tap.

D. 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.
3. Service rating:
   a. 150 psi saturated steam.
   b. 600 psi WOG.
4. Where piping is insulated, ball valves shall be equipped with 2” extended handles of non-thermal conductive material. Provide a protective sleeve that allows operation of the valve without breaking the vapor seal or disturbing the insulation.
5. Provide with memory stop for balancing valves.

E. 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" and smaller.
3. Flange pipe sizes 2-1/2" and larger.
4. Use screw to solder adapters for copper tubing.
5. Use grooved body valves with mechanical grooved jointed piping.

F. Valve Operators
1. Where butterfly valves are provided:
a. Provide gear operators on valves 6" and larger.
b. Where valves are located 7' or more above the finished floor in equipment room areas provide chain-operated sheaves. Extend chains to about 5' 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" and smaller.
d. Provide worm gear operators on discharge side of pumps for balancing, for all sizes of valves.
e. All valves 2-1/2” and larger provided by Milwaukee Valve shall be provided with gear operators.

G. Acceptable Manufacturers
1. Dezurik
2. Crane
3. Nibco
4. Keystone
5. Milwaukee Valve

H. Check Valves
1. Bronze body, 2" and smaller, bronze disc (Teflon disc for steam service), regrinding swing check, screw-in cap, threaded connection.
2. Iron body, 2-1/2" 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.
3. Acceptable Manufacturers
a. Mission Duochek
b. Nibco
c. Keystone
d. Milwaukee Valve

I. Provide valves of same manufacturer throughout where possible.

J. Provide valves with manufacturer's name and manufacturing location, duty and pressure rating clearly marked on outside of body.

K. Where valves are installed in insulated piping, provide with extended neck so valve operator and stop plate clears the full thickness insulation.

L. Provide valve, seat and trim materials suitable for the intended service.

M. Provide memory stops for all valves used for throttling service. Valves for throttling service shall be butterfly, plug, caged or ball type.

2.2 PIPE SYSTEMS STRAINERS

A. Body:
   1. "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.

B. Construction:
   1. 2" size and smaller with screw connections rated 400 psi WOG.
   2. Over 2" 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".
   2. With 0.45 perforations in piping systems 2-1/2" and 3".
   3. With 0.125 perforations in piping systems 4" 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 owners review.

E. Acceptable Manufacturers
   1. Crane
   2. Keckley
   3. Zurn
   4. Mueller
   5. McAlear
   6. Muesco

2.3 SUCTION DIFFUSER

A. For each pump as shown on the drawing, provide an angle type suction diffuser. Body is to fit both the pump inlet and suction pipe size.

B. Components:
   1. Inlet straightening vanes.
   2. Removable end cap.
   3. Gauge ports.
   4. Threaded strainer blow down port.
   5. Adjustable support foot.
   6. Removable magnetic insert.

C. The screen shall be as specified for pipe system strainers.

D. Provide an additional fine mesh disposable strainer for use during start up operations.
   1. Remove after 30 days operation and all flushing is complete.
   2. Attach to piping for owners review.

E. Construction:
   1. 2" size and smaller with screw connections rated 400 psi WOG.
   2. Over 2" size with flanged connections, rated 125 psi WOG.

F. Fabricate screens of Monel or type 304 stainless steel:
   1. With 20 mesh woven wire in piping systems through 2".
   2. With 0.045 perforations in piping systems 2-1/2" and 3".
   3. With 0.125 perforations in piping systems 4" and larger.

2.4 VALVE SCHEDULE

A. Hydronic Service
1. Chilled Water Service
a. Ball Valves up to 2": Nibco T-585-70-66 w/Nib-Seal insulated Handle
b. Butterfly Valve 2-1/2" and larger: Nibco LD - 2000
Keystone Figure 222
2. Heating & Condenser Water Service
a. Ball Valves up to 2": Nibco T-585-70-66
b. Butterfly Valve 2-1/2" and larger: Nibco LD - 2000
Keystone Figure 222
3. Check Valve:
a. Nibco Check Valve: T - 413 - B
b. Nibco Check Valve 2-1/2" and larger: F - 918 - B
c. Nibco Check Valve 2-1/2" and larger: W - 920 -W (Wafer)
d. Keystone Check 2-1/2" and larger: FIQ 810

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 circulating water systems, for balancing duty. Provide infinite position gear operator with memory stop.

D. Provide drain valves at main shut-off valves and low points of piping and apparatus so the systems can be entirely drained.
1. 1" valve for pipes 6" and larger.
2. 3/4" valve for pipes smaller than 6".
3. Terminate with pipe plug.
4. Drain valves shall be ball valves.

E. 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.

F. Provide clearance for installation of insulation and access to valves.

G. Provide access where valves are not exposed.

H. Provide float valves / stilling wells in cooling tower or condenser water basins for water level control. Provide stilling wells around float valve to prevent turbulence ripples or wind interference.

I. Butterfly valves shall be installed per ASME B31.3 Process Piping, and ASME B16.5 Pipe Flanges and Flanged.

3.3 PIPE SYSTEMS STRAINERS

A. Provide an additional fine mesh disposable strainer for use during start up operations.
1. Remove after 30 days operation and all flushing is complete.

2. Attach to piping for owners review.

B. Provide strainer in supply piping for all coil connections.

C. Provide strainer in condenser water piping entering chiller.

3.4 WATER SYSTEM AIR VENTS

A. Provide manual air vents at high points and at any other air pockets of closed circulating pipe systems. Extend 3/8" hard drawn copper tubing discharge drains to nearest floor or hub drain. Provide 1/4" Ball Valve as specified.

B. Where high point vents are not readily accessible provide additional valves at vent termination.

END OF SECTION

SECTION 23 05 33 - HVAC 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 23 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).
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.

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.

END SECTION

SECTION 23 05 48 - 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. VSI.
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.

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.

D. Flexible spherical expansion joints shall employ Peroxide cured EPDM in the covers, tubes and frictioning of the reinforcement. Reinforcement must be DuPont Kevlar. Solid steel rings shall be used within the raised face rubber ends to prevent pullout. No substitutions for the DuPont Kevlar or the solid steel embedded flange rings are acceptable. Sizes 2 inch (50mm) and larger shall have two spheres reinforced with a metal ring between spheres to maintain shape and complete with split ductile iron or steel flanges with hooked or similar interlocks. Sizes 16 inch (400m) to 24 inch (600mm) may be single sphere. Sizes 3/4 inch (20mm) to 1-1/2 inch (40mm) may have threaded bolted flange assemblies, one sphere and cable retention. 14 inch (300mm) and smaller connectors shall be rated at 250 psi (17 BAR) up to 190°F (88°C) with a uniform drop in allowable pressure to 190 psi (13 BAR) at 250°F (121°C). 16 inch (400mm) and larger connectors are rated 180 psi (12 BAR) at 190°F (88°C) and 135 psi (9 BAR) at 250°F (121°C). Safety factors to burst and flange pullout shall be a minimum of 3/1. All joints must have permanent markings verifying a 5 minute factory test at twice the rated pressure. Concentric reducers to the above specifications may be substituted for equal ended expansion joints.

High pressure joints shall be substituted for the above where operating pressures are higher than standard. Expansion joints shall be installed in piping gaps equal to the length of the expansion joints under pressure. Control rods need only be used in unanchored piping locations where the manufacturer determines the installation exceeds the pressure requirement without control rods. Control rods are not desirable in seismic work. If control rods are used, they must have ½- inch (12mm) thick Neoprene washer bushings large enough in area to take the thrust at 1000 psi (6.9 N/mm5) maximum on the washer area. Standard diameter bolt washers are not acceptable.

Submittals shall include two test reports by independent consultants showing minimum reductions of 20 DB in vibration accelerations and 10 DB in sound pressure levels at typical blade passage frequencies on this or a similar product by the same manufacturer. All expansion joints shall be installed on the equipment side of the shut off valves.

E. Flexible stainless steel hose shall have stainless steel braid and carbon steel fittings. Sizes 3 inch (75mm) and larger shall be flanged. Smaller sizes shall have male nipples. Hoses shall be installed on the equipment side of the shut-off valves horizontally and parallel to the equipment shafts wherever possible.

2.3 ISOLATOR APPLICATION

EQUIPMENT	ISOLATOR TYPE	MINIMUM DEFLECTION
Chiller	A	0.35”
Pump	B	1.5”
Condensing Units	A	0.35”
In-Line Fans	C	0.5”
Suspended Fan Coil Units	C	0.5”

2.4 PIPING ISOLATOR APPLICATIONS

EQUIPMENT	ISOLATOR TYPE

EQUIPMENT	ISOLATOR TYPE
Floor Mounted Pumps	D
Suspended Pumps	D
Chiller Pipe Connections	D
Chiller Refrigerant Relief	E

2.5 FLEXIBLE CONNECTIONS IN PIPING AT PUMPS

A. Provide flexible connections at suction and discharge of chilled water, and hot water pumps, piping connections on chillers and where indicated on drawings. Refer to schedule above.

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

SECTION 23 05 93 - 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. Balance, adjust and test the hydronic system.

C. 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 be paid directly by 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.

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 water, 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.

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.
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.
15. Perform variable volume system verification to assure the system and its components track with changes from full flow to minimum flow.

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 engineers 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.
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. VAV Terminal Units:
   a. Set and record volume regulators on all terminal boxes to meet design maximum and minimum CFM requirements.
   b. Identification: Identify the type, location, and size of each terminal unit. This information must be recorded on the terminal box data sheets.
4. 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.
5. 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 TESTING THE HYDRONIC SYSTEMS

A. The TAB agency shall, as applicable, verify that all hydronic equipment, piping, and coils have been filled and purged; that strainers have been cleaned; that water has been flushed and is in a clean condition, and that all balancing valves (except bypass valves) are set full open. As applicable, check air vents and expansion or compression tank for proper operation. The TAB agency shall perform the following testing and balancing functions in accordance with the AABC National Standards and all results shall be recorded in the TAB report:
   1. Record preliminary pump data.
      a. Pump RPM.
      b. Pump shut-off differential head.
      c. Pump operating differential head.
      d. Check and verify pump alignment.
      e. Verify impeller diameter.

B. Adjust balancing valves in the pump discharge lines to obtain design water quantity as read from the manufacturer's pump curve and from a flow meter.

C. In variable flow systems, the water flow of the pump shall be set at the scheduled gpm, not the total of all the valves. Determine the diversity of the system and balance the

individual coils with the maximum pump water quantity flowing in the system.

D. Balance flow through:
1. Chillers.
2. Coils.
3. Boiler.
4. Pumps
5. Condensers.
6. Cooling tower.
7. Heat Exchanger.

E. Use flow meters, differential pressures and temperature relationships as required.

F. Balance by-pass lines to obtain the same pressure drop with systems on by-pass as full flow through the coil including the valve.

G. Repeat steps, as required, to obtain a final systems balance and make a set of recordings showing final systems conditions.

H. Pumps:
1. Test and adjust pumps to meet design water flow requirements. Check pumps for proper operation. Pumps shall be free of vibration and cavitation Record appropriate gauge readings for final TDH and Block-Off\Dead head calculations. Check and verify pump alignment.
2. Current and Voltage: Test and record motor voltage and amperage, and compare data with the nameplate limits to ensure pump motor is not in or above the service factor.

I. Coils:
1. Tolerances: Test, adjust, and balance all chilled water and hot water coils within 5% of design flow requirements.
2. Verification: Verify the type, location, final pressure drop and water quantity (GPM) of each coil. Calculate the actual capacity of all coils. This information shall be recorded on coil data sheets.

J. Boilers:
1. Verify that boilers have been filled and started by others, and are in operation.
2. Current and Voltage: As applicable, test and record motor voltage and amperage, and compare data with the nameplate limits to ensure motor is not in or above the service factor.
3. Test, adjust and record water flows through water boilers.
4. Test and record water temperature profiles of each boiler.

K. Chillers:
1. Verify that chillers have been started by the manufacture and are in operation. Test and adjust chiller water flows to within 5% of the design requirements by using a U-TUBE manometer and setting balancing valves.
2. Current and Voltage: Test and record motor voltage and amperage, and compare data with the nameplate limits to ensure compressor motor is not in or above the service factor.
3. Test and record temperature profiles of each chiller at design water flow.

L. Heat exchangers:
1. Verify that heat exchangers have been filled and started by others, and are in operation.
2. Test and record temperature and pressure profiles of water and steam heat exchangers.

3.8 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.
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).

3.9 BOILERS

A. Check for proper operation and with operation at near design conditions, record the following:
1. Manufacturer, model number, serial number and nameplate.
2. If water type, water flow in GPM, entering and leaving water temperature and water pressure drop in feet.
3. Type of fuel and heating value.
4. Rate of fuel consumption.
5. Capacity in MBH.
6. Efficiency.
7. Flue gas analysis.
8. Motor data.

B. Observe demonstration that all controls and safety devices are functioning properly. Record observations.

3.10 CHILLERS (Air Cooled)

A. Balance flow of water through each evaporator to be within a range of 100% to 110% of design flow with all pumps operating. With only one pump operating, the maximum flow shall not exceed the maximum tube velocity recommended by the manufacturer.

B. Verification of safety interlocks and controls are the responsibility of the manufacturer.

C. With each chiller operating at near design temperature conditions, measure and record the following:
1. Manufacturer, model number, serial number and all nameplate data.
2. Evaporator water entering temperature, leaving temperature, pressure drop (ft.) and water quantity (GPM).
3. Condenser air entering temperature, leaving temperature.
4. Evaporator and condenser refrigerant temperatures and pressures (using instruments furnished with the machine by the manufacturer).
5. Volts and amps for each phase.
6. Power factor.
7. KW input.
8. Tons of cooling.
9. KW per ton of cooling.

D. Reference chiller specification for additional requirements.

3.11 TESTING THE VARIABLE AIR VOLUME SYSTEM

A. All VAV boxes used are to be calibrated to produce the rated air quantity.

B. Set and record the supply air static pressure controller to provide actual design air flow at the most resistive terminal.

C. Measure and adjust the design air delivery at the inlet of each VAV box.

D. Measure and record the air quantity from each VAV box at its maximum flow. Manipulate the controller to achieve maximum flow.

E. Reset each box to yield and record minimum primary air flow.
   1. DDC controllers record the correction factor required to establish actual desired air quantity as designed.
   2. Pneumatic controllers adjust velocity controller as required to establish actual desired air quantity as designed.

F. If the box is operating with inlet static pressure in excess of the minimum cataloged pressure specified by the manufacturer and is not producing rated air quantity, field adjust the box to produce rated air quantity. Retest until approved results are obtained.

G. Position the VAV boxes to the proportion of maximum fan air volume to total installed box maximum volume.

H. Set the fan to deliver the AHUs scheduled design airflow.

I. Perform and record a total air traverse.

J. With the system terminal boxes set for full flow or diversity, the system will be delivering the scheduled design CFM with the most restrictive box in control. Make a speed increase if either or both static and volume are low.

K. Set the boxes to minimum and adjust the inlet vanes and or speed controllers to prevent excessive static in the system.

L. Coordinate with the work specified in Building Management and Control System on the final location of the sensors for the static pressure controller. Locate in the supply duct far enough from the fan discharge to be truly representative of the average static pressure in the system.

M. Modulate the fan speed on the supply fan. Adjust as required to coordinate with the static pressure sensing network.

N. Make a set of recordings showing final system conditions including system duct static pressures and control system setpoint.

3.12 DUCT TEST

A. Test and Balancing Contractor shall verify and record the duct test results. A copy of the duct test results, as completed, shall be submitted to the engineer for review within five days. Provide a complete report of all the duct test results in the final TAB report.

3.13 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.

3.14 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. 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
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
10. Air Monitoring Station Data
   a. Identification/location
   b. System
   c. Size
   d. Area
   e. Design velocity
   f. Design air flow
   g. Test velocity
   h. Test air flow
11. 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
12. Pump Data
   a. Identification/number
   b. Manufacturer
   c. Size/model
   d. Impeller
   e. Service
   f. Design flow rate, pressure drop, BHP
   g. Actual flow rate, pressure drop, BHP
   h. Discharge pressure

l. Suction pressure
j. Total operating head pressure
k. Shut off, discharge and suction pressures
l. Shut off, total head pressure
m. Pressure differential settings

13. 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. Water pressure flow, design and actual
    j. Water pressure drop, design and actual
    k. Entering water temperature, design and actual
    l. Leaving water temperature, design and actual
    m. Air pressure drop, design and actual
    n. Capacity - sensible and latent
14. 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. Water pressure flow, design and actual
    h. Water pressure drop, design and actual
    i. Entering water temperature, design and actual
    j. Leaving water temperature, design and actual
    k. Air pressure drop, design and actual
    l. Capacity
15. Electric 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. Electrical Characteristics
    h. Capacity
16. Sound Level Report
    a. Location (Location established by the design engineer)
    b. N C curve for eight (8) bands-equipment off
    c. N C curve for eight (8) bands-equipment on
17. Vibration Test on equipment having 10 HP motors or greater in size.
    a. Location of points:
        1) Fan bearing, drive end
        2) Fan bearing, opposite end
        3) Motor bearing, center (if applicable)
        4) Motor bearing, drive end
        5) Motor bearing, opposite end
        6) Casing (bottom or top)
        7) Casing (side)
        8) Duct after flexible connection (discharge)
        9) Duct after flexible connection (suction)

b. Test readings:
    1) Horizontal, velocity and displacement
    2) Vertical, velocity and displacement
    3) Axial, velocity and displacement
c. Normally acceptable readings, velocity and acceleration
d. Unusual conditions at time of test
e. Vibration source (if non-complying)

18. 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

SECTION 23 05 94 - 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 effect 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.

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.

HVAC FAN / AIR HANDLING UNIT / START-UP REPORT FORM														
Equipment Description	*Actual*			*Disc. Switch Wired*	*Rotation Correct*	*Belt*		*RPM Correct Submittal*	*Vibration Isolation Correct*	*Attachment To Roof Curb*	*List Of Damage Parts*	*Bearings Lubricated*	*Filter Installed*	*Interlocks & Dampers Operational*
	Voltage	*Amps*	*HP*			*Condition & Part #*	*Tension Correct*							

END OF SECTION

SECTION 23 07 13 - 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. Air Handling Units. Internal insulation for air units is specified in the sections on air handling units. The units do not require external insulation.
2. Internal Duct Liner. Internal duct liner is specified in the section on ductwork.
3. Insulation. Refer to specific sections on individual insulation types.
4. 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.

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. Schuller 814 spin-glas FSK.
      b. Owens-Corning Type 703 board RKF.
      c. Knauf 3 PCF 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. Manville R-series Microlite FSKL.
      b. Owens-Corning ED100 RKF.
      c. Knauf 1.0 PCF FSK.

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.

E. Fireboard Insulation
   1. Totally encapsulated with foil facing.
   2. Two hour rated fire protection.
   3. Zero clearance to combustible protection.
   4. System shall be listed and labeled by an NRTL.
   5. Tested per ISO 6944, Type A Duct and achieve a 2 hour rating for stability,

integrity and insulation.

6. Provided system is subject to the approval of the Local Authority Having Jurisdiction.
7. Acceptable Manufacturers
   a. Unifrax ON Fyrewrap Elite 1.5
   b. Partak Insulation, Inc. Paroc Fireboard
   c. Thermal Ceramics FireMaster 3M
   d. Premier Refractories International, Pyroscat.

F. Rigid Closed Cell Insulation
1. Acceptable Manufacturers
   a. Dow Trymer.
   b. Phenolic Foam.

G. Reinforced Foil Tape
1. Acceptable Manufacturers
   a. Venture 1525CW
   b. 3” FSK
2. Thickness 6.5 mils
3. Color: silver

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 100ºF 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 100ºF 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.

2.3 OUTDOOR DUCT LAMINATED JACKETING

A. Rubberized bitumen compound material:
1. Ultraviolet resistant
2. Weatherproof
3. Vapor retarding jacketing
4. Laminated jacketing
5. Cross-laminated high strength polyethylene film
6. Laminated to aluminum foil
7. Minimum 60-mil thickness

B. Acceptable Manufacturers:
1. Alumaguard 60
2. Flex Clad 400
3. Venture Clad 1577CW

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”. In addition, 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.

C. Insulation shall be wrapped tightly on the ductwork. Adhere insulation to ductwork with adhesive. In addition, 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.

3.4 OUTDOOR DUCTWORK COVERING

A. Cover all supply and return ductwork outdoors:
   1. 1-1/2” thick, rigid closed cell insulation with reinforced foil facing.

B. Install a high point in center and slope in both directions so water will not stand on horizontal surfaces.

C. Impale the insulation over mechanical fasteners and washers.
   1. A minimum of 2 rows of fasteners per side on 12-inch centers.
   2. Seal all breaks, joints and punctures by applying a 1/8” thick vapor barrier mastic coating, embedded in open mesh reinforcing mesh.

D. Standing S, or flanged connections shall be covered with the same thickness of insulation overlapped a minimum of 4”.

E. Apply a tack coat of Childers CP-10/11 or Foster 46-50 weather barrier mastic over the entire surface.
   1. While this coat is still tacky, Childers #5 glass fiber reinforcing mesh shall be smoothly applied and pressed into the mastic. The cloth shall be taut with adjacent edges overlapped a minimum of 4”.
   2. After the first coat of mastic has taken its set, the second coat shall be applied over the cloth by palm, trowel, or spray to sufficient thickness that, when dried, the combined thickness of mastic and cloth is not less than 1/8”.
   3. Upon completion, the openings in the cloth shall be completely sealed and the yarn shall not be visible. The completed work shall be completely smooth and present a plane surface.
   4. Aluminum gray or white finish as approved by the Architect.

F. Standing water on horizontal surfaces is not approved.

G. Apply outdoor duct laminated jacketing protection over entire insulation surface. Apply rubberized bitumen compound, applied to a cross-laminated high strength polyethylene film, laminated to aluminum foil.

3.5 KITCHEN GREASE EXHAUST DUCTWORK / KILN DUCTWORK / FUME HOOD DUCT

A. Secure fireboard insulation to duct with impaling pins and 3” square speed clips. In addition, provide a wire mesh support system and additional sealing or support as required by the code enforcing authority. The insulation support system shall include framed access to allow the insulation to be removed and replaced without damage at the access doors in the duct system for inspection and cleaning. Coordinate location of access openings to correspond accurately. Provide stainless steel banding on 12” centers.

3.6 GENERAL INSTALLATION

A. Install materials in accordance with manufacturer's instructions.

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 23 07 16 - VESSEL INSULATION

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install insulation for both high and low temperature vessels.

B. Low temperature installations include expansion tanks, air eliminators, chiller nozzles, chiller heads and other vessels containing liquids 60°F and below.

C. High temperature installations include expansion tanks, air eliminators, domestic water storage tanks, boiler stack / transition and other vessels containing liquids above 60°F.

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 vessel 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 vessel 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 vessel, 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.

B. 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.

1.4 RELATED WORK

A. Division 9 Finishes. Painting and color-coding

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Glass fiber pipe & tank insulation:
   1. Schuller Type 817
   2. Owens-Corning Type 705
   3. Knauf 2.8 PCF

B. Closed cell, non-wicking pipe & tank insulation:
   1. Armaflex FS, 2” thickness

C. Aluminum Jacketing:
   1. Childers
   2. Pabco
   3. RPR

D. Monel Staples
   1. Bostich Monel
   2. Duo-Fast Monel
   3. Markwell Monel

E. Fiberglass reinforcing cloth mesh:
   1. Perma Glass Mesh
   2. Alpha Glass Mesh
   3. Childers Chil-Glas
   4. Foster Mast a Fab

F. Weather Resistant Coating:
   1. WB Armaflex Finish

2.2 CEMENT, MASTICS, SEALANTS, ADHESIVES AND COATINGS

A. Adhesive: Provide Childers CP-127 or Foster 85-60 fiberglass adhesive to seal insulation for low temperature vessels.

B. Adhesive / Joint Sealant: Provide Armaflex 520 adhesive to seal insulation for low and temperature vessels.

C. Lagging Adhesive / Coating: Furnish Childers CP50AHV2 or Foster 30-36 lagging adhesive / coating to provide a finish coat and to secure finish cloth for high temperature vessels.

D. Insulation Joint Sealant: Use Childers CP-76 or Foster 95-50 to seal the joints of insulation on low temperature vessels.

E. Metal Jacketing Sealant: Use Childers CP-76 or Foster 95-44 on all metal jacketing laps outdoors.

F. Vapor Barrier Coating: Indoors - Use Childers CP-38 or Foster 30-80 vapor barrier coating finish to coat the canvas finish on low temperature vessels. Permeance shall be 0.013 perms or less as tested by ASTM E96. Coating must comply with MIL-C-19565C, Type II and be QPL listed. Permeance shall be 0.03 perms or less at 30 mils, dry. Tested at 100°F and 90% RH per ASTM F 1249 and by Hypalon rubber based.

G. Weather Barrier Mastic: Furnish Childers CP-10/11 or Foster 46-50 weather barrier mastic and reinforcing mesh for outdoor finish.

H. Reinforcing Mesh: Furnish 10 X 10 white glass or polyester reinforcing mesh.

PART 3 - EXECUTION

3.1 HIGH TEMPERATURE VESSELS (FIBERGLASS)

A. Apply a first layer of insulating board. Band the board on immediately after application, using bands on 12” centers, drawn tight and securely fastened.

B. Apply successive layers of insulation as specified for the first layer, with joints staggered. After insulation has been applied, finish with Childers CP-38 or Foster 30-80 vapor barrier coating reinforced with glass or polyester reinforcing mesh per manufacturer's recommendations. Provide a flood coat of Childers CP-10/11 or Foster 46-50 with Foster Mast a Fab polyester or Chil Glas #10 reinforcing mesh.

C. To insulate removable heads, provide two equal sections of heavy-gauge, galvanized sheet metal covers, angle reinforced and lined with insulation board. Make covers easily removable to allow free access to the heads for inspection, cleaning and dismantling. Provide suitable flanges on the sections with neoprene gaskets between them, permitting a tight seal when the two sections are bolted together. Fill the voids with glass fiber wall cavity insulation.

3.2 LOW TEMPERATURE VESSELS (CLOSED CELL)

A. Apply a layer of insulating board. Band the insulation on immediately after application, using bands on 12” centers, drawn tight and securely fastened.

B. To insulate removable heads, provide two equal sections of heavy-gauge, galvanized sheet metal covers, angle reinforced and lined with insulation board. Make covers easily removable to allow free access to the heads for inspection, cleaning and dismantling. Provide suitable flanges on the sections with neoprene gaskets between them, permitting a tight seal when the two sections are bolted together. Fill the voids with closed cell insulation.

C. Apply weather protective finish on closed cell insulation. Provide a minimum of three coats.

3.3 ALUMINUM JACKETING (Insulated vessels outdoors above grade)

A. Apply aluminum jacket on vessels according to manufacturer's recommendations using aluminum strapping and metal jacketing sealant to provide weather tight covering.

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.

C. Install straps on 12” centers.

3.4 VESSEL INSULATION REQUIREMENTS

A. Insulate all low and high temperature vessels located exterior (outside) of the building, including the following:
1. Air separators
2. Expansion Tanks
3. Chemical feeders
4. Chilled water system volume tanks
5. Insulation thickness shall match thickness of adjoining pipe insulation

B. Insulate all low temperature vessels located interior (inside of the building, including the following:
1. Air separators
2. Chemical feeders
3. Chilled water system volume tanks
4. Insulation thickness shall match thickness of adjoining pipe insulation

C. Insulate the following high temperature vessels located interior (inside the building).
1. Air Separators
2. Insulation thickness shall match thickness of adjoining pipe insulation

D. As indicated on the drawings

END OF SECTION

SECTION 23 07 19 - 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 chilled water, heating water, refrigerant lines, condensate piping and make-up 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 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.

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

B. Pipe Heat Tracing

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. Rigid Foam Insulation:
1. Kingsapan Tarec
2. Dow Trymer
3. Tarec Ecophen – Phenolic Foam

D. Aluminum Jacketing:
1. ITW Lock-on (Childers)
2. ITW Z-lock (Pabco)

E. Fiberglass reinforcing cloth mesh:
1. Perma Glass Mesh
2. Alpha Glass Mesh
3. Childers Chil-Glas
4 Foster Mast a Fab
5. Vimasco

F. Mastics, Sealants, Coatings and Adhesives
1. Childers
2. Foster
3. Vimasco
4. Armacell 520 Adhesive

G. Elastomeric Insulation
1. Armacell

H. Weather Resistant Coating
1. WB Armaflex Finish
2 Foster 30-64

I. 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 RIGID FOAM PIPE INSULATION

A. Polyisocyanurate pipe insulation or phenolic foam pipe insulation, with all service reinforced vapor barrier jacket having integral laminated vapor barrier.

1. Polyisocyanurate: Thermal conductivity 0.14 @ 75°F mean (ASTM C518).
2. Phenolic Foam: Thermal conductivity 0.13 @ 75°F mean (ASTM C 518); minimum 2.5# density.
3. Polyisocyanurate is not to be used inside of buildings without 25/50 rating.

2.3 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).

2.4 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 ¾" 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)

2.5 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

2.6 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 ½" 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.

2.7 SEALANT, ADHESIVE AND FINISH

A. Lap Adhesive. Provide Childers CP-82 or Foster 85-20 adhesive.

B. Vapor Barrier Finish:
   1. Indoors: Provide as insulation coating Childers CP-38 or Foster 30-80, white.

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 100ºF and 90% RH per ASTM E96.

2. Outdoors: Provide as insulation coating Childers Encacel X or Foster 60-90. Permeance shall be 0.03 perms or less at 30 mils dry. Tested at 100ºF and 90% RH per ASTM F 1249 and must be Hypalon rubber based.
3. Underground: Provide Childers CP-22/24 or Foster 60-25/26 for fittings and areas. Pittwrap cannot be used.

C. Insulation Joint Sealant. Provide Childers CP-76 or Foster 95-50 vapor barrier sealant.

D. Metal Jacketing Sealant. Provide Childers CP-76 or Foster 95-44 metal jacketing sealant for all outdoor metal jacketing laps.

E. Lagging Adhesive. Provide Childers CP-50AMV1 or Foster 30-36.

F. Other products of equal quality will be acceptable only upon approval.

2.8 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.

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.

2.9 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 hot water 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. Cover all chilled water piping with rigid foam insulation.
1. Adhere the vapor barrier jacket longitudinal seam with vapor barrier adhesive.
2. 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 ½” wide glass filament tape.
3. Apply a tack coat of fitting mastic over the insulation and tape.
4. Neatly embed with 10 x 10 fiberglass cloth into the tack coat.

5. Apply mastic over the fiberglass cloth to a thickness where the fabric is not visible after completion.
6. 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.

C. Install hanger with protective shield, on the outside of all insulation.

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 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. Chilled water and heating water
2. Make-up water
3. Condenser water

3.2 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.

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 shall be painted with two coats of either WB or SB Armaflex finish or Foster 30-64 elastomer foam coating. All seams shall be located on the lower half of the pipe.

E. Outdoor exposed piping after being sealed as noted above apply aluminum jacketing to protect piping insulation exposed to weather, from damage from sunlight, moisture, equipment maintenance, wind, and shall provide shielding from solar radiation. Adhesive Tape shall not be permitted.

3.3 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 Childers CP-82 or Foster 85-20 adhesive. Secure fitting insulation covers and segments in place with ½" wide glass filament tape.

D. Apply a tack coat of fitting vapor barrier coating over the insulation and tape.

E. Neatly embed with 10 x 10 fiberglass or polyester reinforcing mesh into the tack coat.

F. Apply coating over the fiberglass cloth to a thickness where the mesh is not visible after completion.

G. Seal ends of pipe insulation with vapor barrier coating 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.

3.4 UNDERGROUND PIPE COVERING

A. Cover chilled and hot water piping underground with cellular glass insulation.

B. Butter insulation joints with Childers CP-76 or Foster 95-50 vapor barrier sealant. Secure with stainless steel bands or ½" fiberglass reinforced tape on 9" centers.

C. Cover valves and flanges with fabricated fittings of thickness and material equal to the adjoining insulation. Fasten fittings in place with stainless steel bands or ½" fiberglass reinforced tape.

D. Apply a tack coat of fitting mastic Childers CP-22/24 or Foster 60-25/26 over the insulation and bands.

E. Neatly embed with 10 x 10 fiberglass or polyester reinforcing mesh 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 all valves, fittings, flanges and every 21' on straight run piping. Mastic should extend on top of ASJ jacket, across the glass, down onto the pipe, making a complete seal.

H. Finish with 125 mil thickness Pittwrap jacket applied in accordance with manufacturer's instructions. At contractor's option, cover insulation with Servi-Wrap P-500 installed in accordance with manufacturer's instructions.

3.5 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 coating/mastic to the insulated fitting to produce a smooth surface.
   2. After mastic is dry, apply a second coat of vapor barrier coating/mastic. Neatly embed with 10 x 10 fiberglass or polyester reinforcing mesh into the tack coat.
   3. Overlap coating/mastic and fiberglass/polyester reinforcing mesh by 2" on adjoining sections of pipe insulation.
   4. Apply a second coat of coating/mastic over the fiberglass/polyester reinforcing mesh to present a smooth surface.

5. Apply coating/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-38 or Foster 30-80. 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 100ºF and 90% RH per ASTM E96.

B. PVC fitting covers are not acceptable.

3.6 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 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.

3.7 MISCELLANEOUS

A. Insulate pumps.

B. Install materials after piping has been tested and approved.

C. Apply insulation on clean, dry surfaces only.

D. Apply weather protective finish on elastomeric insulation installed in non-conditioned spaces. Provide a minimum of three coats.

3.8 INSULATION THICKNESS

INSULATED UNIT	THICKNESS (Inches)
Refrigerant Piping	1-1/2
Chilled Water Piping (through 2” pipe)	1-1/2
Chilled Water Piping (2-1/2” pipe and Larger)	2
Condensate Drains	1
Heating Water Piping 2” Pipe and Larger	2
Heating Water Piping 1-1/2” Pipe and Smaller	1-1/2
Exterior Chilled and Hot Water Piping, 5” Pipe and Larger	2
Exterior Chilled and Hot Water Piping 4” Pipe and Smaller	1-1/2

END OF SECTION

SECTION 23 08 00 - 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 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 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 1.0ºF and a resolution of + or - 0.2ºF). 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

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.

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.

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. Air Handling Units
b. Energy Recovery Units

c. Terminal Units
d. Pumps
e. Fans
f. Heaters
g. Split Systems
h. Heat Exchanger/Converter
i. Chiller
j. Boiler
k. Valves

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. Terminal Units.
2. Air Handling Unit.
3. Energy Recovery Unit.
4. Heat Exchanger/Converter.
5. Pumps.

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.

C. Air Cooled Chillers
1. Graphics
2. Start/Stop/Schedule
3. Compressor Operation (On/Off/Hand/Auto)
4. Entering/Leaving Temperature
5. Safeties
6. Alarms
7. Temperature Reset Sequences

D. Boilers
1. Graphics
2. Start/Stop/Schedule
3. Firing Operation (On/Off/Hand/Auto)
4. Entering/Leaving Temperature
5. Safeties
6. Alarms
7. Temperature Reset Sequences

E. Air Handling 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. Valve Positions (Off/On/Safety)
7. Safeties (Low Limit/Smoke Detectors/Fire Alarm/Static Pressure)
8. Alarms (Filter/Temperature/etc.)
9. Damper Operation (Normal/Economizer)
10. Valve Operation (Normal Heating & Cooling/Economizer)
11. Fan Speed Control (VFD)
12. Temperature Reset Sequences
13. Static Reset Sequences

F. Energy Recovery Units
1. Graphics
2. Start/Stop/Schedule
3. Fan Operation (On/Off/Hand/Auto)
4. Temperature Calibration (Air/Water)
5. Air Flow Station Calibration
6. Damper Positions (Off/On/Safety)
7. Valve Positions (Off/On/Safety)
8. Safeties (Low Limit/Smoke Detectors/Fire Alarm/Static Pressure)
9. Alarms (Filter/Temperature/etc.)
10. Damper Operation (Normal/Economizer)
11. Valve Operation (Normal Heating & Cooling/Economizer)
12. Fan Speed Control (VFD)
13. Temperature Reset Sequences
14. Static Reset Sequences

G. Terminal Units
1. Graphics
2. Start/Stop/Schedule
3. Fan Operation (On/Off/Hand/Auto)
4. Temperature Calibration (Air/Water)
5. Thermostat Operation
6. Damper Positions (Off/On/Safety)
7. Valve Positions (Off/On/Safety)
8. Safeties (Smoke Detectors/Fire Alarm)
9. Alarms (Temperature/etc.)
10. Unoccupied Overrides

H. Pumps
1. Graphics
2. Start/Stop/Schedule
3. Pump Operation (On/Off/Hand/Auto)
4. Flow Station Calibration
5. Pressure Sensor Calibration
6. Pump Speed Control (VFD)
7. Sequencing and Alarms

I. 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

J. Heaters
1. Graphics
2. Start/Stop/Schedule
3. Thermostat Operation
4. Flow Station Calibration
5. Sequencing and Alarms

K. 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)

L. Recirculation Pump
1. Graphics
2. Start/Stop/Schedule
3. Pump Operation (On/Off/Hand/Auto)
4. Temperature Sensor Calibration

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. Building Loop Chilled Water System
1. Chilled Water Flow.
2. Chilled Water Supply Temperature.
3. Chilled Water Return Temperature.
4. Chilled Water Pressure Differential.
5. Chilled Water Pressure Setpoint.
6. Pump 1 Speed.
7. Pump 2 Speed.

D. Building Loop Hot Water System
1. Hot Water Flow.
2. Hot Water Supply Temperature.
3. Hot Water Return Temperature.
4. Hot Water Pressure Differential.
5. Hot Water Pressure Setpoint.
6. Pump 1 Speed.
7. Pump 2 Speed.

E. Air Handling Unit Supply Air

1. Supply Air Temperature.
2. Supply Air Temperature Setpoint.
3. Mixed Air Temperature.
4. Mixed Air Temperature Setpoint.
5. Chilled Water Valve Position.
6. Hot Water Valve Position.
7. Critical Terminal Unit Air Valve and Heating Position

F. Air Handling Unit Static Pressure
1. Duct Static Pressure.
2. Duct Static Pressure Setpoint.
3. Fan Speed
4. Critical Terminal Unit Air Valve Position

G. Air Handling Unit Economizer
1. Supply Air Temperature.
2. Supply Air Temperature Setpoint.
3. Mixed Air Temperature.
4. Mixed Air Temperature Setpoint.
5. Return Air Temperature.
6. Return Air Enthalpy.
7. Outside Air Temperature.
8. Outside Air Enthalpy.
9. Chilled Water Valve Position.
10. Hot Water Valve Position.
11. Return Damper Position
12. Relief Damper Position
13. Outside Air Damper Position

H. Terminal Units
1. Room Temperature.
2. Room Temperature Setpoint.
3. Supply Air Temperature.
4. Inlet Air Flow.
5. Inlet Air Valve Position.
6. Heating Coil Valve Position.
7. Fan Status.
8. Room CO2.

I. Split System Units
1. Room Temperature.
2. Room Temperature Setpoint.
3. Supply Air Temperature.
4. Fan Status.
5. Cooling/Heating Mode.

J. Fans
1. Room Temperature.
2. Room Temperature Setpoint.
3. Fan Status/Speed.

K. Heaters
1. Room Temperature.
2. Room Temperature Setpoint.
3. Status.

END OF SECTION

SECTION 23 09 33 - BUILDING MANAGEMENT AND CONTROL SYSTEM

PART 1 - GENERAL

1.1 SCOPE

A. Provide and install a complete Building Management and Control System (BMCS), including industrial instrumentation necessary to obtain functions and results specified. A complete system includes items such as sensors, valves, dampers, valve and damper operators, DDC panels, relays, terminal equipment controllers, mounting brackets and thermowell, etc. Integrate all components to provide a complete and functioning system.

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.

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.

1.5 WARRANTY

A. Provide with a manufacturer’s parts and labor warranty for a period of two years from substantial completion.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Reliable by Unify Energy Solutions

B. Automated Logic Branch Office - WebCTRL

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 of 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.

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, chiller, boiler) 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

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.

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. 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.

G. 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.

H. Any invalid operator entry shall result in an error message.

I. 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.

J. 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.

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 affective 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.

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. Hot water reset.
   4. Chilled water reset.
   5. Volumetric control.
   6. Dead band control. Install dual set points as requested by user.
   7. 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

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. Alphanumeric pagers
2. Numeric pagers
3. Email
4. Phones via voice or short message service (SMS)

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.

2.11 TERMINAL EQUIPMENT CONTROLLERS

A. Provide for control of each piece of equipment, including, but not limited to, the following:
   1. Variable Air Volume (VAV) boxes
   2. Constant Air Volume (CAV) boxes
   3. Dual Duct Terminal Boxes
   4. Unit Conditioners
   5. Heat Pumps
   6. Unit Ventilators
   7. Room Pressurization
   8. Fan Coil Units

B. Include the following items:
   1. All input and outputs necessary to perform the specified control sequences.
      a. Analog outputs shall be industry standard signals such as 24V floating control.
   2. Sufficient memory to accommodate point database, operating programs, local alarming and local trending.
   3. All databases and programs shall be stored in non-volatile EEPROM, EPROM and PROM, or minimum of 100-hour battery backup shall be provided.
   4. Return to full normal operation without user intervention after a power outage of unlimited duration.
   5. Operation programs shall be field selectable for specific applications.
   6. Specific control strategy requirements, allowing for additional system flexibility.
   7. Controllers that require factory changes of all applications are not acceptable.

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)
      a. Switch shall be fully adjustable so that cut-in/cut-out points may be preset at any point within angular travel of the motor.
   3. 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

2.13 ETHERNET CARD

A. Ethernet Card:

1. Local area network connection interface card.

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 AUTOMATIC CONTROL VALVES

A. Pressure ratings: Minimum 125 psig or 1.25 times maximum system operating pressure.

B. Construction:
   1. 2" and smaller:
      a. Screwed.
      b. Bodies and internal parts: Bronze, stainless steel or other approved corrosion-resistant metal.
   2. 2-1/2" and larger:
      a. Flanged.
      b. Bodies: Cast iron or cast steel.
      c. Seats and parts exposed to fluid: Bronze, stainless steel or other approved corrosion-resistant metal.
   3. Characterized port ball valves are acceptable for VAV terminal units only.

C. Modulating straight through water valves: Equal percentage contoured throttling plugs.

D. Three Way Mixing Valves: Linear throttling plugs allowing total flow through valve to remain constant regardless of position.

E. Sizes: By Automatic Control System Manufacturer for fully modulating operation.
   1. Minimum pressure drop: Equal to pressure drop of coil or exchanger.
   2. Maximum pressure drop: 5.5 psi.
   3. Relief and bypass valves: Sized according to pressure available.
   4. 2-position valves: Line size.
   5. Manual by-pass operator.

F. Electronic Actuator:
   1. Direct coupled installation
   2. Visual and electronic stroke indicator
   3. Die-cast aluminum housing
   4. Manual override
   5. Self-lubricating bearing and gear train
   6. Automatic calibration
   7. Automatic duty cycle protection
   8. Overload and stall protection
   9. Non-spring return
   10. Floating /0-10 VAC / 4-20mA operation
   11. UL approved
   12. Provide smooth modulating action and tight close off against the system pressure.
   13. Torque to exceed the maximum required operating torque by not less than 150%.
   14. Actuator input signal shall be compatible with output DDC controller.

15. Provide weatherproof enclosure (exterior use).
16. Damper actuators not acceptable for valves.

2.16 FLOW DETECTION SWITCHES

A. Remote Flow Solid-State Flow Detection:
1. Extended length flow probe
2. Cabinet-mounted control monitor
3. Wetted parts, 316 stainless steel probe
4. Optional temperature and wire-break outputs
5. Flow and temperature switch points
6. LED bar graph display for status indication

B. Approved Manufacturer:
1. IFM Effector

2.17 DIFFERENTIAL PRESSURE SWITCHES

A. Wet/wet differential pressure switch
1. Integral Mounting Frame
2. Watertight, dust-tight, and corrosion resistant enclosure.
3. Wetted materials of brass and flouroelastomer.
4. Externally adjustable set point

B. Approved manufacturer:
1. Square D #9012GGW4
2. Dwyer #DXW-11-153-1
3. Carrier #HK06ZC033

2.18 TEMPERATURE LOW LIMIT SWITCH

A. Responsive to the coldest 1' section of its length.
1. Double pole single throw switch
2. 20' capillary
3. Line voltage with bellows actuated switch
4. Auto reset for outdoor installation
5. Manual reset for indoor installation

2.19 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. Flush mounted
a. Stainless steel flush mount sensor, submit sample for review.
5. Location and height to be approved by Architect/Engineer prior to installation.

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 impact resistant Polycarbonate equal to BAPI-Guard covers suitable for

institutional use. Submit sample for review.
6. Provide manufacturers calibration certificate.
7. Provide impact resistant Polycarbonate equal to BAPI-Guard guards in the following locations:
   a. Corridors
   b. Cafeteria
   c. Kitchen.
   d. Gymnasium.
   e. Dressing Rooms.
   f. Industrial Labs.

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.

D. Liquid Immersion Temperature Sensors
1. Platinum type resistance temperature detector (RTD).
2. Match sensor range to medium being monitored.
   a. Hot water range 30° to 250°F.
   b. Chilled Water 20° to 70°F.
3. Furnish stainless steel wells for installation by Mechanical Contractor.
4. Locate all sensors in field with Owner/Engineer present.
5. System accuracy for liquid temperature sensing shall be +/-1/2°.
6. Sensors must be removable from wells.

E. Outside Air / Freezer / Cooler Sensors
1. Range of –58° to 122°F.
2. Weatherproof sun shield.
3. External trim material corrosion resistant with all parts assembled into water tight, vibration-proof, heat resistant assembly.
4. Minimum of 8' long leads.
5. Encapsulated into Type 304 stainless steel tubes with low conductivity moisture proofing material and lag extension for thickness of insulation.

2.20 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.

2.21 DIFFERENTIAL PRESSURE TRANSDUCER

A. Transducers to convert differential pressures to 4-20 MA analog outputs.
1. Solid state pressure sensor with accuracy of +/- 1% of calibration range.
2. Factory calibrated and have zero and span trimmers for field calibration.

3. Range shall be selected to match the medium being monitored.
4. Pressure snubbers to protect from pressure pulses and a 3-way bypass / valve assembly to protect the transducer from overpressure damage during start-up.
5. LCD Display
6. Acceptable Manufacturer: Rosemount 1151 or 3051 Pressure Transmitter

2.22 FLOW DIFFERENTIAL PRESSURE SWITCH

A. The pressure sensing element shall be of the convoluted diaphragm type for sensitivity to system differential pressure.
1. Select the pressure range based on the sensed differential pressure.
2. The unit shall be protected against overpressure to the full static pressure rating.
3. Accuracy: +/- 2% of full scale.

B. Switch assembly.
1. Reed switch.
2. NEMA-4 enclosure.
3. Threaded boss conduit entrance.
4. SPST action.
5. Voltage and rating as required for the control circuit.

C. Wetted parts shall be made of type 303 stainless steel.

D. Install an isolation valve in each sensing pipe leg to permit servicing without shutting the system down.

2.23 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.

2.24 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.

2.25 HIGH STATIC PRESSURE SWITCH

A. With manual reset switch
1. Approved manufacturer: Cleveland AFS-460.

2.26 INSERTION FLOW SENSORS

A. Turbine Flow Meter
1. Retractable hot tap flow sensor
2. Accuracy: +/- 1% of full scale
3. Dual Turbine
4. Custom thread-o-let 400 psi / 250°F rated
5. Line size from 2-1/2 to 72 inch
6. Metering range from 0.3 to 15 f/sec.

7. Remote NEMA 4 wall mounted LCD display
8. Field Pro Software & Communicator
9. Warranty two years
10. Approved Manufacturer: Onicon Flow Meter F1200 Series

B. Electromagnetic Flow Meter
1. Retractable hot tap flow sensor
2. Accuracy: +/- 1% of full scale
3. Electromagnetic
4. Custom thread-o-let 400 psi / 250 degree F rated.
5. Line size from 1-1/4 to 72 inch
6. Metering range from 0.3 to 15 f/sec.
7. Remote NEMA 4 wall mounted LCD display
8. Field Pro Software & Communicator
9. Warranty two years
10. Approved Manufacturer Onicon Flow Meter F3500 or FT3500

2.27 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, sinthered 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. Acceptable Model is Ruskin Model CD60.

2.28 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.

2.29 DRAIN PAN FLOAT SWITCH

A. Rated at 10 Amps.
1. Shuts off equipment if water level becomes too high.
2. DPDT Contacts.

2.30 BY-PASS AUTOMATIC SHUT-OFF TIMERS

A. Rated at 10 Amps, 125 VAC
1. Shuts off equipment with timed switch
2. White decorated timer
3. Without hold feature
4. Time Cycle 60 minutes

2.31 CO_2 SENSOR

A. Telaire Model T5100 CO_2/Temperature Sensor or approved equal
   1. Local visual indication of CO_2 levels in enclosed spaces.
   2. Pre-calibrated with factory default settings of 1000 ppm and 1500 ppm CO_2 levels
   3. Bright LED indicator transitions between green, yellow, and red as the CO_2 threshold is exceeded.
      a. Accuracy: +/- 30 ppm @ 72°F
      b. Output: 0-10 V (100Ω output impedance) and NTC 20k Thermister

2.32 AIR FLOW SENSING SWITCH

A. The pressure sensing element shall be of the convoluted diaphragm type for sensitivity to system positive, negative, or differential pressure.
   1. Select the pressure range based on the sensed differential pressure.
   2. The unit shall be protected against overpressure to the full static pressure rating.
   3. Accuracy: +/- 2% of full scale

B. Switch assembly:
   1. Reed switch
   2. Field adjustable setpoint
   3. Threaded boss conduit entrance
   4. SPST Action
   5. Voltage and rating as required for the control circuit

2.33 HVAC SHUTDOWN STATION

A. Lockdown Switch:
   1. Mushroom Red Button within a clear plastic cover
   2. Latches when depressed
   3. Twist reset
   4. Sign “HVAC SHUTDOWN”
   5. Manufactured by STI Model #SS2031HV-EN

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 in to 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 through BacNet integration. The BacNet interface is for read only points not included within sequences of this specification.

3.2 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 fan is energized for 100% outside air use.
   3. Provide motorized outside air dampers for the following:
      a. Supply fans
      b. AHUs
      c. Exhaust fans (except kitchen exhaust)

B. Close the chilled and hot water valves to the coil when the related unit is de-energized.

C. Interlock each chiller to start its dedicated chilled and condenser water pumps.
   1. On shutdown provide a circuit to permit the chilled water pumps and condenser water pumps to run while the chillers pump down as required by the manufacturer.
   2. As per manufacturer's recommendations

D. Primary chilled water control:
   1. Operating and safety controls are furnished as an integral part of the water-chilling unit and not specified in this section.
   2. Provide a high limit temperature sensor in each primary chilled water pump loop.

E. 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. Interlock related exhaust fan for dishwasher with time delay off relay.
   4. Interlock kitchen hood related supply and exhaust fans.
   5. Provide additional interlocks as indicated on fan schedule and on drawings.
   6. Interlock electrical and mechanical room exhaust fans with thermostat.
   7. Interlock refrigerant monitor with mechanical room purge system.
   8. Interlock science room related supply and exhaust fans.
   9. Interlock outside air supply fans for VAV air-handling unit with air-handling unit status point.

F. Freeze Protection:
   1. Provide a freeze protection sequence to ensure proper operation of equipment during a freeze condition not limited to the following:
      a. Outside Air Handling Units & Supply Fans with heating and cooling coils: If unit is in occupied or unoccupied mode, upon the triggering of software point indicating a freeze condition or the low temperature sensor (freeze stat) indicates a freeze condition, the system will be disabled, close the outside air damper, open both heating and cooling valves to enable full flow condition. If heating coil discharge air sensor indicates a failure to control and is below setpoint then enable software point indicating a freeze condition, disable unit, close outside air damper, and open both heating and cooling valves to enable full flow condition. Ensure HW & CHW pumps are operational.
      b. Boilers - Enable during a freeze condition.
      c. Air Cooled Chillers – Open isolation valves, then enable pumps, run cycle for 15 minutes per hour, open all chilled water valves.
      d. Protect coils downstream of DX cooling coil with freeze protection. If unit is in occupied or unoccupied mode, upon the triggering of software point indicating a freeze condition or the low temperature sensor (freeze stat) indicates a freeze condition, the system will be disabled, close the outside air damper, disable the DX cooling coil. If coil discharge air sensor indicates a failure to control and is below setpoint then enable software point indicating 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.

G. Drain Pan Float Protection:
1. Interlock to shut down unit and close valves.
2. Cooling Coils mounted above ceiling and in roof mounted units.
3. Provide for each cooling coil location.
4. Signal BMCS alarm point

H. Domestic Water System:
1. Interlock in-line circulating pumps at water heaters with return water pipe mounted thermostat to cycle pump with return water temperature.
2. Interlock high temperature entering water solenoid valve with thermostat on discharge side of tempered water mixing valves.

I. Emergency Shutdown Station:
1. Provide an emergency mushroom style push / pull station shutdown switch in the Principal's Office or as directed by Owner / Architect.
2. Signal the building automation system to de-energize the HVAC equipment.
3. This is to stop exhaust fans and outside air units immediately.
4. Other air handling units, chillers and equipment shall be shut down in an orderly manner so as to not damage the equipment.
5. Once stopped, the system may only be restarted with a key operated switch located adjacent to the shutdown switch.

J. Science Room Utility Controllers:
1. Interlock the utility controllers with related air-handling unit through software.

K. Copper Tube Boiler:
1. Interlock each boiler to start its dedicated primary circulating pump. Interlock flow switch and pump to boiler safety terminal strip.
2. On startup enable boiler and primary pump prior to starting secondary system pump until primary loop temperature reaches 105 degrees as per manufacturer's recommendations.
3. Disable secondary pump if boiler goes into alarm or fails to produce heating water within 30 minutes.

L. Hydronic Heating Boiler:
1. Interlock each boiler to start its dedicated pump.
2. On startup enable boiler prior to starting primary pump. Boiler should reach operating temperature prior to starting system pump as per manufacturer's recommendations.
3. Disable system pump if boiler goes into alarm or fails to produce heating water within 30 minutes.

M. Condensing and Non-Condensing Hot Water Boilers:
1. Interlock each boiler to start its dedicated pump.
2. Install communication cable between each boiler and master controller specified by boiler manufacturer.

N. Intrusion Alarm System:
1. Interlock the intrusion alarm system for status of building occupancy.
2. Disable HVAC system when building is in the unoccupied mode and alarm system is enabled. Either Time of Day Schedule and/or contact from the intrusion alarm system shall disable HVAC system.

3.3 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.

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.

E. Provide final graphic room numbers as selected by Owner / Architect.. Obtain a graphic submittal package for review. Construction Drawing room numbers are not to be used unless approved in writing.

3.4 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. A red-white-red 2"x8" laminated plastic engraved identifying nameplate shall be secured to each audible/visual alarm and emergency shutdown device. Provide identification and location of each A/V device laminated in plastic and hung at refrigerant monitor with identification, location of devices and proper operation of system in a graphic floor plan with written sequence of operation. Identifying nameplates shall have ½ inch high, engraved letters. A red-white-red 12”x12” laminated plastic engraved identifying name plate shall be secured to outside of each door to machine room with “A REFRIGERANT LEAK HAS BEEN DETECTED IN THIS BUILDING WHEN AUDIBLE/VISUAL ALARM IS ENABLED. DO NOT ENTER. CONTACT MAINTENANCE DEPARTMENT.”

3.5 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.
   5. Wiring of 120 VAC power circuits for control panels and devices.

C. All materials and methods specified in this section shall comply with the requirements specified in Division 26 of this specification.

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, Green
2. LAN communications, Yellow
3. All THHN wiring shall comply with Division 26 insulation color identification

3.6 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.

C. All Kitchen exhaust fans are controlled by local switch. Kitchen exhaust fans shall be provided with fan status only.

D. Provide by-pass timers for fans indicated in Fan Schedule and in the following locations:
1. Science Room exhaust fans

POINT DESCRIPTION	TYPE	DEVICE
Start/stop	DO	Control Relay
Outside Air Damper	DO	Electronic Operator
Fan Status	DI	Current Sensitive Relay

3.7 BUILDING ELECTRICAL USAGE

A. Provide digital monitoring of the building KVA and KWH. Coordinate with the

switchgear manufacturer.

B. Electrical Quality monitoring:
1. Monitor Watts, VA, VAR, Demand, Imbalance, and Power Factor.

3.8 MISCELLANEOUS

A. Freezer/Cooler Temperature Monitoring:
1. Temperature Monitoring: Provide an analog temperature sensor located in the freezer compartment and cooler compartment.
2. A2L Refrigerant Leak Detection System: If the freezer/cooler A2L refrigerant leak detection system is triggered, BMCS shall receive an alarm. Refer to Freezer/Cooler equipment manufacturer and Foodservice consultant for additional information on the A2L refrigerant leak detection system requirements.

POINT DESCRIPTION	TYPE	DEVICE
Freezer Alarm	AI	RTD
Cooler Alarm	AI	RTD
Refrigerant Leak Alarm	DI	F/C A2L Refrigerant Leak Detection System Alarm Relay

B. Lighting Control:
1. Provide individual time/photo-cell and time based control of each lighting contactor specified in Division 26.
2. Provide momentary push buttons located in Principal's Office to energize exterior lighting for a preprogrammed length of time. Coordinate final location with owner prior to installation.
a. Provide separate control of each contactor.

POINT DESCRIPTION	TYPE	DEVICE
Lighting Contactor	DO	Control Relay
Momentary Control Switch	DI	Switch

C. 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

D. Outside Air: Provide a temperature sensor and a humidity sensor to monitor outside air conditions.

POINT DESCRIPTION	TYPE	DEVICE

Outside Temperature	AI	Thermistor
Outside Humidity	AI	Humidity Sensor

E. MDF/IDF Temperature Sensor: Provide a temperature sensor in each MDF and IDF rooms to monitor space conditions. BMCS shall alarm when temperature is out of setpoint range.

POINT DESCRIPTION	TYPE	DEVICE
MDF/IDF Temperature	AI	Space Sensor

F. Grease Interceptor High Grease Level Alarm:

1. A grease interceptor alarm panel shall provide a high grease level alarm to the BMCS. Coordinate with plumbing for grease interceptor alarm panel sensor connection requirements.
2. Coordinate with owner/district for notification messaging requirements.

POINT DESCRIPTION	TYPE	DEVICE
Grease Interceptor High Grease Level Alarm	DI	Grease Interceptor Alarm Panel

3.9 EXISTING AUTOMATION SYSTEM

A. The new system shall be fully integrated with the existing Building Automation System Host computer located at the School District maintenance facility.

3.10 FAN POWERED TERMINAL UNIT COORDINATION

A. Equipment furnished in this section and installed by Section 23 36 16:
1. Automatic temperature control card (DDC).
2. Damper Actuator

B. Equipment furnished and installed by Section 23 36 16:
1. Damper.
2. Multi-point flow sensor.
3. Power transformer.
4. Controller enclosure.

3.11 VARIABLE FREQUENCY DRIVE INTERFACE

A. Interface to the VFD directly

B. Interface may be hardwired or via RS-485

C. The following points shall be available at a minimum:

Point Name	Type
Start-stop	DO

Drive alarm	DI
Last fault	AI
Reset drive	DO
Percent output	AI
Frequency output	AI
Speed	AI
Current	AI
Power	AI
Drive temperature	AI
KWH	AI
Run time	AI

3.12 DX DUCTLESS MINI SPLIT SYSTEMS (DMS/DMSCU)

A. Each system is furnished with a cooling only direct expansion coil ductless highwall unit and outdoor air cooled condensing unit.
   1. Internal unit controls shall control operation.

B. If the factory A2L refrigerant leak detector is triggered, BMCS shall receive an alarm and the factory A2L leak dissipation board shall disable compressor, shut off refrigerant valves, enable unit supply fan, and deactivate all heat associated with the system. When the A2L refrigerant leak detection system is reset, all systems shall go back to normal operation. Refer to equipment specifications for additional information on the A2L refrigerant leak detection system and coordinate with equipment manufacturer to ensure all points and sequence of operations are in compliance with manufacturer requirements.

POINT DESCRIPTION	TYPES	DEVICE
Refrigerant Leak Alarm	DI	Factory A2L Refrig. Leak Detection System

3.13 SINGLE ZONE VARIABLE AIR VOLUME AIR HANDLING UNITS (AHU-3, AHU-5, AHU-6, AHU-8, AHU-9, AHU-10, AHU-11, AHU-15)

A. This unit is furnished with a chilled water coil, a hot water heating coil in the reheat position, and a variable frequency drive. Control shall be as follows:
   1. A room Thermistor sensing space temperature through the Direct Digital Control Panel shall vary the speed of the fan to maintain room setpoint. The air volume of the fan can range from 100% to 30% of the air quantity specified. A leaving CHW coil air temperature sensor through the Direct Digital Control Panel shall modulate the cooling coil control valve to maintain the scheduled leaving air temperature. When the fan is at 30% of its specified air quantity and the room temperature is below the room setpoint, the room Thermistor shall modulate the valve on the cooling coil and the valve on the hot water coil in sequence to maintain the desired space temperature. A room humidity sensor shall override the operation of the cooling coil control valve to maintain the relative humidity setpoint in the space. The room temperature sensor shall modulate the hot water reheat coil control valve to maintain the space temperature. The dehumidification sequence only applies after the fan has reached 50% of the specified air quantity.
   2. Outside air is being provided from a VAV Outside air unit via an Outside Air VAV terminal unit.

POINT DESCRIPTION	TYPE	DEVICE
Start/Stop	DO	Control Relay
AHU Status	DI	Current Switch
Variable Speed Motor	AO	Motor Controller
Space Temperature	AI	Space Thermistor
Space Humidity	AI	Humidity Sensor
CHW Valve	AO	Electronic Operator
HW Valve	AO	Electronic Operator
CHW Coil Leaving Air Temperature	AI	Averaging Probe
HW Coil Leaving Air Temperature	AI	Averaging Probe
Discharge Air Temperature	AI	Duct Thermistor

3.14 VARIABLE VOLUME OUTSIDE AIR HANDLING UNIT WITH ENERGY RECOVERY SECTION (OAU-1/ERU-1, OAU-5/ERU-2)

A. Each unit shall consist of a supply air fan, exhaust air fan, a total energy recovery fixed plate heat exchanger, hot water preheat coil and chilled water coil and ERV face and bypass damper. The supply fan and exhaust fan shall be started whenever the associated outside air unit fan is signaled to start.

B. A duct mounted sensor sensing supply air temperature shall, acting through the Direct Digital Control Panel, modulate the valve on the cooling coil and the valve on the hot water coil, in sequence, to maintain the desired discharge air temperature as scheduled. The air-handling unit shall be started and stopped from the BMCS System.

C. BMCS shall enable unit operation and open outside air and exhaust air damper. Interlock ERU operation with the related air handling units.

D. The equipment graphics page shall display the instantaneous tonnage reduction displayed and provide trending of this point.

E. Variable air volume control for OAU/ERU units ducted to outside air single duct VAV terminal units:
   1. Duct static pressure sensor shall be located in the duct at a position approximately 2/3 the distance from the fan in the longest duct run. Location is to be approved by Engineer and coordinated with Section 23 05 93.
   2. The static pressure sensors shall, through the DDC panel, accept the signal from the operating control sensor to:
      a. Transmit a signal to the supply fan motor speed controller.
      b. Modulate the fan speed to maintain the desired static pressure. The exhaust fan shall maintain constant as the VFD is for soft start only. Exhaust fan airflow shall not exceed outside air supply fan airflow.
      c. Coordinate signal with the fan motor speed controller specified in another

section.

3. Install a static pressure high limit safety device to de-energize the system.
   a. Manual reset.

F. The ERV face and bypass damper shall be modulated to open the bypass damper and close the face damper (linked damper for opposite action) at any point when the outside air temperature is below the leaving air temperature setpoint of the chilled water-cooling coil and above 40 degrees (adjustable). Bypass damper shall be used to prevent the need for cooling due to the heat recovered through the ERV in a winter condition.

G. Provide a temperature low limit switch located on the discharge side of the hot water preheat coil or the entering side of the cooling coil to de-energize the air handling unit, close the outside air and exhaust air dampers, open the hot water valve 100%, start the boiler and hot water pump, signal an alarm to the BMCS when the temperature drops below 32°F. Device shall be manual reset.

H. Open OA and EA dampers before starting unit. Provide end switch to ensure damper is in the open position in either the manual (hand) or auto position of the motor starter.

I. Supply Fan and Exhaust fan shall be independently scheduled. However, exhaust fan shall not operate without the supply fan being enabled.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
Supply Fan Status	DI	Current Switch
Exhaust Fan Status	DI	Current Switch
Entering OA Temp	AI	Averaging Probe
Entering OA Humidity	AI	Relative humidity sensor
Leaving OA Temp	AI	Averaging Probe
Leaving OA Humidity	AI	Relative humidity sensor
Entering EA Temp	AI	Averaging Probe
Entering EA Humidity	AI	Relative humidity sensor
Leaving EA Temp	AI	Averaging Probe
Leaving EA Humidity	AI	Relative humidity sensor
Supply Fan Variable Speed Motor	AO	Motor Controller
Exh. Fan Variable Speed Motor	AO	Motor Controller
Differential Across Filters	DI	High / Low limit Switch
Exhaust Damper	DO	Control Relay

POINT DESCRIPTION	TYPES	DEVICE
Outside Air Damper	DO	Control Relay
ERV By-Pass Damper	DO	Control Relay
ERV Damper	DO	Control Relay
Duct Static Pressure	AI	Static Pressure Sensor
CHW Valve	AO	Electronic Operator
HW Valve	AO	Electronic Operator
HW Coil Leaving Air Temperature	AI	Averaging Probe
CHW Coil Leaving Air Temperature	AI	Averaging Probe
Freeze Status	DI	Temperature Low Limit Switch
Static Pressure High Limit	DI	Static Pressure Switch

3.15 VARIABLE VOLUME OUTSIDE AIR HANDLING UNITS (OAU-2, OAU-3, OAU-4)

A. These units consist of a hot water preheat coil, chilled water cooling coil and a variable frequency drive on the supply air fan. Control shall be as follows:
   1. A temperature sensor located in the discharge of the hot water preheat coil shall, through the Direct Digital Control Panel, modulate the hot water control valve to maintain a discharge air temperature (adjustable) as indicated on the air handling unit schedule.
   2. Provide a temperature low limit switch located on the discharge side of the hot water preheat coil to de-energize the air-handling unit when the temperature drops below 37°F. Device shall be manual reset and signal an alarm to the BMCS. Provide freeze protection sequence.
   3. A temperature sensor located in the discharge of the air handling unit shall, through the Direct Digital Control Panel, modulate the chilled water control valve to maintain a discharge air temperature (adjustable) as indicated on the air handling unit schedule.
   4. Open O.A. Damper before starting unit. Provide end switch to ensure damper is in the open position in either the manual (hand) or auto position of the motor starter.

B. Variable air volume control:
   1. Duct static pressure sensor shall be located in the duct at a position approximately 2/3 the distance from the fan in the longest duct run. Location is to be approved by Engineer and coordinated with Section 23 05 93.
   2. The static pressure sensors shall, through the DDC panel, accept the signal from the operating control sensor to:
      a. Transmit a signal to the supply fan motor speed controller.
      b. Modulate the fan speed to maintain the desired static pressure.
      c. Coordinate signal with the fan motor speed controller specified in another section.
   3. Install a static pressure high limit safety device to de-energize the system.

a. Manual reset.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
AHU Status	DI	Current Switch
Variable Speed Motor	AO	Motor Controller
CHW Valve	AO	Electronic Operator
HW Pre Heat Valve	AO	Electronic Operator
CHW Coil Leaving Air Temperature	AI	Averaging Probe
HW Preheat Coil Leaving Air Temp.	AI	Averaging Probe
Static Pressure	AI	Static Pressure Sensor
Freeze Status	DI	Temperature Low Limit Switch
Outside Air Damper	DO	Electronic Operator
Discharge Air Temperature	AI	Duct Thermistor
Static Pressure High Limit	DI	Static Pressure Switch

3.16 OUTSIDE AIR VARIABLE VOLUME TERMINAL UNITS (OAVAV)

A. Each unit shall consist of a pressure independent variable volume damper. The terminal unit's damper shall be interlocked with the associated AHU fan.
   1. The Controls Contractor shall furnish the terminal box manufacturer with a controller to be factory mounted. The controller shall display cfm, temperature, and damper position.
   2. A space CO2 sensor associated with the AHU being served by the OAVAV terminal unit shall provide input to the central BMCS controller. The BMCS shall monitor CO2 levels of the zones served by the associated air handling unit and modulate the pretreated outside air damper to maintain set point 600 PPM (adjustable). This feature shall be user selectable on the AHU graphic page.
   3. Terminal units serving Variable Volume Air Handling Units shall not be provided with CO2 control. These unit shall modulate to maintain the scheduled OA CFM during all occupied times.

POINT DESCRIPTION	TYPES	DEVICE
Primary Air	AO	Variable Volume Damper Operator
Discharge Air Temperature	AI	Duct Thermistor

POINT DESCRIPTION	TYPES	DEVICE
CO2 Concentration	AI	CO2 Sensor

3.17 VARIABLE VOLUME AIR HANDLING UNIT (AHU-1, AHU-2, AHU-4, AHU-7, AHU-12, AHU-13, AHU-14)

A. Units consist of a chilled water coil, a fan, and a variable speed drive.

B. The unit shall be started and stopped from the BMCS system.

C. Outside air for these units are being provided pretreated from a separate Outside Air Unit via an Outside Air Variable Air Volume Terminal Unit.

D. Discharge air temperature control:
1. An averaging probe in the chilled water coil discharge shall, through the DDC, modulate the valve on the cooling coil to maintain setpoint. Reference drawing schedule for discharge temperature.

E. Variable air volume control:
1. Duct static pressure sensor shall be located in the duct at a position approximately 2/3 the distance from the fan in the longest duct run. Location is to be approved by Engineer and coordinated with Section 23 05 93.
2. The static pressure sensors shall, through the DDC panel, accept the signal from the operating control sensor to:
   a. Transmit a signal to the supply fan motor speed controller.
   b. Modulate the fan speed to maintain the desired static pressure.
   c. Coordinate signal with the fan motor speed controller specified in another section.
3. Install a static pressure high limit safety device to de-energize the system.
   a. Manual reset.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
AHU Status	DI	Current Switch
Variable Speed Motor	AO	Motor Controller
CHW Valve	AO	Electronic Operator
CHW Coil Leaving Air Temperature	AI	Averaging Probe
Static Pressure	AI	Static Pressure Sensor
Static Pressure High Limit	DI	Static Pressure Switch

3.18 CONSTANT VOLUME / VARIABLE VOLUME TERMINAL UNITS (CVB)

A. Each unit shall consist of a pressure independent variable volume damper, a

constant volume fan, and a hot water heating coil. The fans shall be interlocked with the AHU fan. Constant volume terminal shall start before AHU fan starts. Controls shall be as follows:

1. A space temperature sensor shall, through the direct digital control system, modulate the variable volume damper from full open to a minimum airflow rate to maintain room setpoint. If heating is required, the temperature sensor shall modulate the hot water control valve to maintain room setpoint with the variable volume damper in the minimum airflow position.
2. Control valve, and control valve operator are specified in this section.
3. The Controls Contractor shall furnish the terminal box manufacturer with a controller to be factory mounted. The controller shall display cfm, temperature, damper position, and hot water valve position.

POINT DESCRIPTION	TYPES	DEVICE
Space Temperature	AI	Space Thermistor
Primary Air	AO	Variable Volume Damper Operator
HW Valve	AO	Electronic Operator
Start/Stop	DO	Control Relay
Discharge Air Temperature	AI	Duct Thermistor

3.19 SINGLE DUCT VARIABLE VOLUME TERMINAL UNIT (VAV)

A. Each unit shall consist of a pressure independent variable volume damper. The primary damper shall be interlocked with the AHU fan. Controls shall be as follows:
   1. A space temperature sensor shall, through the direct digital control system, modulate the variable volume damper from full open to a minimum airflow rate to maintain room setpoint.
   2. The Controls Contractor shall furnish the terminal box manufacturer with a controller to be factory mounted. The controller shall display cfm, temperature, and damper position.

POINT DESCRIPTION	TYPES	DEVICE
Space Temperature	AI	Space Thermistor
Primary Air	AO	Variable Volume Damper Operator
Discharge Air Temperature	AI	Duct Thermistor

3.20 HYDRONIC FAN COIL UNITS (CWFCU)

A. Each fan coil unit is furnished with a chilled water coil and hot water coil. Control shall be as follows:
   1. A space temperature sensor shall, acting through a terminal equipment controller, modulate the valves on the chilled water cooling coil and hot water reheat coil in sequence to maintain the desired space temperatures.
   2. Start/stop of fan coil unit shall be by terminal equipment controller.

3. The outside air units providing the outside air shall be activated when the fan coil units are operating during the occupied periods.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
CHW Valve	AO	Electronic Operator
Space Temperature	AI	Space Thermistor
HW valve	AO	Electronic Operator
Discharge Air Temperature	AI	Duct Thermistor
Fan Status	DI	Current Switch

3.21 ELECTRIC UNIT HEATERS

A. An electric thermostat shall activate the unit and stage the electric coil to maintain room setpoint.

3.22 DISHWASHER EXHAUST

A. Interlock exhaust fan to operate when dishwasher is operating. Provide 5 minute (adjustable) run time for fan after dishwasher stops.

3.23 CHEMICAL TREATMENT SYSTEM

A. Monitor water treatment power circuit and alarm contacts from water treatment controllers. Provide with cooling tower systems only.

3.24 CHILLED WATER SYSTEM CONTROL

A. The system consists of two air cooled chiller and two dedicated primary chilled water pumps.

B. Temperature sensors located in the building common chilled water supply and return piping and the flow meter located in the building chilled water common supply piping shall, acting through the DDC system, be used to calculate the building BTUH requirements.

C. During start-up, one primary pump shall start. After flow has been indicated from the flow switch for an adjustable time period, the chiller shall be activated.

D. When the load calculated from the temperature sensors and flow meter exceeds the capacity of one chiller for an adjustable time period, the second primary pump and chiller shall be activated.

E. If the load drops to below half the capacity (adjustable) of one chiller, then the lag chiller will be deactivated. The primary pump serving the chiller will remain on for 3 minutes (adjustable) and then be deactivated.

B. The BMCS shall also incorporate the chiller's performance curves into the staging sequence. Each chiller shall be operated at its most efficient point whenever possible. The specified chillers are more efficient at part load.

G. A temperature sensor located in the chiller by-pass piping shall send an alarm to the host computer and shall start the lag chiller after an adjustable time delay, if the temperature in the by-pass is above 3 degrees (adjustable) higher than the temperature in the common supply from the chillers. This indicates the flow is moving from the primary loop to the secondary loop and a deficit chiller capacity condition exists.

H. Provide time delays between pump starts and stops to allow system to stabilize.

I. Change lead/lag rotation on a weekly basis.

J. Provide interface to each chiller through the chiller BacNet interface card. Provide a graphic page for the interface card that displays all values available.

POINT DESCRIPTION	TYPES	DEVICE
Chiller Start/Stop	DO	Control Relay
Chilled Water Supply Temperature	AI	Pipe RTD (1 each)
Status (Chiller)	DI	Safety Alarm Relay
Primary Pump Status	DI	Differential Pressure Switch
Primary Pump Start/Stop	DO	Control Relay
Building Flow	AI	Flow Meter
Building Supply/Return Water Temp.	AI	Temperature Sensors
Bypass Temperature	AI	Temperature Sensor

3.25 SECONDARY CHILLED WATER PUMPING SYSTEM CONTROL

A. The system consists of two variable speed secondary chilled water pumps controlled as follows:
   1. The chilled water pumping system will be energized whenever there is a call for cooling in either of the two building system.
   2. Two system differential pressure sensors shall modulate the energized pump(s) speed controller to maintain the required system pressure in each building.
      a. Location of each buildings differential pressure system sensors shall be approved by the engineer and contractor specified in Section 23 05 93.
      b. Coordinate with the pump motor speed controller specified in another section.
   3. Alternate the lead pump on a daily basis.

POINT DESCRIPTION	TYPES	DEVICE
Secondary Pump Start/Stop	DO	Control Relay

POINT DESCRIPTION	TYPES	DEVICE
Secondary Pump Status	DI	Differential Pressure Switch
System Differential Pressure (Minimum of two required)	AI	Pressure Sensor
Pump Speed Controller	AO	Motor Controller

3.26 HYDRONIC HOT WATER HEATING SYSTEM

A. This system consists of a two condensing hot water boilers with constant flow primary boiler pumps and variable flow hot water secondary pumps. Control of the hydronic hot water heating system is as follows:
   1. Energize the hydronic hot water heating system whenever there is a call for heating in the building.
      a. Monitor all control valves to determine if a heating requirement exists.
   2. Energize the hybrid sequence controller specified elsewhere.
      a. The hybrid sequence controller shall control all functions and sequencing of the hot water heating boilers.
      b. Connect all boilers to the master boiler controller specified elsewhere with communication cable as required.
   3. Hydronic hot water heating system supply temperature reset:
      a. A temperature sensor sensing outdoor temperature shall provide an input to the hybrid sequence controller to reset the hot water supply temperature.
         1) Maintain 130°F (adjustable) supply water temperature whenever the ambient temperature is 20°F and below.
         2) Maintain 100°F (adjustable) supply water temperature whenever the ambient temperature is 60°F and above.
         3) All reset temperatures shall be adjustable through the BMCS.
   4. Secondary hot water pump control:
      a. A system differential pressure sensor shall modulate the hot water pump variable frequency drives and stage pumps A and B to maintain system differential pressure.
      b. This system shall be completely adjustable in the field.
   5. Boiler Carbon Monoxide Detector shall be wired to shutdown the boiler upon activation. If Co detector is activated the boiler shall not operate in all modes, hand and auto. BMCS contractor to provide 2 hours of technician support to coordinate commissioning of detector and ensure boiler is shut down upon Co detector activation.

POINT DESCRIPTION	TYPES	DEVICE
Hybrid Sequence Controller	DO	Control Relay
Boiler Alarm Status	DI	Safety Relay (Each Boiler)
Secondary Hot Water Pump Start/Stop/Modulation	AO	Variable Frequency Drive (Each Pump)
Pump Status	DI	Current Sensitive Relay
Building Hot Water Supply/Return		

POINT DESCRIPTION	TYPES	DEVICE
Temperature	AI	Pipe RTD
Boiler Discharge Water Temp.	AI	Pipe RTD (Each Boiler)
Ambient Temperature	AI	Thermistor
System Differential Pressure	AI	Pressure Sensor
Boiler Supply Water Reset	AO	Hybrid Sequence Controller
Inlet Temperature (Read Only		Bacnet Card (Each Boiler)
Outlet Temperature (Read Only)		Bacnet Card (Each Boiler)
Header Temperature (Read Only)		Bacnet Card (Each Boiler
Boiler State (Read Only)		Bacnet Card (Each Boiler)
Error Code (Read Only)		Bacnet Card (Each Boiler)

3.27 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.).
   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. Insure 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.
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 insure 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.

3.28 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.
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 in 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.
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.

04. 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.

3.29 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 40 hours of training for Owner's designated operating personnel. Training shall include:

Explanation of drawings, operations and maintenance manuals
Walk-through of the job to locate control components
Operator workstation and peripherals
DDC controller and ASC operation/function

Operator control functions including graphic generation and field panel programming
Operation of portable operator's terminal
Explanation of adjustment, calibration and replacement procedures
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.

3.30 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

SECTION 23 20 00 - 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. Earthwork.
2. Valves, Strainers and Vents.
3. Vibration Isolation.
4. Insulation.
5. 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.

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.

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 manufactured, 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.

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.

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 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 air tight. Seal annular space between pipes and sleeves with mastic compound to make the space water and air tight.

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.

3.10 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.

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

SECTION 23 21 13 - HOT WATER AND CHILLED WATER PIPING, VALVES AND APPURTENANCES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install heating water and chilled water piping, valves and appurtenances, including fittings and strainers. Domestic hot water piping is specified in the Domestic Water Piping and Appurtenances section.

1.2 RELATED WORK

A. Division 23 Mechanical:
1. Pipe and Pipe Fittings - General
2. Valves, Strainers and Vents
3. Vibration Isolation
4. Insulation

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. For pipe 2" and less in diameter, provide pipe conforming to ASTM A 53, Grade A or B, or ASTM A106 standard weight seamless, or electric-resistance welded black steel pipe. Furnish 150 lb. screwed malleable iron fittings conforming to ANSI B 16.3 for chilled water. Provide fittings conforming to ANSI B 16.4 for hot water.

B. For pipe 2-1/2" in diameter and larger, provide pipe meeting the requirements of ASTM A 53, Grade A or B, or ASTM A 106 standard weight seamless, or electric-resistance welded black steel pipe with standard weight seamless steel welded fittings, satisfying ASTM A 234, Grade WPA or WPB, ANSI B16.9.

2.2 VALVES

A. Refer to Section 23 05 23.

B. Refer to Building Management and Control System.

2.3 WATER SPECIALTIES

A. Pressurized Expansion Tanks shall be precharged steel tank with a replaceable heavy duty Butyl rubber bladder. The tank shall have a 1-1/2" system connection, drain, and a standard tire valve to facilitate on-site charging of the tank. The tank shall be fitted with lifting rings and a floor mounting skirt for vertical installation. The tank must be constructed in accordance with Section VIII of ASME Boiler and Pressure Vessel Code and stamped 125 PSI working pressure.
1. Acceptable manufacturers: Bell & Gossett, Taco, Wessels, John Wood Company, and Wheatley.

B. Air and Dirt Separators shall be a full flow coalescing type combination air eliminator and dirt separator. The separator shall be designed for full flow high volume systems. The inlet and outlet connections shall be the same as adjoining pipe. Vessel shall be fabricated steel, rated for 150 psig working pressure, stamped and registered in accordance with ASME Section VIII, Division 1 for unfired pressure vessels, and include two equal chambers above and below the inlet and outlet nozzles. The vessel shall include copper or stainless steel coalescing medium to aid in the separation of air and dirt in the system entrained water. Air elimination efficiency shall be 100% free air, 100% entrained air, and a minimum of 99.6% dissolved air at the installed location. Dirt separation efficiency shall be a minimum of 80% of all particles 30 micron and larger

within 100 passes. Unit shall be provided with a separate venting chamber to prevent system contaminants from harming the float and venting valve operation.

1. Acceptable manufacturer shall be Spirovent Series HV by Spirotherm or TACO High Velocity 4900

C. Automatic Air vents shall be float actuated high capacity air vent designed to purge free air from the system and provide shutoff at pressures up to 150 psig at a maximum temperature of 250 degrees F. The design of the high capacity air vent shall prevent air from entering the system if system pressure should drop below atmospheric pressure. The high capacity air vent shall purge free air at pressures up to 150 psig during normal system operation. The high capacity air vent shall be constructed of cast iron and fitted with components of stainless steel, brass, and EPDM.

1. Acceptable Manufacturers: Bell & Gossett, Armstrong, Taco, and Wheatley.

D. Pressure Reducing Valves shall be diaphragm operated with brass body, low inlet pressure check valve and inlet strainer. The strainer shall be easily removed without system shutdown. The valve seat, strainer, and stem must be removable and of non-corrosive material.

1. Acceptable Manufacturers: Bell & Gossett, Armstrong, Taco, and Wheatley.

PART 3 - EXECUTION

3.1 TESTING

A. Test all piping systems to assure they are absolutely leak free.

B. Apply a hydraulic pressure 1-1/2 times the operating pressure, 150 psig minimum, and check for leaks. Maintain test for a minimum of 24 hours. The piping system must remain absolutely tight during this period. The satisfactory completion of any test or series of tests will not relieve the contractor of responsibility for ultimate proper and satisfactory operation of piping systems and their accessories. The test should be observed by the Architect / Engineer before pressure is removed and water drained.

3.2 AIR HANDLING UNIT PIPING

A. Provide a minimum of 12" of straight pipe at all coil piping connections.

3.3 AIR SEPARATOR

A. Install full size drain to nearest floor drain.

END OF SECTION

SECTION 23 21 23 - HVAC PUMPS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. General characteristics for pumps specified in Division 23 - Mechanical.

1.2 RELATED WORK

Requirements for pumps are specified in other sections of Division 23 - Mechanical, including the following:

A. Division 23 Mechanical - Electrical Provisions of Mechanical 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.

J. Pumps shall be suitable for parallel operation. Where pumps are operated in parallel, individual pumps shall be capable of stable operation with only one pump operating in the system. Submit pump curves with single and multiple pumps operating on system curve for approval.

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. The head capacities indicated in the schedules are listed for bidding purposes only. Calculate the operating head at each pump; take into consideration the actual routing of the various lines, pressure drops in heat exchangers and coils, exact lengths of pipe, fittings, etc. Submit these calculations, together with 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.

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. When multiple pumps are operating in parallel, show pump curves for one pump running, two pumps running, and so on. Show pump curves with system curve plotted.

PART 2 - PRODUCTS

2.1 VERTICAL IN-LINE (VIL) PUMPS

A. Pump Construction:
1. Pump casing, cast iron with 125 psig ANSI/PN16 flanges for working pressure below 175 psig at 150°F and ductile iron with 250 psig ANSI / PN25 flanges for working pressure to 375 psig at 150°F.
2. Suction and discharge connections shall be flanged and the same size and shall be drilled and tapped for seal flush and gauge connections.
3. Impeller: Bronze, fully enclosed type; dynamically balanced, two-plan balancing is required where installed impeller diameter is less than 6 times the impeller width.
4. Shaft: Provide stainless steel pump shaft.
5. Coupling: Rigid spacer type of high tensile aluminum alloy. Coupling is to be designed to be easily removed on site to reveal a space between the pump and motor shafts sufficient to remove all mechanical seal components for servicing and to be replaced without disturbing the pump or motor.
6. Mechanical seals shall be stainless steel multi-spring inside or outside balanced type with Viton secondary seal, carbon rotating face and silicon carbide stationary seat. Provide 316 stainless steel glad plate. Provide factory installed flush line with manual vent.
7. Split coupled pumps shall be provided with a lower seal chamber throttle bushing to ensure seals maintain positive cooling and lubrication.
8. Provide seal flush supply line to the mechanical seal with a 50 micron cartridge filter and sight flow indicator to suit the working pressure encountered. Filters shall be changed by the installing contractor after system is flushed and on a regular basis until turned over to the Owner.
9. Supply in the flush line to the mechanical seal a maintenance free sediment separator with sight flow indicator.

B. Single stage, single or double suction type, with pump characteristics which provide rising heads to shut off. Refer to pump schedule for pump flows and heads and motor speed, enclosure, efficiency and power requirements and other system conditions.

C. 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%

D. 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)

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. Armstrong Series 4300
2. Aurora
3. Bell & Gossett
4. Grundfos
5. Patterson
6. TACO

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. Install pumps on concrete housekeeping base, with anchor bolts, set and level,

and grout in place. Install stainless steel drain pan with trough under chilled water pumps only.

3. Provide air cock and drain connection piped to floor drain.
4. Lubricate pumps prior to start-up.
5. Install condenser water pumps to ensure a full flooded suction.
6. Paint entire unit with two coats of machinery enamel after completion of installation.
7. Provide a spool piece between the suction diffuser and the suction side of the pump minimum length 8" face to face.
8. Provide pressure taps with valves on each side of the pump.
9. 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. Provide an automatic air vent off the pump casing. For base mounted pumps, provide a drain line the full size of the base connection and extend it to and terminate it over the nearest floor drain.

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.
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

SECTION 23 23 00 - 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.

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.

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.

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 shell 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.

END OF SECTION

SECTION 23 25 13 - CIRCULATING WATER SYSTEM CHEMICAL TREATMENT

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide equipment, chemicals and treatment materials for the complete water treatment system.

B. Determine which chemicals to use from the results of a water sample analysis taken from the building domestic water supply.

C. Provide water treatment products, holding reservoirs, equipment and labor for testing, cleaning, flushing and dispensing products to achieve the required water quality for each system specified.
   1. Closed chilled and hot water systems

1.2 SERVICE AND SUPPLIES

A. All work shall be performed by a qualified, full-time, Water Program Manager.
   1. Specialist in the field of industrial water treatment.
   2. Facilities include water analysis laboratory, development facilities and service department.

B. Provide a water treatment test set for each system (pH, alkalinity, hardness, chloride) for field use including test equipment and reagents as required for specific use with the treatment products employed.

C. Where specialized supplementary testing or control equipment is required, provide appropriate items.

D. Provide a water management and service program for a period of one year beginning at substantial completion. Make routine visits bi-weekly during first two months of operation and monthly during the remainder of the specified period.

E. Routing Services
   1. Check and adjust water treatment system operation.
   2. Instruct, train and advise operating personnel.
   3. Check efficiency of chemicals and chemical applications.
   4. Replenish chemicals and replace expendables.
   5. Clean or replace filter in feeder.

F. Chemically clean the piping system.

G. Provide a complete laboratory analysis of water samples. Insert in the Owner's manuals.

H. Provide review of report figures in the field water testing.

1.3 QUALITY ASSURANCE

A. Acceptable program manager shall have:
   1. Research and development facilities.
   2. Regional laboratories capable of making water analysis.
   3. A service department and qualified technical service representatives located within a reasonable distance of the project site.
   4. Service representatives who are registered Engineers or factory-certified

technicians with not less than 5 years of water treatment experience with the water treatment system manufacturer.

B. Ensure that all products, packaging, blow-down or other effluents do not violate local, state, or federal laws or regulations. Use only chemicals that are registered, when required, with the U.S. Department of Agriculture or the U.S. Environmental Protection Agency and that are labeled as required by law.

C. Provide electrical products that have been tested, listed and labeled by Underwriters Laboratories and comply with the National Electrical Manufacturers Association Standards.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Chem Aqua

2.2 CLOSED CHILLED AND HOT WATER SYSTEM

A. By-pass filter feeders in the hot water and chilled water systems:
1. Rated at 40-gpm capacity.
2. Operating conditions: 150 psig and 250°F.
3. Quick opening cap with a Buna N-O ring seal; or 1-1/2" valve and funnel.
4. 5 micron polypropylene filter bag mounted in a perforated stainless steel holder. Filter bag shall be supported from top of feeder.
   a. Filter bag and holder shall extend full length of feeder tank.
   b. Bottom feed tanks are not acceptable.
5. Fabricated hot dipped galvanized steel support legs and frame. Refer to detail drawing for requirements.
6. Provide sufficient quantity of filter bags for warranty period. Minimum of six additional bags provided to owner.

B. Acceptable Manufacturers
1. Neptune Model FTS-5
2. Efficiency Dynamics FF-100.
3. J.L. Wingert Model FHC-5HD.
4. Hydro-systems HS-800
5. Vector Industries, Inc. FA-900

C. Treatment chemicals:
1. Furnished as a concentrated liquid in 5 gallon pails
2. A corrosion inhibitor of the nitrite-borate type.
3. Maintained at a nitrite residual of 600 – 800 ppm in chilled loops and 1000-1500 in hot loops.
4. With effective copper, black iron, stainless steel and aluminum corrosion inhibitors.
5. Form a protective film to prevent corrosion and scale formation.
6. Have colored dye to indicate presence.

D. Multiple chemicals used in a common system shall be compatible.

E. Flow Indicator:
1. Bronze Construction
2. Rotating Wheel

3. Line Size
4. Double Window
5. Ernst Flow Industries Model EFIE-57-3

PART 3 - EXECUTION

3.1 INSTALLATION/START-UP

A. In accordance with manufacturer's recommendations.

B. Anchor the chemical filter feeder to a concrete housekeeping pad using wedge type expansion anchors.

D. Clean and flush closed loops systems.
1. Clear water flush systems before introducing chemical cleaners.
2. Chemical cleaner shall be introduced into the systems to remove construction related oils, greases, threading compounds, and silt.
3. Chemical Cleaner shall passivate and pre-film pipe system.

3.2 WATER ANALYSIS

A. The chemical treatment agency shall provide the services of a testing laboratory to perform a site water analysis. As a minimum, conduct the following tests in accordance with ASTM standards and to the satisfaction of the Owner/Architect/Engineer.
1. Silica in water and wastewater.
2. Acidity or alkalinity of water.
3. Iron in water.
4. Hardness of water.
5. Ph of water.
6. Particulate and Dissolved Matter, Solids or Residue in Water.
7. Turbidity in water.
8. Corrosivity of water in absence of heat transfer.
9. Standard practices for sampling water.

B. Take water samples in accordance with ASTM.

C. Prepare a test report in accordance with ASTM for each of the tests conducted.

D. Submit the test reports to the Architect/Engineer.

3.3 CHEMICAL TREATMENT

A. The chemical treatment agency shall provide complete services necessary for chemically cleaning and treatment the following systems:
1. Chilled water.
2. Hot water.
3. Condenser water.

B. The chemical treatment agency shall provide, but not be limited to the following:
1. Equipment and installation.
2. Chemicals.
3. Analytical and testing work.
4. Inspection.
5. Calculations.
6. Assistance to the trade installing the piping.
7. Instruction to Owner.

C. Determine which chemicals to use from the results of site water analysis. Provide the chemical necessary to achieve the desired water condition.

D. Examine and supervise flushing and pipe cleaning operations and verify that the systems are clean, free of debris and rust and other construction materials before starting water treatment.

E. After the piping has been flushed, cleaned, rinsed and charged with chemicals, then start-up and operate the chemical treatment equipment to provide steady, stable characteristics for the systems treated.

F. During construction, instruct the Contractor in the field piping and wiring of chemical feeding equipment. If such piping and wiring details are not shown on the Contract Drawings, then provide all equipment, piping, wiring, instrumentation and chemicals to provide a complete and operating system without additional cost.

G. After the chemical treatment is functioning as intended, the chemical treatment agency shall demonstrate to the Architect/Engineer the chemical treatment operation.

3.4 OWNER TRAINING

A. A chemical treatment agency, in conjunction with the chemical treatment equipment manufacturer’s factory representative, shall train the Owner to operate and maintain the chemical treatment system as a whole and in part for each piece of equipment.

B. Furnish to the Owner a chemical treatment administration manual covering the chemical treatment program for each of the systems treated. The manual shall include, but not be limited to:
   1. Name, address and telephone number of the chemical treatment agency and each of the equipment manufacturers.
   2. Operation and maintenance manuals.
   3. Test reports.
   4. Chemical data sheets.
   5. A narrative describing the chemical treatment program for each of the systems being treated.

3.5 TESTING AND INSPECTION

A. After the systems have been accepted, the chemical treatment agency shall visit the site every month during the warranty period.

B. During each visit:
   1. Check and adjust the chemical treatment equipment.
   2. Check the chemistry of the treated system to confirm the chemicals are maintaining the system as intended.
   3. Advise and instruct the Owner on operational changes made to the chemical treatment program.
   4. Take a water sample of each system being chemically treated and have the samples tested by a testing laboratory. Prepare a report for each water sample and submit it to the Owner. Include in the test report the changes that need to be made to the chemical treatment program.
   5. Maintain complete records of the treatment program for each system at the project site. Keep the records in a hardbound manual with the building manager. A second copy shall be maintained by the agency for the agency’s records.

C. Routine visits must be coordinated with the Owner.

D. Send copy of monthly report to Engineer for Verification.

END OF SECTION

SECTION 23 31 13 - 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. Air Handling Units
3. Insulation
4. Terminal Units
5 Fan Coil Units
6. Fans
7. Packaged Rooftop Air Conditioners
8. 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 summit details of duct fittings, including particulars such

as gauge sizes, welds, and configurations prior to starting work.

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 and medium pressure duct constructed of sheet metal in accordance with the latest edition of SMACNA HVAC Duct Construction Standards.

C. Medium pressure oval and round ductwork shall be spiral seam. Spiral lock-seam SMACNA Type RL-1. Fittings shall be welded construction.
1. Galvanized

D. 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.

E. Dishwasher Hood Exhaust System: Welded 304 Stainless steel.

F. Shower Area Exhaust Systems: Welded 304 Stainless steel.

G. Kitchen exhaust duct: Welded Black steel, minimum 16 gauge

H. Natatorium Ductwork: 304 Stainless Steel

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 air tight with duct sealer.
   1. Indoor applications – Foster 32-14
   2. Outdoor applications – Foster 32-17

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)
   5. Flexible duct connections from lateral taps to variable volume boxes or terminal boxes shall be rated at twice the maximum pressure rating of the medium pressure system.

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 FLEXIBLE DUCT MEDIUM/HIGH PRESSURE

A. The duct shall be constructed of a heavy coated fiberglass cloth fabric supported by helical wound galvanized steel. The fabric shall be mechanically fastened to the steel helix without the use of adhesives.

B. The internal working pressure rating shall be at least as follows with a bursting pressure of at least two times the working pressure:
Positive: 12" w.g.
Negative: 5" w.g.

C. The duct shall be rated for a velocity of at least 5500 fpm.

D. Suitable for operating temperature range of -20°F to +250°F.

E. Factory insulate the flexible duct with fiberglass insulation.

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

F. Cover the insulation with a fire retarding polyethylene vapor barrier jacket having a permeance of not greater than 0.10 perms when tested in accordance with ASTM E96, Procedure A.

G. Acceptable manufacturers:
1. Flexmaster
2. Omniair
3. Peppertree Air Solutions

2.7 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 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.

B. Acceptable Manufacturers:
1. Ruskin
2. Prefco Products
3. Air Balance
4. Greenheck, Inc.
5. Nailor Industries
6. Pottoroff

2.8 CEILING RADIATION DAMPERS

A. Ceiling Radiation Dampers at location shown on plans constructed and tested in accordance with the current edition of UL555C of a minimum 22 gauge (0.8) blades, hinged in the center and held open with a 165° fusible link. Maximum blade height in the open position shall be 10" overall regardless of damper area. Maximum distance between blades held in the open position shall be 1-1/4" for units not requiring blade insulation and 1/4" for units with sheetrock blade insulation. Blades requiring radiation protection insulation shall utilize sheetrock. Refractory Ceramic or Mineral Wool Fiber is not allowed in the air stream. Radiation insulation outside of the air stream shall be Mineral Wool Fiber only. Ceramic Fiber Material is not approved for use. Units shall be constructed of a minimum 20-gauge (0.9) frame welded at all seams.

B. Acceptable Manufactures
1. Ruskin
2. Prefco
3. Air Balance
4. Phillips
5. Safe-Air
6. Nailor Industries

2.9 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-550 tested and approved.

E. Acceptable manufacturers:
1. American Warming and Ventilation
2. Arrow
3. Greenheck
4. NCA
5. Pottorff
6. Ruskin

2.10 FLUES FOR POWER EXHAUST AND HIGH EFFICIENCY BOILERS AND WATER HEATERS

A. Double wall air insulated positive pressure chimney equal to Metalbestos, Van-Packer, Schebler or Metal-Fab. Chimney shall be rated for 550°F maximum flue gas temperature and with a UL tested pressure rating of 40 inches w.c. The interior pipe shall be constructed of AL 29-4C stainless steel and the exterior pipe shall be constructed of 304 stainless steel. Stack system shall be complete with a one inch air gap between inner liner and outer cover. Chimney shall be constructed and installed per UL-1738 and NFPA-211. All accessories shall be made by the same manufacturer and designed to be a part of a positive pressure chimney system.

2.11 FLUES FOR FAN POWERED FIRETUBE BOILERS AND WATER HEATERS

A. Double wall air insulated positive pressure chimney equal to Metalbestos, Van-Packer, Schebler or Metal-Fab. Chimney shall be rated for 1400°F continuous operation, 1800°F intermittent operation and for positive pressures up to 60 inches w.c. The interior pipe shall be constructed of 304 stainless steel and the exterior pipe shall be constructed of 304 stainless steel. Stack system shall be complete with a one-inch air gap between inner liner and outer cover. Chimney shall be constructed and installed per UL-103 and NFPA-211. All accessories shall be made by the same manufacturer and designed to be a part of a positive pressure chimney system.

2.12 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 Schuler Lina-Coustic, Certain-Teed Ultralite, or equal meeting requirements of NFPA 90-A. Provide I.A.Q. rated liner.

2.13 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. Pottoroff

2.14 ACCESS DOORS

A. Round spin-in door of galvanized steel.
1. Fire proof 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

2.15 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.
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. Pottoroff

2.16 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.

C. Acceptable Manufacturers:
1. Ruskin
2. Air Balance, Inc.
3. Greenheck, Inc.
4. Nailor Industries
5. Pottoroff

2.17 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

2.18 AUXILIARY DRAIN PANS

A. Galvanized steel, same gauge and same bracing or cross breaks as a duct with same dimensions. Sides of pan turned up to 1-1/2”, all joints soldered watertight. Pan is to be large enough to complete cover drip lines of unit.

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.

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 location 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. All ductwork between the variable volume air handling units and the terminal units shall be constructed to the medium pressure ductwork specification.

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. In each zone at multi-zone unit discharge installed downstream of duct mounted re-heat coils
6. At each outside air and return air duct connection to plenum of constant volume units
7. At discharge side of constant volume boxes
8. Where otherwise indicated or required for balancing coordinate location of additional dampers required by TAB Contractor.
9. Provide multi-blade dampers when blade width exceeds 12". Provide end bearing where damper shaft penetrates duct wall.

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 at least 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 at least 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.

L. Branch connections for medium pressure ductwork shall be made with a conical lateral. Field installed conical branch ducts shall be minimum 20-gauge galvanized sheet metal, “Everdur” welded and coated with “Galvabar”.

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 air tight, 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.

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 DISHWASHER HOOD EXHAUST SYSTEM

A. All material and fittings shall be 304 Stainless steel, welded joints, watertight construction. Grade horizontal duct 1/4" per lineal foot to drain toward the washer.

3.10 SHOWER AREA EXHAUST SYSTEM

A. All material and fittings shall be 304 Stainless steel, welded joints, watertight construction. Grade horizontal duct 1/4" per lineal foot slope down to grille connection. Install in accordance with Fig. 2-21 of SMACNA HVAC Duct Construction Standards.

3.11 KITCHEN EXHAUST DUCT

A. All material and fittings shall be minimum 16 gauge, coated black steel to prevent rusting. All seams and joints in the kitchen exhaust duct, and penetrations of the hood enclosure to its lower outermost perimeter that directs and captures grease-laden vapors and exhaust gases shall have a liquid tight continuous external weld. All ducts shall be installed without forming dips or traps that might collect residues. Provide 18" x 18" or equal area at each elbow and as required for cleaning access, in direction of air flow. UL Listed access panel shall be located on the vertical wall of the duct 1-1/2" from the bottom of duct and shall be fitted with two handles, grease and air tight fitting access door and latch. All interior surfaces of ducts shall be accessible for cleaning and inspection purposes. Duct shall maintain minimum 1/4" per lineal foot slope to the exhaust hood. Provide duct over lay at the roof curb for a complete seal. Install kitchen exhaust system per local authority. In the absence of a local authority, the requirements of the Uniform Mechanical Code and NFPA 96 shall govern.

3.12 FUME HOOD EXHAUST SYSTEM

A. All material and fittings shall be 304 stainless steel construction.

3.13 ACOUSTICAL DUCT

A. Install in the following locations:
   1. Where indicated on the drawings

3.14 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.

3.15 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.

3.16 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.

3.17 AUXILIARY DRAIN PANS

A. Where coils that have a condensate drain are located above ceiling.

3.18 TESTING OF LOW PRESSURE DUCTWORK

A. Test ductwork for leaks before concealing. Maximum allowable leakage is 5% of total airflow.

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.

3.19 TESTING OF MEDIUM AND HIGH PRESSURE DUCT

A. As the project progresses, test the ductwork in sections.

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. Finally as a complete system, test ductwork at a minimum of 2.5” with a maximum allowable leakage of 1% of the total design supply airflow.

D. Test method as set forth in SMACNA "HVAC Duct Construction Standards".

END OF SECTION

SECTION 23 31 14 - FABRIC AIR DISPERSION SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of non-metal ductwork is indicated on drawings and by requirements of this section.

1.2 QUALITY ASSURANCE

A. Building Codes and Standards:
   1. Product must be Classified by Underwriter's Laboratories in accordance with the 25/50 flame spread/smoke developed requirements of MFPA 90-A and are also classified in accordance with ICC Evaluation Service AC 167.
   2. All product sections must be labeled with the logo and classification marking of Underwriter's Laboratories.
   3. Product must be treated with an EPA registered antimicrobial agent.

B. Design and Quality Control:
   1. Manufacturer must have documented design support information including duct sizing; vent, orifice, and/or nozzle location; vent, orifice, and/or nozzle sizing; length; and suspension. Parameters for design, including maximum air temperature, velocity, pressure and textile permeability, shall be considered and documented.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's specifications on materials and manufactured products used for work of this section.

B. Building Code Data: Submit UL file number under which product is Classified by Underwriter's Laboratories for both NFPA 90-A and ICC AC167.

C. Submit manufacturer's documented design support information including duct sizing, vent and orifice location, vent and orifice sizing, length, and suspension. Submit parameters for design, including maximum air temperature, velocity, pressure and fabric permeability.

D. Provide detailed drawings confirming configuration of Fabric Air Dispersion System (diameter, lengths, airflow, pressure, and textile permeability).

E. Provide detailed installation instructions for components to be installed.

F. Color selections

G. Manufacturer's recommended suspension system

1.4 WARRANTY

A. Manufacturer must provide a 10 Year Product Warranty for products supplied for the fabric portion of this system as well as a Design and Performance Warranty.

1.5 DELIVERY, STORAGE AND HANDLING

A. Protect fabric air dispersion systems from damage during shipping, storage and handling.

B. Where possible, store products inside and protect from weather. Where necessary to store outside, store above grade and enclose with a vented waterproof wrapping.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

Subject to compliance with requirements, choose one of the following:

A. DuctSox Corporation

B. Fabric-Air

C. KE Fibertec

D. Prihoda

2.2 FABRIC AIR DISPERSION SYSTEM

A. Air diffusers shall be constructed of a woven fire-retardant fabric complying with the following physical characteristics:
   1. Fabric Construction: 100% Flame Retardant and treated with a machine wash-able anti-microbial agent from the manufacturer.
   2. Weight: 6.75 oz./yd^2 per ASTM D3776
   3. Air Permeability: 2 (+2/-1) cfm/ft^2 per ASTM D737, Frazier
   4. Temperature Range: 0 degrees F to 180 degrees F
   5. Fire Retardancy: Classified by Underwriters Laboratories in accordance with the flame spread/smoke developed requirements of NFPA 90-A and ICC AC 167.
   6. Antimicrobial agent shall be proven 99% effective after 10 laundry cycles per AATCC Test Method 100.

B. Systems Fabrication Requirements:
   1. Air dispersion and extended throws accomplished by reinforced orifices and permeable fabric. Reinforced orifices are to be installed to deep the integrity of opening and withstand laundry processes.
   2. Diameter, quantity, and location of reinforced orifices to be specified and approved by manufacturer.
   3. Inlet connection to metal duct via fabric draw band with anchor patches as supplied by manufacturer. Anchor patches to be secured to metal duct via zip screw fastener – supplied by contractor.
   4. Inlet connection includes zipper for easy removal/maintenance.
   5. Lengths to include required zippers as specified by manufacturer.
   6. System to include adjustable flow devices to balance turbulence, airflow and distribution as needed. Flow restriction device shall include ability to adjust the airflow resistance from 0.06 – 0.60 in w.g. static pressure.
   7. End cap includes zipper for easy maintenance.
   8. Fabric system shall include connectors to accommodate suspension system listed below.
   9. Any deviation from a straight run shall be made using a gored elbow or an efficiency tee. Normal 90 degree elbows to be 5 gores with the radius of the elbow 1.5 times the diameter.

C. Systems Design Parameters:
   1. Use fabric diffusers only for positive pressure air distribution components of the mechanical ventilation system.
   2. Do not use fabric diffusers in concealed locations.

3. Fabric diffusers shall be designed from 0.25” water gauge minimum to 3.0” maximum, with 0.5” as the standard.
4. Fabric air diffusers shall be limited to design temperatures between 0 degrees F and 180 degrees F (-17.8 degrees C and 82 degrees C).
5. Design CFM, static pressure and diffuser length shall be designed or approved by the manufacturer.

D. Fabric Tensioning System:
1. Air diffusers shall be constructed with internal tensioning frame.
2. System shall cylindrically tension textile along the entire length of textile duct.
3. Tensioning system shall include full 360 degree tensioning and intermediate rings with quick connection spacer tubes concealed inside the fabric system.
4. Interior structure to include multiple mechanically adjustable tension devices. To provide proper textile tensioning, structural and textile system shall be configured in segments of no more than 45 feet.
5. Textile components supported solely by metal cylindrical rings.
6. Each cylindrical ring shall require vertical metal to metal vertical cable safety attachment.
7. Component options include:
a. Stainless Steel Cable
b. Adjustable Gripple Mid-Supports – incremental lengths of 5’, 10’, 15’, 20’ and 30’

PART 3 - INSTALLATION

3.1 INSTALLATION OF FABRIC AIR DISPERSION SYSTEM

A. Install approved suspension system in accordance with the requirements of the manufacturer. Instructions for installation shall be provided by the manufacturer with product.

3.2 CLEANING AND PROTECTION

A. Clean air handling unit and ductwork prior to installation of the fabric duct system. Clean external surfaces of foreign substance which may cause corrosive deterioration of facing.

B. Temporary closure: At ends of ducts which are not connected to equipment or distribution devices at time of ductwork installation, cover with polyethylene film or other covering which will keep the system clean until installation is completed.

C. If fabric duct systems become soiled during installation, they should be removed and cleaned following the manufacturers standard terms of laundry.

END OF SECTION

SECTION 23 33 19 - DUCT SILENCERS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install duct silencers.

1.2 RELATED WORK

A. Division 23 Mechanical.
   1. Ductwork.
   2. Air Balance.

1.3 SUBMITTALS

A. Submittal to submittal drawings detailing all duct silencer data specified in the mechanical drawing schedule.

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.

C. Silencer manufacturer shall submit certified laboratory performance obtained using ASTM E477-13. The laboratory must be NVLAP accredited for the ASTM E477-13 test standard and a copy of the accreditation certificate must be included with submittals. Data from non-NVLAP accredited test facilities is not acceptable.

D. Submitted silencer pressure drops should not exceed those listed in the silencer schedule unless approved by project engineer. Silencer pressure drop measurements shall be made in accordance with ASTM E477-13. 4. Submitted silencer dynamic insertion loss and self-noise data should satisfy values listed in the silencer schedule at the project's air distribution system airflow requirements. ASTM E-477-13 tests to obtain this data shall be conducted in the same facility and utilize the same silencer.

E. Silencer dynamic insertion loss shall not be less than that listed in the silencer schedule unless approved by the project engineer.

F. Silencer generated noise shall not be greater than that listed in the silencer schedule unless approved by the project engineer.

G. The silencer manufacturer shall provide, for approval, acoustic calculations for relevant duct systems with silencers to validate that the submitted silencers will satisfy occupied space design guidelines. Use sound power levels of actual equipment scheduled for installation on project. Acoustic Analysis shall include breakout noise calculations as required. In the absence of specified background noise level criteria, the guidelines outlined in the 2015 ASHRAE Applications Handbook Chapter 48, Table 1 shall apply.

1.4 SHIPPING PROTECTION

A. Silencers shall be shipped with factory-installed end caps

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Price

B. Vibro-Acoustics

C. Kinetic Noise Control

D. IAC Acoustics

E. Ruskin

2.2 GENERAL REQUIREMENTS

A. Silencers shall be of the size, configuration, capacity and acoustic performance as scheduled on the drawings. Silencers shall be fabricated by the same manufacturer.

B. Silencer inlet and outlet connection dimensions must be equal to the duct sizes shown on the drawings. Duct transitions at silencers are not permitted unless shown on the contract drawings or approved by the project engineer.

2.3 CONSTRUCTION

A. Silencers shall be constructed in accordance with ASHRAE and SMACNA Standards for the pressure and velocity classification specified for the air distribution system in which it is installed.

B. Casing seams and joints shall be lock-formed and sealed or stitch welded and sealed except as noted, to provide leakage-resistant construction.

C. Airtight construction shall be achieved by use of a duct-sealing compound supplied and installed by the contractor at the jobsite.

D. Perforated steel shall be adequately stiffened to insure flatness and form. Spot welds shall be painted as required.

E. Fire-Performance Characteristics:
1. Silencer assemblies, including acoustic media fill, natural cotton fiber, sealants and acoustical spacers shall have Class 1 flamespread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E84, NFPA 255 or UL 723.

F. Material gauge thickness:
1. Material gauges noted in other sections are minimums and shall increase as required for the system pressure and velocity classification.
2. The silencers shall not fail structurally when subjected to a differential air pressure of 8 inches water gauge.

G. Outer casing shall be ASTM A 653/A 653M, G90 galvanized sheet steel, gauge as listed below.
1. Rectangular Silencers, including STC-rated models: 22 gauge
2. Rectangular Elbow Silencers: 22 gauge
3. Circular Silencers:
a. For units up to 20 inches in diameter: 22 gauge
b. For units 21 through 44 inches in diameter: 18 gauge
c. For units over 44 inches in Diameter: 16 gauge
d. Transitional Silencers: 22 gauge

H. Rectangular Elbow Silencers: 1. Acoustical splitter/baffles shall be internally radiused and

aerodynamically designed for efficient turning of the air.

I. Transitional Silencers:
1. Transitioning shall occur internal to the silencer such that the height of the gap or air passage is changing with the length of the splitters/baffles.

J. Inner perforated metal liner shall be supplied in accordance with ASTM A 653/A 653M, G90 galvanized sheet steel in the following gauge thicknesses according to silencer type or connection size:
1. Rectangular Silencers: 22 gauge
2. Rectangular Elbow Silencers: 22 gauge
3. Circular Silencers: 22 gauge
4. Transitional Silencers: 22 gauge

K. Principal Sound-Absorbing Mechanism:
1. Packless (No-Media) Silencers:
a. Models shall not contain absorptive media. Attenuation shall be achieved with controlled impedance membranes and broadly tuned resonators. 2.
2. Absorptive (Dissipative) and Film Lined Silencers:
a. Standard Acoustic media:
1) Media shall be of acoustic quality, shot-free glass fiber insulation with long, resilient fibers bonded with a thermosetting resin. Glass fiber density and compression shall be as required to insure conformance with laboratory test data.
2) Media shall be packed with a minimum of 15% compression during silencer assembly.
3) Media shall be resilient such that it will not pull apart during normal applications, and shall resist settling, breakdown, and sagging from vibration. Media shall not rot, mildew, or otherwise deteriorate, and shall have sufficient flexibility to readily form around corners and curved surfaces.
4) Media shall not cause or accelerate corrosion of aluminum or steel.
b. Natural cotton and film lined natural cotton:
1) Media shall be natural cotton fibers treated with an EPA registered, non-toxic borate solution, and “flash dried” to actively inhibit the growth of mold, mildew, bacteria, and fungi.
2) Media shall not contain formaldehydes, phenolic resins or Volatile Organic Compounds (VOC’s) that can off-gas and/or cause health concerns.
3) Media shall be 100% recyclable and comply with UL181 and NFPA 90A. Insulation shall be packed with a minimum of 15% compression during silencer assembly.
4) Media shall not cause or accelerate corrosion of aluminum or steel. Glass fiber, fiberglass and mineral wool are not permitted as a substitute for natural cotton.

L. Media Protection:
1. Dissipative silencers:
a. Where indicated on the silencer schedule, media shall be encapsulated in glass fiber cloth to help prevent shedding, erosion and impregnation of the glass fiber.
b. Axial Fan silencers shall have a glass fiber cloth liner.
2. Film Lined silencers:
a. The acoustic media shall be completely wrapped with polymer film to help prevent shedding, erosion and impregnation.

b. The wrapped acoustic media shall be separated from the perforated metal by a factory-installed acoustically transparent spacer.
c. The spacer shall be flame retardant and erosion resistant.
d. Mesh, screen or corrugated perforated liner will not be acceptable as a substitute for the specified spacer.
e. Silencer manufacturer shall provide a written test report showing silencer assemblies have Class 1 flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84, NFPA 255 or UL 723.

3. HTL Casings:
a. Where indicated on the silencer schedule, silencers shall have high transmission loss (HTL) walls externally applied and completely sealed to the silencer casing by the silencer manufacturer.
b. If requested by the project engineer, relevant breakout noise calculations shall be provided to ensure compliance with the relevant room noise criteria that are based on the sound power levels of the specified equipment.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install silencer according to manufacturer’s written installation instructions.

3.2 FIELD QUALITY CONTROL

A. Ensure duct silencers are installed with airflow arrows in direction of airflow.

END OF SECTION

SECTION 23 34 16 - 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. Vibration Isolation
3. Air Balance
4. Electrical Provisions of Mechanical Work

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. Penn Barry Ventilator

D. Twin City Fans

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. Belt Drives:
1. Unless otherwise specified for belt-driven fans, equip the fan motors with variable pitch sheaves. Select the sheave size for the approximate midpoint of adjustment and to provide not less than 20% speed variation from full open to full closed. Size drives for 150% of rated horsepower. Key the fan sheave to the fan shaft.
2. Nonadjustable motor sheaves may be used for motor sizes over 15 horsepower, at the Contractor's option. However, if changing a nonadjustable sheave becomes necessary to produce the specified capacity, the change must be made at no additional cost.
3. Provide belt guards and apply the same finish as used on the fan.
4. Oil and heat resistant, nonstatic type belts.
5. Bearings shall be designed and individually tested specifically for use in air handling applications. Construction shall be heavy duty, regreasable, ball type, in a pillow block, cast iron housing, selected for a minimum L50 life in excess of 200,000 hours at maximum catalog operating speed.

C. Safety Disconnect Switch: Provide a factory-wired to motor, safety disconnect switch on each unit.

D. Relief Vents and Air Inlets: Provide vents and inlets with aluminum frames and 1/2" mesh, galvanized bird screens. Include dampers where shown.

E. 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.

F. Where motorized damper is scheduled:
1. The motor and damper are specified in the Building Management and Control System Specification.

G. 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. Number of Belts/Make/Size
10. Motor volts

H. Utility Vent Set Fans, provide minimum ¾ inch threaded coupling drain connection at lowest point of housing.

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 each belt driven fan with approved, totally enclosed belt guard.

D. Provide approved safety screen where inlet or outlet is exposed.

E. Provide duct flanges where required for connections.

F. Furnish kitchen hood exhaust fans with vented curb extension that meets NFPA 96, cleanout port, grease tap, curb seal, drain connection and hinge kit.

G. Furnish supply fans with 1” aluminum, washable filter section.

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 allow aluminum.

E. Aluminum base shall be continuously welded curb cap corners.

2.6 GRAVITY ROOF-TOP 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 roof-top 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 ¼” gasket. Gasket shall be glued or attached with pressure sensitive adhesive.

D. Install curbs and equipment in level position.

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.

3.2 EXTRA MATERIALS

A. Provide two sets of belts for each fan, not including the set installed on the fans. Tag set to identify fan.

END OF SECTION

SECTION 23 36 16 - VARIABLE VOLUME TERMINAL UNITS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install variable volume terminal units, including hangers, controls and other required elements.
   1. Provide constant fan variable volume terminal units where indicated on the drawings.
   2. Provide variable volume terminal units where indicated on the drawings.

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. Vibration Isolation,

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.

B. Coordinate the primary (input) voltage with the electrical power source. Refer to the Electrical Drawings for specific requirements.

1.4 SUBMITTALS

A. Submit product data for control devices, terminal boxes, and similar equipment for review prior to placement of purchase order. Submit internal wiring diagrams, installation and operation manual as a complete submittal package.

B. Submit certified sound power levels for both discharge sound and casing radiated sound in accordance with ARI 880-98 Certification Program. All NC levels shall be calculated using ARI 885-98, Appendix E attenuation factors for mineral ceiling.

C. Submit for each box the following information:
   1. Box size
   2. Inlet size
   3. Box number
   4. Box designation
   5. Minimum / Maximum Fan CFM
   6. L / R Coil connection
   7. GPM
   8. Motor HP
   9. NC Level
   10. External Static Pressure
   11. Scheduled MBH
   12. Actual MBH
   13. Heating Coil Pressure Drop (ft.)
   14. Entering and Leaving Water Temperature
   15. Entering and Leaving Air Temperature

1.5 QUALITY ASSURANCE.

A. Make air flow tests and sound level measurements in accordance with applicable ASHRAE Standards 130-96 and ARI 880-98.

B. Manufacturer shall certify cataloged performance and ensure correct application of terminal units.

C. Sound power levels to occupied space shall not exceed NC-30 as calculated using ARI 885-98 Appendix E attenuation factors for mineral tile ceiling.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Titus.

B. Krueger

C. Price

D. Nailor

E. Metalaire

2.2 BOX CONSTRUCTION

A. Galvanized 22-gauge steel casing with suspension lugs.

B. Lined with minimum 1.5 PCF / 1" thick fiber free
1. Flame spread not higher than 25.
2. Smoke developed rating not higher than 50.
3. Condensation on the exterior of the box is not approved.
4. Coat all cut edges of liner with NFPA approved sealant.
5. Lining shall pass UL 181, NFPA 90A and ASTM C 665.

C. Provide access to controls, fan compartment, and unit servicing, without disturbing duct connections. Limit the size of access doors to 24 inches. Where required, provide multiple access doors. Gasket each door in the unit casing.

D. Components shall be constructed of corrosion resistant materials.

E. Bearings shall not require lubrication.

F. Casing leakage shall not exceed 2.0% of scheduled design air flow at 3.0” WG interior casing pressure.

G. Seal casing joints with approved adhesive if required to meet the maximum casing leakage rate.

H. The maximum overall height of the variable air volume unit shall not exceed available ceiling space.

I. Maximum static pressure drop of air through terminal box shall be 0.2” w.g.

J. Maximum velocity through duct inlet shall be 2,000 fpm.

2.3 COMPONENTS

A. The entire terminal unit, including the heating coil, shall be designed and built as a single unit.

B. Provide each unit with a primary variable air volume damper that controls the air quantity in response to a space sensor.

C. Each unit shall contain:
1. Fan and motor assembly. For Fan Powered Units Only
2. Heating coil.

D. Locate the heating coil in the discharge of the blower section.

E. Provide single point electrical connections for the entire unit. Entire assembly shall be UL or ETL Certified, electrical components shall be UL listed and installed in accordance with the National Electrical Code.

F. The variable air volume units provided by the manufacturer shall be the quietest design available from the manufacturer for the type specified.

G. Induced air filter frame for 1” thick disposable filter.

H. Sufficient power for the VAV unit DDC controller, electric actuator and other components necessary to satisfy the sequence of operation. Size each transformer for the total connected load plus an additional 25% of the connected load. Primary and secondary fuses housed in a fuse block.

I. Inlet attenuator for induction airside of box with liner to lower radiated noise.

2.4 BLOWER FAN AND MOTOR

A. Blower fan:
1. Constructed of steel.
2. Forward curved centrifugal wheel.
3. Dynamically balanced wheels.
4. Direct drive motors.

B. Motor
1. Ultra-high efficiency ECM motor technology

C. Motor current characteristics as scheduled. Coordinate motor voltage with Division 26. Verify voltage with Electrical Plans.
1. Thermal overload protection.
2. Sleeve bearings.

D. Provide isolation between fan motor assembly and unit casing.

E. Provide a manual speed control system to allow continuously adjustable fan speed from maximum to minimum.
1. Electronic speed control matched to operate with the motor.
2. Speed controller shall incorporate a minimum voltage stop to ensure motor cannot operate in a stall mode.

F. Fan disconnect switch. This is not to be used as a main disconnect switch.

G. Provide electric heating models with the following items:
1. Single point electrical connection
2. Line side disconnect switch
3. Motor fuse
4. Motor disconnect switch
5. Fan SCR and relay
6. Control transformer
7. Air flow switch
8. Heat contactors
9. Thermal Hi-Limit Auto Reset switch

2.5 PRIMARY AIR DAMPER AND ACTUATOR

A. The control actuator shall vary the primary air damper in response to the control signal.
1. Damper leakage at shutoff shall not exceed 2.0% at 1" WG pressure.
2. Locate the damper inside the unit.
3. Damper connection to the operating shaft shall be a positive mechanical connection.
4. Damper shall have bearings at all penetrations of inlet tube and terminal housing. Penetration of damper shaft in terminal lining shall have seal at surface of lining to prevent fiber entrainment through rotation of damper shaft.
5. Two damper stop pins shall be provided. One pin shall ensure damper cannot rotate beyond full closed position. One pin shall ensure damper cannot rotate beyond full open position.
6. Inlet tube shall have rolled bead (outward position) prior to penetration point of flow sensor tubing to provide stop point for hard duct and anchor point for flex duct.
7. Flow sensor tubing shall have gaskets at penetration point of inlet tube.
8. Flow sensor shall be center averaging type. Non-center averaging flow sensors are not acceptable.

2.6 AIR FLOW CONTROL

A. Provide a flow control device that will limit the maximum CFM of the unit to that scheduled on the drawings.
1. Air quantity shall be factory set.
2. Thermostat signal shall reset the flow control device to reduce primary air quantity to match load requirements.
3. Control shall be pressure independent.
4. Each terminal shall incorporate a flow cross sensor with pick-up points connected to a center averaging chamber to ensure the following performance:
a. Controller fidelity shall be +/-5% of set volume with a flex inlet configuration and inlet static variation of 0.5" WG to 6.0" WG.
5. Provide flow measuring taps and a flow chart with each unit for field balancing air flow.

B. HOT WATER HEATING COILS
1. Provide hot water heating coils sized as scheduled.
a. The hot water heating coil is specified to be provided and mounted under the work of this Section.
b. Coil access door upstream of coil.
c. Install coil with supply inlet at bottom and on leaving airside of coil.
d. Maximum static pressure drop of water through heating coil shall not exceed 10’ w.g.
e. Maximum static pressure drop of air through heating coil shall not

exceed 0.25” esp

PART 3 - EXECUTION

3.1 INSTALLATION

A. Deliver and store products in a clean and dry place. Protect products from the weather, dirt, dust, construction debris and physical damage.

B. Install each unit in accordance with the manufacturer's printed installation instructions.

C. Suspend each unit from 1/4" electroplated zinc thread rods secured from structure.
1. Provide sub-structure where required.
2. Mount bottom of terminal unit no more than 18" above the finish ceiling height.
3. Install units so that they are level and plumb.

D. Install a straight length of rigid ductwork upstream of all boxes. Provide at least 3 primary air inlet diameters of straight ductwork upstream of the primary air inlet connections. Flexible duct connections at boxes are allowed but are not a substitute for the straight run of rigid duct. A maximum of 4' of flexible duct is allowed at each box. All changes in direction shall be made with rigid duct. Seal connection at box, as required to comply with system maximum allowable leakage.

E. Coordinate the location of each variable air volume unit to ensure proper clearance so that all components are accessible and not blocked by other trades. Provide no less than the code required clearances to electrical components.

F. Cover and seal the openings of the VAV inlets during construction to prevent the inside from getting dirty. Where VAV units are considered dirty, as determined by the Architect / Engineer / Owner, clean the VAV units with a vacuum machine, and then wipe all surfaces with a cleaning agent, using clean rags.

G. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

H. All installation shall be in accordance with manufacturer’s published recommendations.

I. Provide clearance for inspection, repair, replacement and service. Ensure accessibility to all terminal unit electrical control panel doors, controllers and operators are located a minimum of 30 inches from all obstructions (walls, pipe, etc.).

J. Provide ceiling access doors or locate units above easily removable ceiling components.

K. Support units individually from structure. Do not support for adjacent ductwork. Terminal units shall be supported using unit’s hanger brackets and threaded rods.

3.2 MISCELLANEOUS CONTROLS

A. The following equipment items are to be furnished by Building Management and Control System and installed by Fan Powered Terminal Unit manufacturer:
1. Automatic temperature control card (DDC).
2. Damper actuator.

B. The following equipment items are to be furnished and installed by the Fan Powered Terminal Unit manufacturer:

1. Damper.
2. Multi-point flow sensor.
3. Controller enclosure.
4. Power transformer.

C. Coordinate the output voltage required by the Building Management and Control System.

D. Coordinate location of controller enclosure.

3.3 ACOUSTICAL PERFORMANCE TEST

A. Test each size for each type of variable air volume unit furnished on the project.

B. Test for radiated noise and discharge noise in all operational modes from minimum to maximum primary air settings; at inlet air pressures of 1 and 2 inches water column, and at primary air settings of 20, 40, 60 and 100 percent.

C. Testing shall be done by an independent testing laboratory. Sound values submitted shall be certified by the laboratory doing the testing. Testing laboratory must be approved by Engineer. Final testing and approval must be witnessed by Engineer.

D. Testing procedures shall be in accordance with ASHRAE Standard 130-96 and rated in accordance with ARI 880.

E. Test the unit complete with damper, coils and controls. The unit shall be operational and represent a final version of the units to be installed on the project.

F. If the units do not meet sound criteria, modify the units and retest at no additional cost to the Owner until the sound criteria is in accordance with Contract Documents. The variable air volume unit manufacturer shall be held liable for the costs associated with construction delays resulting from failed test, not to exceed the purchase order cost.

G. Sound Levels: Maximum sound power levels resulting from any box shall not exceed the following:

OCTAVE BAND CENTER FREQUENCY, Hz.						
	125	250	500	1000	2000	4000
Radiated SPL db	52	45	40	36	34	33
Discharge SPL db	44	37	31	27	24	22

1. Sound power levels are referenced to 10-12 watts.
2. Box inlet static pressure = 1-1/2”
3. No discounting for roof effect, ceiling attenuation, lined duct, division of flow and other similar effects.

H. All terminal boxes shall be equipped with a sheetmetal elbow with liner connected to plenum air inlet.

3.4 SPARE PARTS

A. Provide one spare motor for each size box.

END OF SECTION

SECTION 23 37 13 - 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.
   3. Electrical Requirements for Mechanical Work.

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. Krueger.

C. Nailor Industries.

D. Price

E. Metal-Aire

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.

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.

B. 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

SECTION 23 41 00 - AIR FILTRATION

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install air filters and air filter gauges.

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. 16 pleats per linear foot of filter.
5. 2" thick.
6. Minimum MERV 8

B. Media of reinforced nonwoven cotton fabric treated with adhesive and continuously laminated to a supporting steel wire grid conforming to the configuration of the pleats.
1. Seal the media pack in a chipboard frame.

C. Rated average dust spot efficiency of not less than 36%.
1. Average synthetic arrestance in excess of 93% when tested in accordance with the ASHRAE 52-68 test standard.

D. Filter capable of operating with variable face velocities up to 500 fpm without impairing efficiency.

E. Initial resistance to air flow:
1. 300 fpm - 0.12" WG.
2. 500 fpm - 0.28" WG.

F. UL listed with Class II rating.

G. Provide one spare set for a complete change, in original cartons, for Owner's use during the warranty period.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install the filters and filter gauges in accordance with the manufacturer's instructions.

END OF SECTION

SECTION 23 52 35 - GAS-FIRED MODULATING HOT WATER BOILER (Condensing)

PART 1 - GENERAL

1.1 WORK INCLUDED

A. This section specifies a packaged, gas-fired, power type condensing cast iron or stainless steel boiler complete with all controls and trim for indoor installation.

B. Each factory "packaged" boiler shall be complete with all components, accessories and appurtenances necessary for a complete and operable boiler as hereinafter specified. Each unit shall be furnished factory assembled with required wiring and piping as a self-contained unit. Each unit shall be readily transported and ready for installation.

C.. Each factory "packaged" boiler, including pressure vessel, trim, valve trains, burner, control system, and all related components, accessories and appurtenances as herein specified shall all be assembled and furnished by the boiler manufacturer. The boiler manufacturer shall provide unit responsibility for the engineering, coordination, workmanship, performance, warranties, and all field services for each factory "packaged" boiler as specified herein. The boiler manufacturer shall be fully responsible for all components assembled and furnished by him whether or not they are of his own manufacture.

1.2 RELATED WORK

A. Division 23 - Mechanical
1. Hot Water Piping
2. Gas Piping
3. Ductwork

1.3 PERFORMANCE

A. Provide performance as scheduled on drawings. Boiler shall be certified for up to 99% efficiency.

1.4 WARRANTIES

A. The boiler manufacturer shall warrant each boiler, including boiler, trim, boiler control system, and all related components, accessories, and appurtenances against defects in workmanship and material for a period of eighteen (18) months from date of substantial completion. Heat exchanger and fuel burner shall be warranted for a period of five (5) years and thermal shock shall be warranted for a period of ten (10) years from date of substantial completion.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Hydrotherm – KN

B. Patterson Kelly - Sonic

C. Lochinvar - Crest

2.2 PERFORMANCE CRITERIA

A. Each boiler shall be capable of operating continuously at rated capacity while maintaining a CSA certified efficiency of not less than 92 % on 500 MBH input boilers and less and not less than 95% on larger than 500 MBH input boilers. Each boiler shall be capable of operating with a minimum outlet water temperature of 68º F.

B. Boiler shall comply with ASME Section IV for 80 psig, max 200º F (100 psig on 1500 MBH and larger

units).

C. Fuel shall be natural gas with an assumed higher heating value of 1,030 Btu/Cu Ft and an assumed specific gravity of 0.60 (relative to air). Natural gas shall be supplied at a pressure of no less than 3.5 inch WC to the inlet gas valve. Maximum inlet gas pressure shall not exceed 14 inch WC.

D. Boilers shall be certified for low NOx by the TCEQ. NOx emissions shall not exceed 30 PPM when referenced at 3% O2 at all firing rates.

E. The burner, gas train and controls shall conform to the requirements of I.R.I. /G.E. Gap.

2.3 BOILER DESIGN

A. Each hot water boiler shall consist of a horizontal, cast iron or stainless steel heat exchanger complete with trim, valve trains, burner, and boiler control system. The boiler manufacturer shall fully coordinate the boiler as to the interaction of its elements with the burner and the boiler control system in order to provide the required capacities, efficiencies, and performance as specified.

B. Each boiler heat exchanger shall be cast iron or stainless steel, counter-flow design for maximum heat transfer with the multiple sections arranged in a reverse return configuration to assure balanced flow through each section

C. Contractor must, when filling the system, verify that the pH level is maintained between 6.0 and 8.5.

D. All boiler pressure parts shall be constructed in accordance with the latest revision of the ASME Boiler and Pressure Vessel Code, Section IV, and shall be so stamped.

F. Boiler heat exchanger headers shall be fabricated steel and be completely removable for inspection. Seals shall be EPDM, rated for 400 deg F service. Push nipples or gaskets between the sections are not permitted.

G. Boiler shall be enclosed with a single wall outer casing. It shall be fabricated from minimum 16 gauge carbon steel. The front and top wall shall be secured in place with ¼ -20 NC bolts (sheet metal screws are not acceptable).The complete outer casing shall be finished, inside and out, with a powder coat finish. The composite structure of the boiler combustion chamber, insulating air gap and outer casing shall be of such thickness and materials to assure an outer casing temperature of not more than 50ºF above ambient temperature when the boiler is operated at full rated load.

H. An observation port shall be located on the boiler to allow for observation of the burner flame.

I. Boiler shall have a single condensing heat exchanger. A boiler that utilizes a secondary condensing heat exchanger is unacceptable.

2.4 BOILER TRIM

A. Each boiler shall be provided with all necessary trim. Boiler trim shall be as follows:
1. Safety relief valve shall be provided in compliance with the ASME code. Contractor is to pipe to acceptable drain.
2. Water pressure-temperature gauge.
3. Primary low water flow fuel cutoff (probe type with manual reset).
4. Manual reset high limit water temperature controller.
5. Operating temperature control to control the sequential operation of the burner.
6. Separate inlet and outlet water temperature sensors capable of monitoring flow
7. Exhaust temperature sensor
8. Provide condensate neutralization kit (shipped loose).

2.5 BOILER FUEL BURNING SYSTEM

A. The boiler manufacturer shall furnish each boiler with an integral, power type, straight gas, fully automatic fuel burner. The fuel burner shall be an assembly of gas burner, combustion air blower, valve train, and ignition system. The burner manufacturer shall fully coordinate the burner as to the interaction of its elements with the boiler heat exchanger and the boiler control system in order to provide the required capacities, efficiencies, and performance as specified.

B. Each burner shall be provided with an integral gas firing combustion head.

C. Each burner shall provide adequate turbulence and mixing to achieve proper combustion without producing smoke or producing combustibles in the flue gases.

E. Each boiler shall be provided with an integral variable speed power blower to premix combustion air and fuel within the blower. The combustion air blower shall have sufficient capacity at the rated firing rate to provide air for stoichiometric combustion plus the necessary excess air. Static and total pressure capability shall comply with the requirements of the boiler. The blower shall operate at 6000 RPM maximum without undue vibration and noise and shall be designed and constructed for exposure to temperatures normal to its location on the boiler. The operating fan speed will be tachometer sensed and be capable of being displayed at the text based display.

F. Each burner shall of the radial-fired (down-fired) type and constructed of steel with a stainless steel inner and stainless steel mesh outer screen.

G. Each boiler shall be provided with a “Full Modulating” firing control system whereby the firing rate is infinitely proportional at any firing rate between 20% and 100% as determined by the pulse width modulation input control signal. Both fuel input and air input must be sequenced in unison to the appropriate firing rate without the use of mechanical linkage.

H. The Micro Processor shall use a Proportional Integral Algorithm to determine the firing rate. The control must have the following capabilities:
1. Maintain single set point
2. Reset the set point based on outdoor air temperature.
3. Boiler shutdown based on outdoor air temperature
4. Internal dual set point program with an external switchover. (e.g. - night setback w/external clock, supplied by others)
5. Alarm relay for any for any manual reset alarm function.
6. Programmable Low Fire Delay to prevent short cycling based on a time and temperature factor for release to modulation.
7. Text Based Display showing current supply and return temperatures, current set points as well as differential set points. It must also display any fault codes whether automatically reset or manually reset.
8. Local Manual Operation.
9. Remote Control System (Building Management / Sequencer Control) - The boiler control shall be capable of accepting a 0 -10vdc remote external analog signal to control the firing rate
10. Computer (PC) interface for programming and monitoring all functions

2.6 MAIN GAS VALVE TRAIN

A. Each boiler shall be provided with an integral main gas valve train. The main gas valve trains shall be factory assembled, piped, and wired. Each gas valve train shall include at least the following:
1. Two (2) safety shutoff valves. Valves equipped with dual solenoids that can independently energized for leak testing.
2. Air – Gas ratio control (maximum inlet pressure 14 inch WC)
3. One (1) low gas pressure switch (manual reset).
4. One (1) high gas pressure switch (manual reset).
5. Two (2) pressure test ports

2.7 IGNITION SYSTEM

A. Each boiler shall be equipped for direct spark ignition

2.8 COMBUSTION AIR CONTROL SYSTEM

A. Each boiler shall be provided with an integral combustion air control system. The combustion air system shall be factory assembled. Each combustion air control system shall include at least the following:
   1. The primary control shall vary the speed of the blower based on load demand. The blower shall apply a varying negative pressure on the gas valve which will open or close to maintain zero pressure at the valve orifice, thereby increasing or decreasing the firing rate. Both the air and gas shall be premixed in the blower.
   2. One (1) low airflow differential pressure switch to insure that combustion air is supplied.
   3. High exhaust back pressure switch

2.9 BURNER CONTROL SYSTEM

A. The control system shall be supplied with a 24 VAC transformer (120 VAC, single phase, 60 hertz primary). The 120/1/60 power supply to each boiler shall be protected by a 15 Amp circuit breaker located in the MCC (supplied by contractor).

B. The boiler shall include an electric spark ignition system. Main flame shall be monitored and controlled by flame rod (rectification) system.

C. Each boiler shall be provided with all necessary controls, all necessary programming sequences, and all safety interlocks. Each boiler control system shall be properly interlocked with all safeties.

D. Each boiler control system shall provide timed sequence pre-ignition air purge of boiler combustion chamber. The combustion airflow sensor shall monitor and prove the airflow purge.

2.10 BOILER CONTROL PANEL

A. The boiler manufacturer shall provide each boiler with an integral factory prewired control panel. The control panel shall contain at least the following components, all prewired to a numbered terminal strip:
   1. One (1) burner "on-off" switch.
   2. One (1) electronic combination temperature control, flame safeguard and system control.
   3. Control circuit breaker, 5 amp
   4. All necessary control switches, pushbuttons, relays, timers, terminal strips, etc.
   5. Text Based Display Panel to adjust set points and control operating parameters. Text Based Display is to indicate burner sequence, all service codes (0-65), fan speed, boiler set point, and sensor values such as inlet, outlet, flue gas and outdoor air.

2.11 FACTORY TESTING - HYDROSTATIC

A. Each factory "packaged" boiler shall be hydrostatically tested and bear the ASME “H” stamp.

2.12 FACTORY TESTING - FIRE TESTING

A. Each factory "packaged" boiler shall be fire tested. The boiler manufacturer shall perform this fire test under simulated operating conditions, with the boiler attached to a working chimney system and with water circulating through the boiler. The manufacturer shall provide a fire test report, including fuel and air settings and combustion test results permanently affixed to the boiler.

2.13 SEQUENCE CONTROLLER

A. Boiler shall be provided with a boiler sequence controller that is capable of controlling a) one or multiple boilers, b) all condensing or all non-condensing boilers, c) combination of condensing and non-condensing boilers (hybrid system). When controlling hybrid systems, sequence controller shall sequence the lead boiler based on its condensing capabilities to provide the most efficient operation.

Controller shall be capable of communicating via MODBUS protocol. Controller shall allow boiler or boilers to operate off of a remote header sensor (header sensor provided by boiler manufacturer, installed by contractor). Controller shall be capable of allowing boiler or boilers to operate based on outdoor reset, see specification Section 23 09 33 for reset schedule. This shall be achieved by either, a) programming the controller with an outdoor air reset curve in conjunction with a separate outdoor air sensor (outdoor sensor shall be provided by boiler manufacturer, installed by contractor), b) setpoint control via 0-10 VDC analog communication with building automation system, c) setpoint control via BACNET communication. Controller shall visually display relay status, firing rate of each boiler, header temperature, outdoor air temperature. Coordinate wiring of this controller with mechanical and control's contractor.

2.14 CARBON MONOXIDE MONITORING SYSTEM

A. Provide and install a manual reset Carbon Monoxide Detector located within the boiler room. 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 isolation valves and unions on supply and return water lines to boiler.

B. Install strainer, drain with valve, pressure and temperature gauge on return water line to boiler.

C. Install main gas cock, drip leg and union close to boiler.

D. Install on 4" concrete pad and place into operation in accordance with manufacturer's instructions. Pipe as detailed on drawings.

F. Provide Category IV vent stack material. Mechanical contractor shall coordinate draft requirements and other venting requirements between stack supplier and boiler supplier.

G. Install boilers, piping and accessories in accordance with the manufacturer's installation instructions and state boiler code.

H. Pipe each gas relief vent to the outdoors, in accordance with the manufacturer's recommendations and the local codes.

I. Contractor must, when filling the system, verify that the pH level is maintained between 6.0 and 8.5.

J. Contractor to route condensate connection off of boiler and stack to acid neutralization kit and then to appropriate drain. Trap as required by boiler manufacturer.

3.2 BOILER MANUFACTURER STARTUP SERVICE

A. Provide factory authorized startup services to assure its proper operation.

B. Set the boiler operating and safety controls.

C. Perform a flue gas analysis at the boiler outlet. Record the following results of the analysis:
   1. Carbon dioxide percent volume.
   2. Oxygen percent volume.
   3. Stack temperature.
   4. Calculated combustion efficiency.

D. Do not operate the boiler for any reason until the factory startup service has been completed.

E. 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.

END OF SECTION

SECTION 23 65 28 - AIR-COOLED VARIABLE SPEED ROTARY SCREW CHILLER

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and Install a packaged, electric-driven, air-cooled, water chilling unit with variable speed rotary screw compressors complete with controls.

1.2 RELATED WORK

A. Division 23 – Mechanical:
   1. Chilled Water Piping
   2. Insulation
   3. Building Management Control System
   4. Vibration Isolation.
   5. Electrical Provisions of Mechanical Work.

1.3 REFERENCES

A. ANSI/ARI 550/590 - Water Chilling Packages using the Vapor Compression Cycle.
B. ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration.
C. ANSI/ASHRAE ASHRAE 90.1-1999 Minimum Chiller Efficiency Requirements
D. ANSI/ASME SEC 8 - Boiler and Pressure Vessel Code
E. ANSI/NEMA MG 1 - Motors and Generators.
F. ANSI/UL 465 - Central Cooling Air Conditioners.
G. ANSI/AFBMA 9-1978 - Load Ratings and Fatigue Life for Ball Bearings. Bearings must have life of not less than 200,000 hours.
H. ASTM B117 - Standard Method of Salt Spray (Fog) Testing
I. ASTM A123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
J. ASTM A525 - Zinc (Hot-Dip Galvanized) Coatings on Sheet Steel Products
K. ASTM D1654 - Evaluation of Painted or Coated Specimens, Subjected to Corrosive Environments

1.4 PERFORMANCE

A. Provide performance as scheduled on drawings.

1.5 WARRANTY

A. The Chiller manufacturer shall provide a full machine parts, labor, and refrigerant warranty for a period of five (5) years from substantial completion.
   1. The warranty shall include, but not be limited to the compressor assemblies including motor, condensers, fans, variable frequency drives, controls, evaporator, condenser, refrigeration system and all other auxiliary components and accessories as well as refrigerant and oils in systems.
   2. In the event of failure, provide new or factory authorized rebuilt parts. Shop or job site rebuilt parts are not acceptable.
   3. On all manufacturers warranties the chiller manufacturer shall provide a factory certificate listing as a minimum chiller model, serial, and warranty information as specified above. Each chiller tag shall be provided with an individual and unique warranty certificate. Manufacturer’s representative warranty letters are not acceptable as an alternative to the original manufacturer’s certificates.
   4. The chiller manufacturer authorized service agency is required to perform any and all warranty service. Contractor warranty service is not authorized. Warranty work shall be performed with District Representative present.

1.6 SUBMITTALS

A. Submit manufacturer's certified computer generated performance and capacity data 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. Maximum conductor / Terminal Lug size.
5. Minimum flow thru evaporator.
6. Electrical interlocks.

C. Submit recommended clearance dimensions for air flow and service.

D. Submit coordination drawings as specified.
1. Give consideration to adjacent structures as they affect air flow patterns.

E. Submit internal wiring diagram of Control Center.

F. Submit sequence of operation in narrative form.

G. Submit a letter stating chiller being proposed meets the efficiency requirements of Centerpoint Energy’s Score Program listed in Centerpoint Energy’s Design Guide: HVAC Recommendations document.

H. Mark-up a copy of the specifications, indicating in the margin of each paragraph, the following: COMPLY, DO NOT COMPLY, NOT APPLICABLE.

1.7 STORAGE/HANDLING/SHIPPING

A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

B. Protect units from physical damage. Factory coil shipping covers shall be kept in place until installation.

C. Unit controls shall be capable of withstanding 203°F (95°C) storage temperatures in the control compartment for an indefinite period of time.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Carrier

B. Trane

2.2 COMPRESSORS

A. Provide a minimum of two independently circuited semi-hermetic direct drive, variable speed rotary screw compressors with the following:
1. Rubber isolation pads.
2. Crankcase heaters.
3. Semi-hermetic motor.

4. Oil sight glass.
5. Load and unload solenoid valves.
6. Discharge oil separator.

B. Provide compressor with automatic capacity reduction equipment consisting of a capacity control variable speed drive. The controls system logic must start the compressor at minimum speed for a soft start.
   1. Control to be based upon leaving chilled water.

C. Ultra-Low Sound Compressor Control: Chiller manufacturer shall provide the following attenuation package and meet scheduled maximum A-weighted sound pressure level rating of 76dBA at 30' from the condenser coil side of chiller per AHRI. Complete sound attenuation package shall be provided regardless if scheduled dBA is met without.
   1. Provide ultra-low sound blanket on a minimum of 100% coverage of each compressor, suction line, discharge line and oil separator.
   2. Removable Sound Covers shall be constructed with a Silicone-fiberglass cloth outer jacket, a loaded vinyl barrier septum, fiberglass needle mat (11 lbs./ft.3 density), and a Silicone-fiberglass cloth inner jacket. The covers shall be connected together by means of a cloth straps with "D" rings and Velcro fasteners. The inner and outer jackets shall protect against UV rays, oil and water. Finished Surface Mass – 3 lbs. per sq. ft., to cover compressors and extended components for the specified chiller. Stainless steel wire tie fastening assemblies are not acceptable.
   3. Provide detailed ultra-low sound acoustical data with submittal. Data shall include sound pressure rating across each octave band and A-weighted average for chiller as built with attenuation package.

2.3 CONDENSER COILS

A. Coil shall be microchannel design and shall have a series of flat tubes containing multiple, parallel flow microchannel layered between the refrigerant manifolds. Tubes shall be 9153 aluminum alloy. Tubes made of 3102 alloy or other alloys of lower corrosion resistance shall not be accepted. Long Life Alloy Microchannel shall pass 4500hr salt spray rating uncoated.

B. All aluminum brazed fin microchannel construction designed for a minimum of 350 psig working pressure and leak tested at 1.5 times the working pressure.

C. Protect all vertical or angled coil sections from hail or physical damage with corrosion resistant hail guard.

D. Chiller shall be capable of stable operation in ambient temperatures down to 15°F and temperatures up to 130°F.

E. Protect condenser coils during shipping.

F. Provide condenser coils coated with corrosion resistant epoxy utilizing a dip and bake. Coating shall be flexible and uniformly bonded to all condenser coil surfaces.

2.4 FANS AND MOTORS

A. Direct Drive Ultra Low Sound propeller type fans.
   1. Vertical discharge with sound reduction without performance degradation.
   2. Protect fan blades with a heavy-gauge wire guard.
   3. Statically and dynamically balanced
   4. Sound reduction engineered heavy-duty molded plastic blades designed to reduce airflow turbulence.

5. All condenser fans shall have integral drives to provide variable speed for optimized efficiency.

B. Motors with built in thermal overload protection
1. Permanently lubricated ball bearings.
2. Weatherproof (TEAO or TEFC) motors.

2.5 EVAPORATOR

A. Provide shell and tube direct expansion cooler with:
1. Copper tube and steel shell construction
2. 150 psig water side working pressure
3. ASME coded 200 psig refrigerant side working pressure
4. Fully independent refrigerant circuit for each compressor.
5. Serviceable construction including removable heads and field replaceable tubes.

B. Protect cooler with ambient controlled heater cable and minimum 1-1/4" thick flexible elastomeric rubber closed cell insulation. Heater cable to protect evaporator to -20ºF (-29ºC). Heater cable shall be wrapped helically around the shell under the insulation.

C. Protect insulation and equipment from abrasion by unit enclosure.

D. After completion of successful start-up, installing contractor shall seal all openings and apply a protective aluminum sheet metal cover.

E. Provide water drain connection, vent and fittings for factory installed leaving water temperature control and low temperature cutout sensors.

F. Water connections shall be grooved or flanged.

G. Proof of flow shall be provided by the equipment manufacturer factory installed.

2.6 CASING/ENCLOSURES

A. House components in minimum 12 gauge galvanized steel frame and mounted on welded structural steel base. Hot-dip galvanized steel frame coating shall be Underwriters Laboratories Inc. (UL) recognized as G90-U, UL guide number DTHW2.

B. Unit panels, and control panels shall be finished with a baked on powder paint. Control panel doors shall have door stays.

C. Mount starters and disconnects in weatherproof panel provided with full opening access doors. Provide lockable disconnect operating handle external to panel and clearly visible from outside of unit indicating if power is on or off.

D. Casings fabricated from steel that do not have a Zinc coating conforming to ASTM A 123 or ASTM A525 shall be treated for the prevention of corrosion with a factory coating or paint system. The coating or paint system shall withstand 500 hours in a salt-spray fog test in accordance with ASTM B 117. Each specimen shall have a standard scribe mark as defined in ASTM D 1654. Upon completion of exposure, the coating or paint system shall be evaluated and rated in accordance with procedures A and B of ASTM D 1654. The rating of failure at the scribe mark shall be not less than six (average creepage not greater than 1/8"). The rating of the unscribed area shall not be less than ten (no failure). Thickness of coating or paint system on the actual equipment shall be identical to that on the test specimens with respect to materials, conditions of application, and dry-film thickness.

E. Coated wire mesh to limit access beneath the condenser coils, cooler, and compressor section area.

F. Convenience outlet (GFIC) at control panel connected to 120-vac circuit provided for heat tracing on cooler.

G. A control power transformer shall be factory installed to provide unit control power.

2.7 REFRIGERANT CIRCUIT

A. All units shall have a separate independent refrigerant circuit for each compressor.

B. Provide for each refrigerant circuit:
1. Liquid line isolation valve.
2. Filter dryer (replaceable core type).
3. Liquid line sight glass and moisture indicator.
4. Electronic expansion valve sized for maximum operating pressure. Expansion valves with less than five years of proven field operation are not acceptable.
5. Charging valve.
6. Discharge and oil line check valves.
7. Compressor suction and discharge service valves.
8. Relief valve.
9. Full operating charge of refrigerant and oil.

2.8 CONTROL PANEL

A. The Control Center.
1. NEMA 3R weatherproof cabinet with hinged lockable outer door.
2. Control system.
3. Solid-state compressor three phase motor protection.
4. Single point field power connection points.
5. Control interlock terminals.
6. Fan motor and control circuit fuses.
7. Individual contactors for each fan motor.
8. Unit power terminal blocks for connection to remove disconnect switch.
9. Power supply terminals for evaporator heater circuit.
10. Dead front panels over line voltage.
11. Control power / circuit transformer.
12. Provide incoming power terminals, sized to accept the feeder conductors.
13. Pump output relay for chilled water pump control
14. Freeze protection and low limit control of pumps
15. Chiller run and alarm status relay cards.

B. Microprocessor control system.
1. Stage unit based on leaving water temperature control.
2. Oil differential pressure setpoints.
3. Motor protection.
4. High pressure alarm.
5. Loss of refrigerant alarm.
6. Loss of water flow alarm.
7. Freeze protection alarm.
8. Low refrigerant pressure alarm.
9. Auto start/stop switch.
10. Chilled water setpoint adjustment.
11. Anti-recycle timer.
12. Compressor run status.

13. Password protection.
14. Low water temperature safety (freeze protection).
15. Automatic pump down cycle.
16. Limit supply water temperature pull down on start up to 1° per minute.
17. Automatic lead-lag sequence change of compressors.
18. Unload the compressors if the return water is too high.
19. Compressor starts with the controlled cylinders unloaded.
20. Reset of the chilled water temperature.
21. Indicate status of safeties.
22. Non-volatile memory (EPROM) with setpoints retained with battery backup.
23. Automatic high pressure unloader to unload compressor at pressures above 375 psig.
24. Auto restart after power failure.
25. BacNET Interface
26. Alarm Relay
27. Percent of Running Load Amperage

C. Display the following information with Alphanumeric Liquid Crystal Display for outdoor viewing.
1. Supply and Return water temperature.
2. Low water temperature cutout setting.
3. Low ambient temperature cutout setting.
4. Outdoor air temperature.
5. English and Metric data.
6. Suction pressure cutout setting.
7. Each system suction pressure.
8. Each system discharge pressure.
9. Each system oil pressure.
10. Percent of full load motor current.
11. Liquid control range. (2.0 - 20°F above setpoint)
12. Liquid pull down rate sensitivity adjustment.
13. Anti-recycle timer status for each compressor.
12. Compressor starts & operating run hours.
13. Safety shutdown shall be date and time stamped.
14. Compressor run status.
15. Display data in English or metric units.

D. All control functions and information shall be available at the unit control panel or via RS 232 cable and phone modem to personal computer.

E. Chiller shall include a relay board with dry contacts for alarms to notify a Building Automation System of certain events or statues of the chiller.

F. Chiller shall include input for leaving chilled water temperature setpoint based upon a 2-10VDS or 4-20mA signal from a Building Automation System.

G. Chiller shall include input for chiller current limit setpoint based upon a 2-10VDC or 4-20mA signal from a Building Automation System.

2.9 LOW VOLTAGE VARIABLE SPEED DRIVE, UNIT MOUNTED

A. The water chiller shall be furnished with an air cooled variable speed drive (VSD) as shown on the drawings.

B. The VSD will be specifically designed to interface with the water chiller controls and allow for the operating ranges and specific characteristics of the chiller.

C. The VSD efficiency shall be 97% or better at full speed and full load. Fundamental displacement power factor shall be a minimum of 0.96 at all loads.

D. The VSD shall be solid state, microprocessor based pulse-width modulated (PWM) design. The VSD shall be voltage and current regulated. Output power devices shall be IGBTs.

E. Power semi-conductor and capacitor cooling shall be from a liquid or air cooled heatsink.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install system in accordance with manufacturer's instructions.

B. Where the chiller unit is mounted on a grade, a concrete pad shall be provided that is a minimum of 4" high and extends 6" all around the chiller.

C. Align chiller package on steel or concrete foundations.

D. Locate away from overhead restrictions. Maintain side clearances according to manufacturer's recommendations and maintain overhead clearance to allow full elimination of hot air discharge.

E. Install units on vibration isolation pads.

F. Arrange piping for easy dismantling to permit tube cleaning, removing and or repair.

G. Level chiller.

H. Provide flexible elastomeric rubber closed cell insulation to prevent condensation from occurring at cooler and suction piping. After completion of successful start-up, installing contractor shall seal all openings in insulation and apply a protective aluminum sheetmetal jacket over insulation.

3.2 CHILLER MANUFACTURER START-UP/ FIELD SERVICES

A. Provide the services of a factory trained service technician employed full time by the chiller manufacturer to start-up the system. Technicians, as required, shall be factory trained and experienced in the work they perform. (Contractor startup is unacceptable.)

B. The technicians shall utilize comprehensive report forms to document results. Sample forms shall be submitted for review prior to commencing work.

C. Upon completion of the work, the report forms shall be signed by the technicians and their supervisor and included in the final report and Owner's manual.

D. Submit four copies of the final report to the Architect/Engineer for approval within 10 working days of start-up.

E. Follow the manufacturer's start-up procedures.
1. Verify interlocks.
2. Test and verify operation of safety controls.
3. Calibrate controls.
4. Verify microprocessor based control operation.

5. Test, calibrate, and set the chilled water temperature controls.
6. Verify chilled water temperature reset sequence.
7. Verify operation of the integrated control panel.

F. Measure and record the following data:
1. Chilled water entering/leaving temperature.
2. Chilled water flow through the chiller.
3. Suction pressure/condensing pressure.
4. Suction pressure/unloading steps.
5. Air entering/leaving condenser; dry bulb temperature.
6. Outdoor ambient; dry bulb.
7. Motor nameplate voltage; phase and full load amperes.
8. Heater coil in starter (as applicable)
   a. Rating in amperes.
   b. Manufacturer's recommendation.
9. Power reading (voltage and amperes of legs at motor terminals).

G. Test and calibrate the operation of the electronic ground current sensing devices.

H. If the system has been shipped with a holding charge, provide the following:
1. Leak test.
2. Refrigerant pressure test.
3. Evacuate, dehydrate and charge.

I. Verify that accessories are installed and performing the specified functions. Insert certification in Owner's manual.

J. Instruct the Owner's operating personnel. Provide Owner with 8 hours of training prior to substantial completion.

K. Do not operate the equipment for any reason until the factory start-up service has been completed.

L. Provide a printout from the unit microcomputer control system showing the correct operation of all system controls and components.

M. Provide minimum 24-hour history log displaying accuracy of temperature control system in 15-minute intervals and documented number of compressor cycles during the 24-hour period.

3.3 OWNER TRAINING

A. The manufacturer shall provide, as part of their proposal, training for (3) three Owner representatives at the Manufacturer’s facility. The owner will provide all travel accommodations.

B. Submit a training agenda two (2) weeks prior to the proposed training session for review and approval.

C. Training shall include a combination of hands-on and classroom type training which pertains to the purchased equipment. The training shall give the trainees the ability to completely tear down and overhaul the purchased equipment. Any and all literature, manuals or information shall be provided to the trainees.

END OF SECTION

SECTION 23 73 13 - AIR HANDLING UNITS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install air handling units with casing, fans, coils, filters, and special items.

1.2 RELATED WORK

A. Division 23 Mechanical
   1. Air Balance
   2. Ductwork
   3. Controls
   4. Electrical Provisions of Mechanical Work
   5. Air Filtration
   6. Heating and Cooling Coils
   7. Other applicable sections

1.3 PERFORMANCE

A. Unit capacities and characteristics as indicated.
   1. Units must be certified in accordance with ARI Standard 430-66.
   2. UL 1995 certification for safety including electric heat.
   3. ARI 430 listed and meet NFPA 90A requirements.

1.4 SHOP DRAWINGS

A. Indicate assembly, unit dimensions, weight loading required clearances, construction details, field connection details, and electrical characteristics and connection requirements.

B. Submit fan performance curve for each unit:
   1. Plot fan volume against static pressure, horsepower, and efficiency.
   2. Show point of rating based on static requirements of the system.
   3. Chart of specific sound power level at each octave band center frequency.
   4. For variable volume units, plot fan volume over entire range.

C. Submit for review a unit internal static pressure loss calculation.
   1. Provide an itemized list of static pressure loss at the scheduled CFM for each unit component including and not limited to:
      a. Coils
      b. Dirty filters
      c. Fan and unit system effect
      d. Cabinet and cabinet inlet and outlet
      e. Unit mounted dampers
   2. If a unit mounted outside air pretreatment section without supply fan, “piggyback” is specified:
      a. Provide an itemized static pressure loss as indicated above.
      b. Determine losses for unit configuration, i.e. parallel or series.
      c. Include losses in the primary unit internal static pressure required by configuration.
   3. The air handling unit schedule indicates static pressure external to the unit and does not include any losses associated with the air handling equipment.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, condensate properly tapped, piping connections verified and leak tested, belts aligned and tensioned, all shipping braces have been removed, and fan has been tested under observation.

1.6 DELIVERY, STORAGE AND HANDLING

A. Inspect for transportation damage and store in a clean, dry location. Protect from weather and construction traffic.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Carrier

B. Trane

2.2 MISCELLANEOUS REQUIREMENTS

A. Provide factory assembled units. Large units may be shipped in sections, at contractor's option, to enable entrance to building, or for oversize shipping reasons only. Sectioned units shall be furnished with sufficient gasket, seal material and bolts for reassembly in the field by the contractor with manufacturers on site supervision.

B. Furnish units with sealing and fastening hardware supplied by the manufacturer. Include written instructions needed to complete field assembly of the components.

C. Provide units designed and constructed so that coils, panels, fan housing and fans can be removed without affecting the structural integrity of the unit.

D. Unit casing panels shall be a minimum of 2” double wall construction with solid galvanized exterior and solid galvanized interior. Panels shall have a minimum thermal resistance of R-13. The casing shall not exceed 0.0042-inch deflection per inch of panel span at 1.5 times the design static pressure up to a maximum of +8 inches in all positive pressure sections and -8 inches in all negative pressure sections.

E. Provide full perimeter base rail channel under units constructed of heavy gauge galvanized steel (minimum 10 gauge) and intermediate cross members to assure unit integrity. Provide minimum size base rail to ensure proper trapping and slope of condensate drain (minimum 6 inch from bottom of drain opening).

F. Fan assembly shall be provided with 1" deflection internally mounted spring vibration isolation under the fan and motor base on units with coils less than 8 sq. ft. and 2" deflection internally mounted spring vibration isolation under the fan and motor base with coils greater than 8 sq. Ft. Units with coils over 35 sq. ft. shall have spring thrust restraints securing the fan housing to the discharge opening panel on units. Fan motor shall be internally mounted. Provide internal flex connection of fan discharge. Maximum acceptable RPM of fan shall not exceed 1000.

G. Provide factory installed removable hinged access doors in the following locations:
1. Entering side of all coils to allow for cleaning of coils on both sides of unit.
2. Each side of filter compartment to allow changing of filters from either side.
3. Each side of motor compartment to allow motor and isolation access.
4. Each side of condensate drain pan to allow for cleaning and inspection.

5. Swing the doors against the casing static pressure.

H. Provide all coil modules, including heating coil modules, with stainless steel drain pans to facilitate cleaning and maintenance of the coils. Drain pan to extend 10” minimum downstream of cooling coil.

I. Provide coils with stainless steel casings, end plates, tube supports and top & bottom plates.

J. Units shall meet ASHRAE III Class 6 Low Leakage Standard. Casing shall have less than a 1% leakage rate at plus or minus 8 inches W.G.

K. Provide units with a low velocity angled filter section unless otherwise specified.

L. The maximum face velocity shall be 500 fpm for standard cooling coils and shall be 450 fpm for outdoor air-cooling coils.

M. Provide a minimum of 18 inches of clearance between coils for access.

2.3 DRAW THROUGH AIR HANDLING UNITS

A. Provided with:
1. Non-Overloading direct drive plenum fans. Provide minimum number of fans as indicated on drawings.
2. Insulated sheet metal cabinet with removable panels for access to the interior.
3. Hinged double wall doors with two-step safety handles.

B. Drive assembly:
1. Sized for 50% overload.

C. Motors and Control:
1. Totally enclosed, fan cooled, Variable speed, 1750 rpm.
2. Maximum operating point of 70 Hz.
3. Minimum 90% nominal efficiency at loads of 70%-100%.
4. Premium efficiency inverter duty
5. NEMA B design, with Class B insulation, capable to operate continuously at 104 deg F without tripping overloads.
6. +/- 10% voltage utilization range to protect against voltage variation.
5. Cast iron frame and end plate
6. Forged steel lifting eye
7. Oversized conduit box with ground lug
8. Provide with factory installed shaft grounding rings by Aegis
9. Motor selected so that the brake horsepower required to deliver the design air quantity at the system static pressure will not exceed the motor nameplate rating.

D. Supply Fans:
1. Single width, single inlet, backward curved welded aluminum plenum fan.
2. Statically and dynamically balanced to a BV-3 per AMCA 204 test standard.
3. Tested after being installed in the fan sections.
4. Selected for the design air quantities and pressure of the system.
5. Mounted on a common shaft if multiple wheels.
6. The fan shall be rated in accordance with AMCA 210 for performance and AMCA 300 for sound.
7. Minimum of Class II fan.

E. Fans selected with isolation shall be internally isolated with spring isolators. A flexible connection shall be installed between fan and unit casing to ensure complete isolation. Flexible connection shall comply with NFPA 90A and UL 181 requirements. If fans and motors are not internally isolated, then the entire unit shall be externally isolated from the building, including supply and return duct work, piping, and electrical connections. External isolation shall be furnished by the installing contractor to avoid transmission of noise and vibration through the ductwork and building structure.

F. Each direct drive fan in a multiple-fan array shall be provided with integral back flow prevention: a backdraft damper that prohibits recirculation of air in the event a fan or multiple fans become disabled. Dampers are tested and rated based on AMCA Standard 500. Dampers to be heavy duty type capable of a maximum back pressure that exceeds the design total static pressure with minimal leakage. The dampers should have a minimal total effect on airflow performance; both pressure drop when open and system effect on the fan. The damper blades and frame shall be extruded aluminum with blade edge seals locked into the blade edge. Adhesive type seals are unacceptable. AHU manufacturer responsible for providing proper spacing upstream of dampers to ensure full, uniform airflow through upstream components. For units where the damper(s) are supplied at the jobsite, the installing contractor shall contract a certified TAB contractor to verify uniform airflow thru upstream components.

G. Where multiple fans are provided, a single source power motor control panel shall be factory installed. All fans shall be factory-wired to motor control panel which shall consist of individual motor overload relays and on-off disconnect switch for power isolation.

H. Select fan to operate at or near its maximum efficiency point when handling the required air quantity and static pressure.

I. Stainless steel condensate pan with positive slope in all directions to outlet. Line the condensate drain pan with minimum 1-1/2" waterproof insulation.

J. Insulation, vapor barriers, facings and adhesives shall have:
1. Flame spread not higher than 25.
2. Smoke developed rating not higher than 50.

K. Double wall casing construction. Construct interior casing panels with 3 lb. minimum density insulation for acoustical and condensation control.
1. Condensation on the exterior of the air handling units is not acceptable.

L. Filter section:
1. Constructed with substantial hinges.
2. Neoprene gasketing.
3. Permanent quick release latching devices.
4. Arranged to accommodate the 2" thick filters as specified.
5. Low velocity angled filter section unless otherwise specified.

M. Cooling coils as specified. Extend drain and vent piping through cabinets. Provide grommets at all pipe penetrations through cabinets.

N. Heating coils as specified. Extend drain and vent piping through cabinets. Provide grommets at all pipe penetrations through cabinets.

O. Provide each fan section with an additional 2” thick perforated metal inner liner which utilizes fiberglass insulation. Liner shall be installed on all walls and top surface.

P. Factory dynamic fan balancing shall be conducted from 16Hz to 60Hz to identify and

eliminate critical speeds to ensure stable operation through the entire operating range of the fan and drive assembly. Field fan balancing is not acceptable. Forward factory balancing test report to Engineer upon request.

Q. Integral Air-to-air, heat exchangers shall be provided as indicated on the schedule and drawings. Exchangers shall be a cross flow, with no moving parts or secondary heat transfer surfaces. Access to all four faces of exchangers shall be provided for cleaning and inspection. Drain pans shall be provided under each supply and exhaust sides of the exchanger, with drain connections extending to the exterior of the unit base. Drain pans shall be stainless steel of the same construction as specified in the unit guide specs.

R. Sensible and latent heat exchanger core shall contain a combination of polymeric core and plate frame aluminum core. Enthalpy plate exchanger shall be impregnated with a RC134 polymeric desiccant. Polymer shall exchange water by direct vapor transfer using molecular transport with the need of condensation. Core shall be capable of operating in the temperature range from -40F and 140F (-40C and 60C). Enthalpy plate exchanger shall withstand, without more than 10% increase in pressure drop, pressure differential of at least 5” w.g. Enthalpy plate exchanger shall withstand pressure differential of 10” w.g. without permanent deformation. Use of sensible and latent exchanger shall meet ASHRAE 90.1 compliance requirements of minimum total effectiveness energy recovery, and fan power limitations.

1. Acceptable Manufacturer
    a. Core Energy Recovery Solutions
    b. Trane
    c. InnergyTech

S. Core shall be provided with a 10 year parts warranty.

T. Energy recovery section shall be provided with a ERV face damper and ERV bypass damper that utilized Ruskin CD-60 motorized dampers to allow full outside air flow bypass. These dampers shall be mechanically linked to operate in reverse action of each other.

U. Provide each supply fan and exhaust fan section (ERV) with an additional 2” thick perforated metal inner liner which utilizes fiberglass insulation. Liner shall be installed on all walls and top surface.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install air handling units according to manufacturer's instructions.

B. Provide additional drive packages as required by the Testing and Balancing firm.

C. Air leaks detectable by sound or touch are to be corrected.

D. Air handling units are to be properly supported to prevent flexing, bending, or distorting base rails.

E. All coils are to be cleaned prior to substantial completion if units are used during construction.

F. Clean all air handling units and return to original manufacturer's condition prior to substantial completion. Vacuum clean all debris from inside air handling equipment.

G. Install piping to unit with full size 6-inch-long dirt leg with 1/2" valve at bottom for cleaning.

H. Provide for positive gravity drainage of coil condensate. Pipe full size of unit connection.

I. Adjust fan drives as required to obtain scheduled capacities as directed by the Test and Balance Firm to include sheave and belt replacement.

J. Align belts to eliminate wear and vibration of belts.

K. Verify correct drainage of condensate from condensate pan.

L. Verify correct rotation of fan and wiring of motor.

M. Lubricate all greaseable ball bearings with manufacturer’s suggested lubricant.

N. Replace filters as required if units are used during construction.

O. Provide piping installation so that after piping is completed and insulated there is full access to service unit and remove fan housing. Piping to coils shall not block fan section access or cause damage to piping insulation during access.

3.2 IDENTIFICATION

A. Furnish each unit with a durable, deep etched, .025” thick, factory installed aluminum identification plate, permanently mounted with the following information:
1. Unit identification as indicated on Contract Drawings.
2. Serial Number.
3. Model Number.
4. Capacity (CFM) and static pressure.
5. Motor HP.
6. Unit power supply: Volts / PH / Amps.
7. Supply Fan Type.
8. Coil GPM and pressure drop.
9. Sales Order #.
10. Date unit manufactured.

END OF SECTION

SECTION 23 82 16 - HEATING AND COOLING COILS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install heating and cooling coils.

1.2 SUBMITTALS

A. Submit manufacturer's product data sheets and unit capacity information as specified.

B. Submit manufacturer's Installation, Start-Up and Service Instructions.

C. Submit internal wiring diagram.
   1. Electrical interlocks. *

1.3 RELATED WORK

A. Division 23 Mechanical.
   1. Air Handling Units.
   2. Fan Coil Units.
   3. Ductwork.
   4. Terminal Boxes.

PART 2 - PRODUCTS

2.1 HOT WATER COILS

A. Hot water coils:
   1. Constructed of copper tubes and aluminum fins.
   2. Designed and circuited for hot water.
      a. Maximum temperature 200°F.

B. Where coils are installed in fan powered VAV boxes, unit heaters and other locations where the incoming air is not filtered, the maximum approved fin spacing is 8 fins per inch.

C. Non-trapping circuit design:
   1. Working pressure 200 psi
   2. Tappings for drain and air vent

D. Provide a Peterson Pete's Plug with retainer strap on the inlet and outlet of each coil.
   1. Positioned to permit accurate pressure readings.

E. Coils shall be constructed in casings as required for installation.

2.2 CHILLED WATER COILS

A. Chilled water coils:
   1. Constructed of copper tubes and aluminum fins
   2. Designed and circuited for chilled water
   3. Minimum of six rows

B. Non-trapping circuit design:
   1. Working pressure 200 psi.

2. Tappings for drain and air vent.

C. Provide a Peterson Pete's Plug with retainer strap on the inlet and outlet of each coil. Position to permit accurate pressure readings.

D. Coils shall be constructed in casings as required for installation.

E. Where coils are stacked, provide intermediate drain pans with drop tubes to drain condensate to the main drain pan without flooding the lower coil.

2.3 DIRECT EXPANSION COOLING COILS

A. DX cooling coils:
1. Constructed of copper tubes and aluminum fins.
2. Designed and circuited for use with direct expansion refrigeration.

B. Cooling coil face velocity:
1. Not of magnitude to cause moisture to be carried off the coil.
2. Maximum velocity as scheduled.

C. Circuit cooling coil with interlaced tubes so the entire face is active under all modes of unloading. Refer to the schedule on the drawings.

D. Coils shall be constructed in casings as required for installation.

E. Where coils are stacked, provide intermediate drain pans with drop tubes to drain condensate to the main drain pan without flooding the lower coil.

2.4 ELECTRIC HEATERS

A. Capacity shall be as scheduled on the drawings. Heater shall have 80% nickel, 20% chromium, open resistance coils insulated by floating ceramic bushings, and be supported in an aluminum steel frame.

B. Ceramic bushings shall be recessed into embossed openings and staked into supporting brackets spaced 3-1/2" maximum center to center.

C. Coil shall be machine-crimped into threaded terminals and insulated with phenolic bushings. All terminal hardware shall be stainless steel.

D. Heater shall be listed by the Underwriters Laboratories for zero clearance to combustible surfaces and for use with central air conditioners.

E. For primary protection, furnish a disk-type automatic reset thermal cutout for pilot duty only.

F. For secondary protection, load-carrying manual reset thermal cutouts shall be wired in series with each heater circuit. Cutouts shall be rated at 480 volts minimum.

G. Voltage, phase and number of heating stages shall be furnished in accordance with duct heater schedule. Three-phase heaters shall have single-phase circuits for operation from a 3-phase, 4-wire power source. Circuits shall be rated at 48 amperes maximum. Furnish one set of line terminals to feed all circuits. Heater shall be tested dielectrically at 2000 volts before shipment. Field-installed conductors feeding the heater shall be sized for 125% of the connected load.

H. Built-in components shall be factory wired to terminal blocks for field connection. All internal wiring shall be insulated for 105°C. Built-in magnetic contactors shall disconnect all ungrounded conductors to each circuit. Furnish heaters with an air flow switch that will not allow heaters to energize without proof of air flow. Built-in transformer shall be dry industrial type, sized to carry full contactor holding coil load. Primary windings shall be fused at the factory. Built-in fuses shall be factory wired to each circuit to protect all underground conductors. Type NON or NOS fuses to be factory installed in phenolic fuse blocks. Built-in disconnect switch to be snap action, industrial type. Provide a door interlock mechanism to prevent hinged terminal box cover from being opened when the switch is on. Switch shall be unfused.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install the duct heaters in accordance with the manufacturer's Installation, Start-Up and Service Instructions.

END OF SECTION

SECTION 23 82 18 - DUCTLESS MINI SPLIT DX UNITS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install mini split system. Complete with a slim silhouette, compact, high wall mounted indoor fan coil section with wired wall mounted type controller and a slim silhouette horizontal discharge outdoor condensing unit. Unit shall be provided with constant speed compressor, pre-charged with R32 or R454B 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 R32 or R545B 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. UL Compliance: Comply with UL 60335-2-40.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Carrier

B. Trane

C. Mitsubishi Electric

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 INDOOR UNIT CABINET

A. The casing shall have a smooth front, top return, in a white finish.

B. Multi directional drain and refrigerant piping offering four (4) directions for refrigerant piping and two (2) directions for draining shall be standard.

C. There shall be a separate installation plate which secures the unit firmly to the wall. Secure mounting of plate and all mounting hardware shall be furnished by and be the responsibility of the installer.

2.4 INDOOR UNIT 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. Manual adjustable vertical guide vanes shall be provided with the ability to change the airflow from side to side (left to right).

D. An integral, motorized, horizontal air sweep flow louver shall provide an automatic change in airflow by directing the air up and down to provide for uniform air distribution.

E. The indoor unit fan motor shall operate in four (4) selectable speeds, Powerful, High, Medium, and Low.

2.5 INDOOR UNIT FILTER

A. Return air shall be filtered by means of easily removed, washable, Catechin air filter and an anti-allergy enzyme filter – blue bellows type.

2.6 INDOOR UNIT 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 groves 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. (Option: A condensate mini-pump shall be provided to provide a means of condensate disposal when a gravity drain is not available.)

2.7 INDOOR UNIT ELECTRICAL

A. Power for the indoor unit shall be supplied from the outdoor unit.

B. Power supply shall be as indicated on the drawings.

C. The unit shall be equipped with a micro-processor control system directing indoor and outdoor unit coordinated operation.

D. The indoor unit shall not have any supplemental electrical heat elements.

2.8 INDOOR UNIT CONTROL

A. This system shall have a wired wall mounted type 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 wall mounted type 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.

2.9 OUTDOOR UNIT GENERAL

A. The outdoor unit is designed specifically for use with MS series indoor units. These units are equipped with a circuit board that interfaces to the MS 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.

B. When refrigerant lines are exposed on exterior of building provide “LINE-HIDE” line set cover system.
   1. Material, Weather resistant, UV stabilized, ASA/PVC/ABS/Poly/PE
   2. Assembly Screws, stainless steel.

2.10 OUTDOOR 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 as follows:
   1. The MS-A09WA base shall be of Aluminum-Zinc-Magnesium alloy coated steel, with welded mounting feet.
   2. The base for the MS-A12WA shall have a galvanized steel base with welded mounting feet.

C. Cabinet mounting and construction shall be sufficient to withstand 155 MPH wind speed conditions for use in Hurricane condition areas. Mounting, base support, and other installation to meet Hurricane Code Conditions shall be by others.

2.11 OUTDOOR UNIT 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.

2.12 OUTDOOR UNIT COMPRESSOR

A. The compressor shall be a high performance, inverter driven 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.

2.13 OUTDOOR UNIT 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.

2.14 OUTDOOR UNIT ELECTRICAL

A. The electrical power of the system shall be 115 volts, 1 phase, 60 hertz. The unit shall be capable of satisfactory operation within voltage limits of 103 volts to 127 volts.

B. The outdoor unit shall be controlled by the microprocessor located in the indoor unit. The control voltage between the indoor unit and the outdoor unit shall be 115 volts, AC.

2.15 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.

G. Dissipation system shall “Fail Safe” per UL requirements.

H. Dissipation shall allow smoke and building fire systems to override in case of event.

I. Sequence upon receiving leak detection signal from any indoor unit:
1. Switch to COOL operation regardless of previous operation mode.
2. Close liquid shutoff valve and run pump-down operation.
3. Upon completion of pump-down operation, close suction shutoff valve.
4. Stop compressor operation.

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 wired wall mounted type 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 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 shell be made part of the public record.

3.6 START-UP

A. Follow the manufacturer's start-up procedures.

B. Provide flexible elastomeric rubber closed cell insulation to prevent condensation from occurring op suction piping. After completion of successful start-up, installing contractor shall seal all openings in insulation and apply a protective aluminum sheetmetal jacket over insulation exposed on exterior of building.

END OF SECTION

SECTION 23 82 19 - FAN COIL UNITS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Floor mounted cabinet fan/coil units.

1.2 RELATED WORK

A. Division 23 Mechanical
   1. Air Balance
   2. Controls
   3. Electrical Provisions of Mechanical Work
   4. Ductwork
   5. Air filtration

1.3 REFERENCES

A. ANSI/AHRI 410 - force circulation air cooling and air heating coils

B. National Electrical Code

1.4 SUBMITTALS

A. Submit manufacturer's dimensioned product data sheets.
   1. Show location of filter access doors.

B. Submit fan performance curve for each unit:
   1. Plot fan volume against static pressure, horsepower and efficiency.
   2. Show point of rating based on static requirements of the system.

C. Submit the fan performance plot at each motor speed position with consideration for the reduced internal static.

D. Submit a chart of specific sound power level at each octave band center frequency.

E. Submit manufacturer's certified heating and cooling coil capacity data.

F. Submit filter manufacturer's product data sheets and capacity information.

G. Submit manufacturer's data on housing insulation material.

1.5 CAPACITY

A. Refer to equipment schedule.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Carrier

B. Trane

C. York

2.2 COMPONENTS

A. Fan section

B. V-belt drive assembly, or,

C. Multi-speed direct connected motor

D. Filter section

E. Coil section

F. Insulated sheet metal cabinet with removable panels for access to the interior

G. Motor and drive inside the cabinet

2.3 FAN SECTION

A. Locate the motor and drive assembly inside the cabinet.

B. Size each v-belt drive for 50% overload.
1. Adjustable pitch motor pulley
2. Provide built-in motor protection
3. Belt adjustment means

C. Provide multi-speed direct connected fan motor with built-in motor protection.
1. Three-speed windings
2. Factory wired to a junction box with provisions for motor speed change, mounted on the box
3. Resiliently mounted

D. Select the fan motor so that the brake horsepower required to deliver the design air quantity at the system static pressure will not exceed the motor nameplate amperage rating.

E. Supply Fans:
1. Double width, double inlet, forward curve blade
2. Statically and dynamically balanced
3. Tested after being installed in the fan section
4. Selected for the design air quantities and static pressure of the system
5. Mounted on a common shaft if multiple wheels

F. Select fan to operate at or near its maximum efficiency point when handling the required air quantity and static pressure.

G. Fan Bearings:
1. Permanently lubricated
2. Self-aligning

2.4 DECORATIVE HOUSING AND PLENUM

A. Where units are exposed to view in occupied spaces and where scheduled, construct cabinets of cold rolled steel, bonderized and coated with baked enamel finish.

B. Access panels shall have position locking fasteners for easy removal.

1. Plated screws with captive nuts
2. Hinged if too large for one man operation

2.5 UNIT HOUSING

A. Construct the unit of galvanized steel sheets, and formed members.
   1. Provide structure to brace the assembly for the pressure of the system.

B. Bolt housing components together with neoprene gasketed airtight joints.

C. Internally insulate the entire unit with neoprene coated, 1-1/2 lb. density glass fiber insulation, applied to internal surfaces with adhesive and weld pins. Coat exposed edges of insulation with adhesive.

D. Insulation, vapor barriers, facings and adhesives:
   1. Flame spread not higher than 25
   2. Smoke developed rating not higher than 50

E. Condensation on the exterior of the unit is not approved.

F. Provide a duct flange on four sides of the return air inlet and supply air outlet of the unit.
   1. Sized to permit connection of the flexible connection to the ductwork
   2. Extend beyond the primary drain pan
   3. Minimum dimension 2"

G. Provide insulated, removable panels for access to the interior.
   1. Plated captive screws and nuts
   2. Neoprene gaskets

2.6 CONDENSATE DRAIN PANS

A. IAQ style drain pans shall be provided under all coils.
   1. Pitch to drain connection
   2. Fabricated from 16 gauge 304 stainless steel
   3. Triple pitched for complete drainage with no standing water
   4. Insulated to prevent condensation
   5. Welded corners
   6. Stainless drain connection

2.7 COILS

A. Reference Schedule and Specification Section 23 82 16.

2.8 FILTER SECTION

A. Locate behind access doors.
   1. Construct with substantial hinges
   2. Neoprene gaskets
   3. Permanent quick-release latching devices

B. Arranged to accommodate the 1" thick filters as specified.
   1. Single section filter

C. Provide full length tracks to support the filter.

PART 3 - EXECUTION

3.1 SPARE PARTS

A. Provide the following spare parts and material to the Owner for use after the warranty period.
   1. One spare fan motor for each size of fan motor on the project
   2. One spare set of filters or filter media for each fan coil unit on the project

3.2 ELECTRICAL REQUIREMENTS

A. Bring electrical connections to a common junction box.

3.3 STORAGE

A. Storage and shipping in accordance with manufacturer's recommendations.

3.4 INSTALLATION

A. Install unit so motor connections and filters are accessible.

END OF SECTION

SECTION 23 82 39 - 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.
   2. Ductwork.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Modine

B. Reznor

C. Chromalox

D. Trane

E. Markel

2.2 COMPONENTS

A. Casing:
   1. Construct casing of sheetmetal with a structural frame.
   2. Enamel or lacquer finish to manufacturers 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 requiremens
   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

2.3 CONTROLS

A. Automatic controls:
   1. Factory mounted

2. Prewired to the junction box
3. Unit 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. Automatic reset thermal protection

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. 120 volt, single phase, 60 cycle motor
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

SECTION 26 01 00 - 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.

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.

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.

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.

3.7 O&M MANUALS

A. Refer to sections 016500 - GENERAL COMMISSIONING REQUIREMENTS

END OF SECTION

SECTION 26 01 05 - 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 the completed manuals in final electronic form to the Architect / Engineer.
   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. Complete electronic manuals shall be delivered to the Owner prior to substantial completion.

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.
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
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

SECTION 26 05 00 - 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.

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 another 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/otpca/nrtl/.

C. Where material and equipment are 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 Plans* (“Red Book”)
   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. IEE 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 11oo™, *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]
   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.

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, reproducibles 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.

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.
   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.

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.

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 deices 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 ¼-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.
      Example: Panel HA
      Fed From MSB
      Located Main Elec. RM 100
      Example: Disconnect for Panel LK
      Location: Kitchen
      Fed From Transformer TLK
      Located Main Elec. RM 100
   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 ¼-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.
   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	Receptacle Contactor C2

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	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
GTD Example	
Exterior lighting wall packs / north soffit / west metal canopy Fed from Panels EHA-2 located in Elec. RM 105 and HA-1 via Lighting Contactor controlled by BMCS located in Elec. RM 200.	

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 ATS-1	Wall Mounted Lighting ATS Example 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. Switchgear, switchboards, panelboards, motor control centers, or service equipment available fault current labeling: Provide a 2x3 inch permanently affixed (notice) label with white lettering on contrasting blue background permanently affixed to the equipment prior to energizing the equipment. The label shall include the date of installation and the date of calculation and comply with ANSI Z535.4 current standards design and durability. The date of calculation shall be the date indicated by the Engineer of Record’s seal on the Construction Documents. Example:

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.

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, 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.

3.4 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.

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 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 ™
   3. Working distance calculated in accordance with IEEE Std 1584a ™
   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 ™, paragraph 9.2.3.
   17. Use a “DANGER” label where the calculated arc-flash incident energy exceeds 40 cal/cm.

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-systemts7.pdf

END OF SECTION

SECTION 26 05 08 - TELECOMMUNICATIONS, CATV, VOICE, DATA, VIDEO UTILITY COORDINATION AND SERVICE ENTRANCE

PART 1 - GENERAL

1.1 WORK INCLUDED

A. General: Provide infrastructure, conduit, ductbanks and pathways from public street right-of-way to building for telecommunications, CATV, voice, data, and video.

B. Utility Company Data: Obtain from utility company information and installation standards for telecommunication, CATV, voice, data, video 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. Utility Data: Ensure that utility company service data is accurate and verified.

2.2 UTILITY INFRASTRUCTURE

A. General: Division 26 shall make provisions for utilities as required by utility company, including, but not limited to permanent or removable/lockable vehicular barriers, grounding rods, grounding conductors, sleeves, conduits, concrete ductbanks, pull boxes and manholes.

B. The utility company shall provide cabling and connections to the Owner’s demarcation point of service.

C. Coordinate communications pathway with Division 27.

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.

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 utility company that shall be provided by the contractor includes, but is not limited to permanent or removable / lockable vehicular barriers, grounding rods, grounding conductors, sleeves, concrete pads, concrete reinforced ductbanks, conduits, racks and metering enclosures, pull boxes and manholes.

E. Utility pole and utility conduits and/or ductbank locations shall be staked and surveyed prior to utility installations 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, conduit and ductbank location and easements do not interfere with existing easements, right-of-ways, 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 provider and Owner within 14 days of Notice to Proceed to ensure all utilities will be available to the site. Any delays resulting from lack of this coordination shall be the responsibility of the Contractor.

END OF SECTION

SECTION 26 05 09 - ELECTRIC UTILITY COORDINATION AND SERVICE ENTRANCE

PART 1 - GENERAL

1.1 WORK INCLUDED

A. General: Electrical service shall be provided by local utility company.

B. Power Company Data: Obtain from utility company information and installation standards for electrical 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, concrete transformer pads, concrete duct bank, utility service and metering equipment enclosures, manholes, and pull boxes as required and as specified.

B. Utility company shall provide primary cables, splices, utility metering instruments, terminations, and primary underground and overhead service conductors.

2.3 TRANSFORMERS AND SWITCHGEAR

A. General: Division 26 shall make provisions for service as required by utility company, including, but not limited to permanent or removable/lockable vehicular barriers, grounding rods, grounding conductors, and sleeves.

B. The utility company shall provide service transformers, primary switchgear, primary protective relaying, and connections to the customer service.

2.4 SECONDARY SERVICE CONDUCTORS

A. General: Division 26 shall provide secondary service entrance conductors, conduit and concrete duct bank.

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.

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, concrete reinforced ductbanks, conduits, metering racks and metering enclosures.

E. Utility 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, right-of-ways, 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 power provider (retail seller), utility (transmission and distribution), 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

SECTION 26 05 10 - 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. Submit a narrative outline of the Quality Control Program or Plan.

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. Persons performing electrical work shall be required to be licensed. There shall be on-site supervision at all times, including punch list work, with that person having a minimum of journeyman license. Helpers, apprentices shall have a minimum of apprentice license.

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 matching 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 manufacturer’s 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. 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

B. Refer to other specification sections for pre-functional checklist for requirements to aid in preparing mock-ups.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIAL

A. Comply with recognized National rating and approval agencies as well as all codes and ordinances at the federal, state and city levels.

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.

B. Coordination Drawings:
1. Electrical room size and location required and to scale
2. Equipment and accessories, switchgear and piping
3. Indicate clearances and service access.

3.2 ELECTRICAL ACCEPTANCE TESTING

A. Perform electrical acceptance testing and inspections in accordance with the current edition of the International Electrical Testing Association (NETA), *Acceptance Testing Specification* (ATS).

B. Perform acceptance testing, inspection, function tests, and calibration to assure that installed electrical systems and components, both Contractor and user-supplied are:
1. Installed in accordance with design documents and manufacturer’s instructions.
2. Tested and inspected in accordance with applicable codes and standards (e.g. NFPA 110 and NFPA 111).
3. Ready to be energized.
4. Operational within industry and manufacturer’s tolerances.

3.3 INSPECTIONS BY LOCAL AUTHORITY HAVING JURISDICTION (AHJ)

A. Contractor shall notify design prime consultant and associated Architect / Owner's Construction Manager when he requests an inspection by the AHJ.

3.4 MOCK-UPS

A. Mock up the light fixture fireproofing for each type of light fixture to be located in fire rated ceilings. Demonstrate that the fire proofing material does not interfere with the mechanical operation of light fixture doors, hinges, or latches.

B. Mock up a typical classroom, science lab of each type, and computer lab with all wiring devices, all lighting controls, covers plates, rough-in boxes, conduits, MC cables, etc. Provide all conductors from all wiring devices to above ceiling space to demonstrate conduit or MC Cable routing and conductor fill.

C. Mock up a typical panelboard backbox with Surge Protective Device (SPD) panelboard extension backbox or SPD device.

D. Mock up ten feet of cable tray including all supports, hardware and bonding.

END OF SECTION

SECTION 26 05 12 - 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.

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 roduct ot 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. Substutions 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 requried 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.

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.

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 arch 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.
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
22. Sports Lighting Equipment, Photometrics, Fixtures, and Poles
27. Surface Raceways
28. Electrical controls and time switches
29. Motor control centers, including renewal components for existing motor control centers
30. Busway
31. Uninterrupted Power Supply systems
32. Power quality improvement filters or capacitors
33. Lightning protection system
34. Fire Rated Cables and Connectors
35. Low Voltage Switchgear
36. Medium Voltage Cable and Connectors

37. Medium Voltage Switchgear

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; manufacture’s and code required clearances.
3. Construction methods, materials and finishes

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
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

SECTION 26 05 16 - EXCAVATING, BACKFILLING AND COMPACTING FOR ELECTRICAL

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 apply to this section.

B. Refer to Instructions for substitution of materials and products.

C. Addenda issued during the bidding period that affect this section of the specifications.

1.2 WORK INCLUDED

A. Coordinating all excavating and backfilling for the electrical underground, and all related appurtenances. Provide concrete duct banks as specified in other related Division 26 specification sections.

B. The extent of raceways, excavation, and backfill shall be in conformance with the locations, raceways, elevations and grades shown on the drawings.

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM) Use current edition.
1. ASTM D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3)
2. ASTM D1556, Standard Test method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
3. ASTM D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
4. ASTM D4254, Standard Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density

B. Local Authority Having Jurisdiction Standards

C. Local Governing Agencies or Utilities

1.4 WARRANTY

A. Provide written warranty against defects in the material and workmanship for the work of this Section for a period of one year from the Date of Substantial Completion of the Project. Refer to Division 1 for Warranty form.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Concrete: Refer to other Division 26 specification section where concrete encasement is required or specified.

B. Cement-Stabilized Sand: Clean, local sand mixed with not less than 1-1/2 sacks of Portland cement per ton; mix in a mill-type mixer.

C. Sand: Clean, local sand

D. Earth Backfill: Clean local material consistent with the surrounding earth material and free of large clods, roots, organic materials, rocks or other debris.

PART 3 – EXECUTION

3.1 EXCAVATION

A. General:
1. All utility trenches shall be constructed in conformance with OSHA trench safety standards.
2. Refer to project Geotechnical Report for additional requirements for excavating and backfilling of utility trenches.
3. Sheeting and shoring shall be accomplished to the extent necessary to maintain the sides of the trench in a vertical position throughout the construction period for trenches five feet in depth or deeper. Where approved, trench sides may be laid back in lieu of shoring to meet OSHA safety standards.
4. Utilities shall not be constructed or laid in a trench in the presence of water. All water shall be sufficiently removed from the trench prior to the raceway placing operation to ensure a dry, firm bed on which to place the raceway.

B. Appurtenances:
1. Any overdepth excavation below appurtenances shall be refilled with cement-stabilized sand.

C. Electrical Trenches:
1. Electrical underground raceways must be the minimum depth required by the local governing authority and Power Company.
2. Trench width for the electrical raceway shall be a minimum of the outside raceway encasement plus 12 inches.
3. Trenches shall be excavated to a depth of at least 6 inches below the conduit raceway. The conduit raceway bedding or concrete encasement shall then be placed in accordance with the specifications, local governing authority, and Power Company standard details.

3.2 BEDDING AND BACKFILL

A. Electrical Trenches:
1. Place backfill, consisting of sand or cement stabilized sand, to a depth of one foot above top of raceway or concrete duct bank and compact to 90% maximum density.
2. Backfill the remainder of the trench in 6 inch lifts with select excavated material and compact as required to achieve density of soil of surrounding area.

B. Utility Locators:
1. Provide metallic locators for utility company raceways as required by respective utility.
2. Refer to other specification sections for additional requirements for underground raceway locators and markers.

END OF SECTION

SECTION 26 05 19 - 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.

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.

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. Conductor ampacity shall be based on 75C. Combination UL Type insulation types are permissible where the required UL Type is part of the combination UL listing.
1. Conductors installed underground: Insulation for underground fire rated conductors shall be wet location, UL Type RHW 75 degrees C, or UL RHW-2 90 degrees C.
2. Conductors installed above ground: Insulation for above ground fire rated conductors shall be UL Type RHH 90C or RHW 75C or UL RHW-2 90C.
3. 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.

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 form 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.
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.

D. Two-hour fire rated cable:
1. 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.
2. Two-hour fire rated power cable shall be installed in rigid steel EMT or rigid steel galvanized conduit (RGC) with steel fittings. Provide fire rated sealant to the end of the raceway to prevent gases from migrating from the fire rated cable into the equipment.
3. Provide two-hour rated cable where conduit or cables enters or passes through the building envelope at areas or rooms that are not two-hour rated equipment rooms for the following:
   a. Fire Pump feeders.
   b. Emergency Feeders (Life Safety) as defined by NFPA Article 700.
   c. Legally required level one standby systems as defined by NFPA 110 and NFPA Article 701. These systems include but are not limited to those used to aid firefighting and rescue operations, smoke removal systems, and elevators designated for ADA and/or fire rescue operations.
4. Alternate two hour rated feeder conductor sizes may be substituted for the required conductor ampacity, voltage drop, or equipment lug terminations based on two-hour fire rated conductor standard size availability or provided equipment manufacturer's cable terminations. Substituted conductor ampacity shall meet or exceed the specified cable ampacity and exceed the required equipment minimum circuit ampacity. Provide substitutions and the required conduit sets and sizes as required for the substitutions at no additional cost to the Owner.

E. Identification: Label each phase conductor in each junction box with corresponding circuit number, using self-adhesive wire markers.

F. 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.

G. 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.

H. 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:

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.

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

CONDUCTOR PER PHASE	A-N	B-N	C-N	A-G	B-G	C-G	A-B	B-C	A-C

END OF SECTION

SECTION 26 05 26 - 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

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.

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.

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.
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 handing 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.

3.6 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.

3.7 COORDINATION

A. General: Coordinate installation of grounding connections for equipment with equipment installation work.

3.8 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.

END OF SECTION

SECTION 26 05 33 - 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, Robroy Plasti-Bond, or Calbond – 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, Robroy Plasti-Bond, or Calbond – 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

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 ¾-inch unless indicated otherwise in Divisions 26, 27 or 28.
   1. Branch Circuits: Minimum conduit size shall be ¾-inch.
   2. Feeder Circuits: Minimum conduit size shall be ¾-inches.
   3. Technology, telecommunications, and low voltage systems: The minimum conduit size shall be ¾-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 ½ 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
   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 H_2O 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.

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 condulet 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 condulet manufacturer: Ipex, Cantex

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

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
4. Integral bottom
5. Box height as required for specified conduit depth and required top elevation.
6. Concrete design strength of minimum 5,500 PSI at 28-days
7. Place enclosures on a minimum of 6 inches of coarse gravel with a border of 6-inches beyond the enclosures exterior dimension.
8. 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.

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 Control Systems
13. 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.

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.
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.

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.

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.
   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 Owner and Architect 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 ¼-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.
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: ½-inch flexible steel conduit or steel MC cable, length not to exceed 6-feet.
   2. Non-accessible ceilings: ½-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.

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.

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.
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.

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

SECTION 26 05 35 - 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.

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 condulet,

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” condulet below the enclosure’s bottom elevation. Provide conduit from the condulet 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.

J. Elevators and Escalators, and Wheelchair Lifts: Refer to Other Divisions. Coordinate power and control provisions shown with the provisions required for the furnished equipment. 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. Provide lockable disconnect switches for main power, control power, lighting power, etc. as required by the NEC and all local codes. Provide all necessary means of two-way communication for emergency phones.

END OF SECTION

SECTION 26 05 37 - 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

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.

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.

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.

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.

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

SECTION 26 05 38 - ELECTRICAL FLOOR BOXES AND FITTINGS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide electrical floor box and fitting work as required, scheduled, indicated, and specified.

B. All floor boxes and all poke-throughs for line voltage wiring devices or telecommunication outlets shall be the concealed service type.

1.2 QUALITY ASSURANCE

A. UL Label: Electrical boxes, covers, and fittings shall be UL listed.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS – Provide products that are Buy American Act Compliance

A. Wiremold

B. Hubbell

2.2 CONCEALED SERVICE - FLOOR BOXES

A. Wiremold Evolution RFBA 4/6/10 Series

B. Floor box shall be electro-galvanized sheet steel with fusion-bonded epoxy suitable for direct contact with concrete on grade.

C. Cover assembly shall die-cast aluminum, finish as selected by Architect.

D. Shall deliver electric power and telecommunications from non-proprietary building standard wiring devices and non-proprietary building standard telecommunications ports installed below the surface of the floor.

E. Shall deliver telecommunications without interference from the electric power delivery.

F. Hinged cover shall accept carpet or tile to match floor covering and be 180 degrees reversible.

G. Shall accept conduit sizes up to 2-inches.

H. When hinged cover is closed and no services in place, device shall have no obstructions above surface of floor.

2.3 CONCEALED SERVICE, FIRE RATED, POKE-THROUGH DEVICE

A. Wiremold Evolution Series - 6AT (3-gang) / 8AT (5-gang) /10AT (8-gang)

B. Shall be UL classified two-hour fire rating. Where floor fire rating is three-hour, provide only the 6AT series with a 3-hour fire rating.

C. Shall be UL listed for use with power and low voltage in a single service fitting and shall protect against ingress of water or foreign materials.

D. Shall deliver electric power and telecommunications from non-proprietary building standard wiring devices and non-proprietary building standard telecommunications ports installed below the surface of the floor.

D. Center data channel for six-inch 6AT poke throughs shall accept a minimum of (22) Category 6a cables, center data channel shall accept a minimum of (5) Category 6a cables.

E. Shall be installed in a single core drilled hole.

F. Shall permit use with “H” cut opening in carpet so carpet can be restored if position is vacated

G. Shall have interchangeable service fitting accessories including hinged guard and low voltage communication inserts

H. Service fitting cover shall be aluminum, finish as selected by Architect.

2.4 RECESSED FURNITURE FEED POKE-THROUGH DEVICES

A. Wiremold Evolution 6ATCFF Series.

B. Shall be UL classified for use in up to two-hour fire rated floors.

C. Shall be UL listed for use with power and low voltage in a single service fitting and shall protect against ingress of water or foreign materials.

D. Shall be installed in a single core drilled hole

E. Die-cast aluminum covers, finish as selected by Architect.

2.5 SERVICE FITTING HEADS

A. Shall be brushed aluminum or stainless steel.

B. Shall deliver electrical power from receptacles as designated on the plans.

C. Shall deliver telephone/data through precut bushed opening

D. Provide non-proprietary building standard line voltage wiring devices

E. Shall be furnished standard with conduit nipple for direct screw threading into cover assembly

PART 3 - EXECUTION

3.1 GENERAL

A. Locate position for floor boxes and runs of conduit as shown on the plans, or as required. Coordinate with the Structural Engineer and Architect for dimensional locations of floor boxes prior to cutting or pouring slab.

B. Select appropriate size of floor boxes, poke-through, or multiple services floor boxes for quantity of wiring devices or cables indicated and as recommended by manufacturer.

3.2 INSTALLATION

A. Position floor boxes and install conduits at locations approved by the Architect.

B. After concrete pour, pull wires and install devices according to manufacturer's recommendations.

C. Activate in accordance with the National Electrical Code.

D. Coordinate with floor covering contractor to complete installation.

E. Core drill openings for poke-through service fitting and installation in accordance with manufacturer's instructions and where approved by the Structural Engineer and Architect.
   1. Minimum spacing of 2-feet on center and not more than one unit per each 65-square feet of floor area in each span as required by Fire Resistance Directory.

END OF SECTION

SECTION 26 05 40 - 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.

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

SECTION 26 05 50 - 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

SECTION 26 08 00 - ELECTRICAL COMMISSIONING COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section outlines commissioning requirements and activities of the Contractor, Owner, CxA and Design Professionals as related to the Division 26 Electrical.

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
5. Division 27 – Communications
6. Division 28 – Safety and Security

1.2 DEFINITIONS

A. Refer to Specification Section 01 91 13, General Commissioning for definitions.

1.3 CONTRACT INFORMATION

A. The Owner will contract directly for commissioning services.
1. Commissioning Agent fee will be paid for directly by the Owner.
2. Contractor shall provide coordination with the CxA including but not limited to labor, materials, and testing equipment as required for the CxA as 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 and other items required for Functional Performance Testing includes but not limited to those listed below. Data logging and software required for testing and corrective measures as required by the contract documents 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. 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 and the CxA.

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 26 specifications, including specific contractor provided or furnished items indicated by this Section, shall be provided by the Contractor.

3.2 SUBMITTALS

A. Electrical:
1. Lighting controls and lighting equipment submittals conforming to the contract documents.

3.3 EQUIPMENT START-UP

A. Notification:
1. Contractor shall provide ten Owner business day notice to CxA, Owner and Design Team of start-up dates. Owner business days are defined as the Owner's Construction and Maintenance Operations department's normally scheduled work days, typically Monday through Friday, excluding Federal, State, Local, and Owner scheduled Holidays.

B. Prior to start-up, Contractor shall:
1. Verify that equipment and systems are complete, accessible, correctly connected and ready for operation. Perform all pre-start inspections and tests as called for in Division 26 and as recommended by the equipment manufacturer.
2. Pre-start requirements of the manufacturer shall include but not limited to the Contractor's completed applicable documentation and completed inspection and check-list.
3. Complete applicable sections of Pre-functional Checklists (PFCs).
4. Coordinate start-up attendance by manufacturer or their authorized representative as required by the specifications and the manufacturer.

C. At start-up, Contractor shall:
1. Supervise the activities of the manufacturer's authorized start-up technician and/or authorized manufacturer's representative.
2. Verify proper voltage, overcurrent protection, phase, phase sequence, and any other conditions that may cause damage if not correct.
3. Execute start-up under supervision of contractor personnel familiar with the installation and operation of equipment being commissioned and the equipment manufacturer's personnel 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 and noted during start-up to CxA, Owner and Design Team. Outline recommendations for corrective action to comply with the Contract Documents and equipment manufacture's installation and operation requirements.

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. If approved by the Cx as an alternate, contractor may submit alternate versions of the PFC's to the CxA for review and comment.

B. Contractor shall complete PFC for each of the following equipment:
1. Electrical.
a. Lighting and lighting controls.

3.5 FUNCTIONAL TESTING

A. General:

1. Contractor shall organize and schedule Contractor Team members to execute the functional testing , which will be directed by CxA.
   a. Lighting and lighting controls.

END OF SECTION

SECTION 26 09 25 - 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.

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

SECTION 26 09 43 - LIGHTING CONTROLS

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Lighting control system and components:
   1. Touch panel controls
   2. Lighting management panels
   3. Lighting management modules
   4. Low voltage wall stations
   5. Power interfaces
   6. Wired sensors
   7. Stand-alone room based architecture. Provide hardware capable of system network architecture without network connectivity or network interface hardware.

1.2 SUMMARY

A. The lighting control system specified in this section shall provide control devices networked together for individual rooms or local areas only. Building wide networking hubs and equipment are not required and shall not be provided unless these base components and equipment are essential for proper operation of the specified controls for individual rooms or local areas. The standalone networked controls at each room or local area shall be capable of being networked together to build a complete building wide networked system in future, if needed.

B. The system shall be capable of turning lighting loads on/off as well as dimming lights (if lighting load is capable of being dimmed). Dimmers shall be capable of “dimming lights to off”, when used in theatrical, large group instruction, or other designated areas where dim to off is indicated or required.

C. All system devices within a group or controlled area shall be networked together, enabling digital communication between devices.

D. The system architecture shall be capable of enabling stand-alone groups (areas) of devices. If the system is networked together the groups or areas shall continue to function in a default capacity, even if network connectivity to the greater system is lost.

E. The system architecture shall facilitate remote operation via a computer connection when the system is networked together.

F. The system shall not require any centrally hardwired switching equipment.

G. The system shall be complete wired solution (no wireless solutions or battery-operated devices) but still shall be capable of wireless, wired, or hybrid wireless/wired architectures.

H. 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)

E. Example Contractor Startup/Commissioning Worksheet – must be completed prior to factory start-up and commissioning.

F. Hardware and Software 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 steps in sensor manufacturing process shall occur in North America; including population of all electronic components on circuit boards, soldering, programming, wiring, and housing.

B. All components and the manufacturing facility where product was manufactured must be RoHS compliant.

C. In high humidity or cold environments, the sensors shall be conformably coated and rated for condensing humidity and -40 degree Fahrenheit (and Celsius) operation.

D. All applicable products must be UL / CUL 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.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
1. Acuity Brands Lighting, Inc.
2. Legrand North America, LLC
3. Lutron
4. Crestron
5. Cooper Lighting Solutions
6. Leviton

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 3) network capable backbone for remote or time based system operation.

B. 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.

C. System may interface directly with intelligent LED luminaires such that only CAT-5 cabling is required to interconnect luminaires with control components such as sensors and switches, refer to Networked LED Luminaire section below.

D. Lighting control zones shall consist of one or more intelligent lighting control components, be capable of stand-alone operation, and be capable of being connected to a higher level network backbone.

E. Devices within a lighting control zone shall be connected with low voltage cabling in any order.

F. Lighting control zone shall be capable of automatically configuring itself for default operation without any start-up labor required.

G. When Network architecture is implemented, individual lighting zones must continue to provide a user defined default level of lighting control in the event of a system communication failure with the backbone network or the management software becoming unavailable.

H. Power for devices within a lighting control zone shall come from either resident devices already present for that zone, controls enabled luminaires, or from the network backbone. Standalone “bus power supplies” are not acceptable.

I. 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. Specific applications may require remote switching and shall be capable of being networked into the system.

J. Networked systems shall have one or more primary network control “gateway” devices that are capable of accessing and controlling connected system devices and linking into an Ethernet LAN.

K. Networked Systems may use a network bridge device to route communication and distribute power to directly connect lighting zones together for purposes of decreasing system wiring requirements.

L. Network system communications shall be hard wired. When systems devices are capable of WiFi, they shall be capable of wirelessly connecting a lighting zone to a WiFi (802.11n) wireless data network for purposes of eliminating the network bridge devices and all cabling that connects zones to bridge devices. Use of WiFi shall only be enabled with written permission and documentation from the Owner.

M. Networked systems shall have a web-based software management program that enables remote system control, status monitoring, and creation of lighting control schedules and profiles.

N. Individual lighting zones shall be capable of being segmented into several local channels of occupancy, photocell, and switch functionality for more advanced configurations and sequences of operation.

O. Devices located in different lighting zones shall be able to communicate occupancy, photocell (non-dimming), and switch information via either the wired or WiFi backbone.

P. Networked systems shall be capable of operating a lighting control zone according to several sequences of operation. System shall be able to change a space’s sequence of operation according to a time schedule so as to enable customized time-of-day, day-of-week, utilization of a space.

Q. Operating modes shall be utilized only in manners consistent with local energy codes.
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.
    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)
    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. 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 (network capable):
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 one integrated dry contact switching relays, 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. All sensors shall have the ability to detect when it is not receiving valid communication and blink its LED in a pattern to visually indicate of a potential wiring issue
7. Every sensor parameter shall be available and configurable remotely from the software (when networked) and locally via the device push-button.
8. System shall have sensors that can be embedded into luminaire such that only the lens shows on luminaire face.
9. Embedded sensors shall be capable of both PIR and Dual Technology occupancy detection. Embedded sensors shall have an optional photocell
10. Ceiling, fixture, recessed, & corner mounted sensors shall be available.
11. Sensors shall have optional features for photocell/daylight override, dimming control, and low temperature/high humidity operation.
12. Sensors shall be the following nLight model numbers, with device options as specified:

C. 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, lamp depreciation, or lamp outages).
4. Combination units that have all features of on/off photocell and dimming sensors shall also be available.
5. A dual zone option shall be available for On/Off Photocell, Automatic Dimming Control Photocell, or Combination units. The second zone shall be capable of being controlled as an “offset” from the primary zone.
6. Luminaire mounted dimming photocells shall be embedded into luminaire such that only the lens shows on luminaire face.

D. 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 remotely from the software (if networked) and locally via the device push-button.
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 lighting loads or 120/277 VAC line voltage dimmable fluorescent ballasts (2-wire and 3-wire versions).
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.

E. Relay & Dimming Panels:
1. Panel shall incorporate up to 4 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.
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 be capable of operating as either two networked devices or as one.
6. Panel shall supply current limited low voltage power to other networked devices connected via CAT-5.
7. Panel shall provide auxiliary low voltage device power connected wired directly to a dedicated terminal connection.

F. Networked Auxiliary Input / Output (I/O) Devices:
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 dimmable ballasts or LED drivers by sinking up to 20 mA of current.
4. Specific I/O devices shall have an input that reads a 0-10 VDC signal from an external device.
5. 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.
6. Specific I/O devices shall sense state of low voltage outdoor photocells.
7. Specific I/O devices shall enable RS-232 communication between lighting control system and Touch Screen based A/V control systems.
8. 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).

G. Low Voltage Wall Switches & Dimmers:
1. All 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
5. Devices with a single “on” button shall be capable of selecting all possible lighting combinations for a bi-level lighting zone such that the user confusion as to which of two buttons (as is present in multi-button scenarios) controls which load is eliminated.

H. 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.

I. 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. When networked, the device shall be capable of selecting a lighting profile be run by the system’s upstream Gateway so as to implement selected lighting profile across multiple zones (and not just its local zone).
6. Device shall have LEDs indicating current selection.

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 system software is installed.

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.

C. Label each controller with 120/277 Volt circuit (i.e. “HD-27) and room graphic name and number. Do not use architectural room name or number on drawings, use room graphic identification only.

C. Provide ceiling mounted sensors. Wall mounted sensors shall only be used where ceiling mounted sensors are proven by the manufacturer to be impractical.

D. For ceilings up to 12-feet AFF, control equipment shall be mounted Above ceiling control equipment shall be wall mounted above an accessible ceiling on 24x24-inch fire resistive 0.75-inch thick plywood back board mounted to the wall above the ceiling, 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.

E. 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.

3.2 INSTALLATION

A. When using wire for connections other than Cat 5e with RJ-45 connectors, provide detailed point to point wiring diagrams for every termination. Provide wire specifications and wire colors to simplify contactor termination requirements. 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.

B. Install the work of this Section in accordance with manufacturer’s printed instructions unless otherwise indicated.

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, floor, or ceiling in where they are installed.

J. Install wall occupancy sensor switches in boxes on the strike side of doors as hung. Install a uniform position so the same direction will open and close the circuit throughout the project. 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. Fasten all plates outdoors with type 302 Allen Head "tamper-proof" screws.

L. 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.

M. Unless indicated otherwise, circuit relays/switchpacks ahead of local control switches. Source –> relay/switchpack –> local toggle switch(s).

N. Coordinate with BMCS/BAS Contractor for interface of BMCS/BAS System and wiring connections.

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.

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:
1. Time delay = maximum
2. Zero Time Delay = Off
3. Auto-On = On (Occupancy) Auto = OFF (Vacancy)
4. Manual-On = Off
5. Self-Adjust = Off
6. Disable Self-Adjust = On
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.

3.4 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 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.

END OF SECTION

SECTION 26 12 17 - ULTRA HIGH EFFICIENCY K-RATED TRANSFORMERS (EXCEEDS DOE 2016 EFFICIENCY)

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Copper-wound three-phase transformer exceeding US Department of Energy 2016 Efficiency Standards, with extremely low no load losses.
   1. Transformers shall be designed to an efficiency standard higher than NEMA Premium.

B. Load Mix: Transformer shall be UL 1561 Listed to feed a mix of equipment load profiles such as computers without derating or significant degradation of efficiency.

1.2 REFERENCES

A. FEDERAL REGISTER – US Department of Energy, Office of Energy Efficiency and Renewable Energy. 10 CFR Part 431. Energy Conservation Program for Commercial and Industrial Equipment: Energy Conservation Standards for Distribution Transformers; 2016 Standards

B. DOE Test Method For Measuring The Energy Consumption Of Distribution Transformers Under Appendix A To Subpart K Of 10 CFR Part 431.

C. Metering Standards:
   1. Computational algorithms per IEEE Std 1459-2000
   2. UL 916, UL 61010C-1 CAT III

D. IEEE-1100 – Recommended Practice for Powering and Grounding Sensitive Electronic Equipment
   1. IEEE Standard 1100 documents how typical transformers feeding electronic equipment produce substantially higher losses under electronic equipment load compared to under linear load, requiring derating.

E. LEED – Leadership in Energy and Environmental Design, U.S. Green Building Council.

F. ISO 9000:2000 – International Standards Organization - Quality Management System

G. ISO 14000:2004 – International Standards Organization - Environmental Management System

H. NFPA 70 - National Electrical Code (Latest Edition)

I. NEMA ST20-2014 - Dry-Type Transformers for General Applications

J. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment

K. US Department of Energy, 10 CFR Part 431, 2015. Energy Conservation Program: Energy Conservation Standards for Distribution Transformers; Final Rule.

L. IEEE C57.110-2008 – IEEE Recommended Practice for establishing transformer capability when feeding non-sinusoidal load currents.

M. ISO 17025 – International Standards Organization - General requirements for the competence of testing and calibration laboratories.

N. UL 1561 - Dry-Type General Purpose and Power Transformers.

1.3 SUBMITTALS

A. Submit product data including the following:
1. Copy of ISO 14001:2004 Certification of manufacturing operation.
2. Copy of ISO 9001:2000 Certification of manufacturing operation.
3. Construction Details including enclosure dimensions, kVA rating, primary & secondary nominal voltages, voltage taps, BIL, unit weight
4. Basic Performance characteristics including insulation class, temperature rise, core and coil materials, impedances & audible noise level, unit weight
5. Inrush Current (typical 3 cycle recovery)
6. Short Circuit Current data: Primary (Sym. O/P S/C) & Secondary (L-N/G S/C)
7. Efficiency Data
   a. No load and full load losses per NEMA ST20
   b. Linear load Efficiency data @ 1/6 load
   c. Linear load efficiency data @ 1/4, 1/2, 3/4 & full load
   d. Linear Load Efficiency @ 35% loading tested per NEMA TP-2.
   e. Efficiency under specified K rating load profile at 15%, 25%, 50%, 75%, 100% of nameplate rating.
8. Copy of Factory ISO 9001 documentation describing nonlinear load test program
   a. Meter and CT details including model, accuracy, serial numbers and calibration information.
9. Copy of Linear & Nonlinear load test report for a representative 75kVA transformer
10. 25 year Product Warranty Certificate

B. Description of manufacturer’s factory nonlinear load test program.
1. In light of the significant degradation of transformer performance when feeding nonlinear load compared to linear load, it is mandatory that the manufacturer test the transformers under nonlinear load representative of real world load mix. Transformers that have not been subject to testing under nonlinear load will not be considered for this project due to the uncertainty related to their real world performance.
2. Given the lack of a standard for testing transformers under nonlinear load, the manufacturer must have a nonlinear Load Test Program operating in the production environment that is audited and documented per quality standard ISO 9001.
3. The nonlinear load bank shall consist of a phase-neutral loading with a specified K rating load profile, representative of a mix of typical commercial equipment.
4. Meters and CTs shall both be revenue class accurate. CTs shall be operated within their approved accuracy loading range. Dual meters shall gather simultaneous primary and secondary energy and harmonic data. Meter and CT details including model, accuracy, serial numbers and calibration information.
5. Efficiency: Measurements shall be taken at multiple load levels and plotted to show compliance with specification and correlation to the designed efficiency

curve.

6. Efficiency shall be determined purely by measurements using method and instrumentation per NEMA TP-2 Standard. Other methods are not acceptable.
7. Harmonic data including current and Voltage THD at the different load levels shall be included with the test report.

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.

1.5 DELIVERY, STORAGE AND HANDLING

A. Store and protect products

B. Store in a warm, dry location with uniform temperature. Cover ventilation openings to keep out dust, water and other foreign material.

C. Handle transformers using lifting eyes and/or brackets provided for that purpose. Protect against unfavorable external environment such as rain and snow, during handling.

1.6 WARRANTY

A. Transformer shall carry a 25-year pro-rated warranty, which shall be standard for the product line.

1.7 INTERNATIONAL STANDARDS ORGANIZATION REGISTRATION OF MANUFACTURING PLANT

A. Registration to current ISO standard is required.

B. Independent annual audits are conducted.

C. Product shall be manufactured in registered facility

D. ISO 9001:2000 Registered – Quality Management System

E. ISO 14001:2004 Registered – Environmental Management System
1. Transformer manufacturing can produce significant emissions of volatile compounds and significant other waste. To minimize environmental impact, the transformer must the product of a manufacturing process that has been independently audited to comply with the ISO 14001:2004 Environmental Management System Standard, where strict quality control of raw material sourcing and construction techniques maximize product efficiency and minimize emissions and waste byproducts.
2. ISO 14001:2004 ensures that a facility has had an independent environmental impact assessment of raw material sourcing and all manufacturing processes, and has implemented an independent annually audited program that minimizes

environmental impact during manufacturing process and includes a strictly monitored continuous improvement program.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS/PRODUCT

A. Powersmiths E-Saver OPAL

B. Power Quality International (Z3 e-Rated)

C. Mirus - ULLTRA

2.2 TRANSFORMER SPECIFICATION

A. Minimum UL Listed and Labeled K-Rating: K7

B. Copper-wound, 3-phase, common core, ventilated, dry-type, isolation transformer built to NEMA ST20 and relevant NEMA, UL and IEEE standards; 200% rated neutral; 60Hz rated; Transformers 750 kVA and less, 600 volt primary and less, shall be UL Listed and bear the label. All terminals, including those for changing taps, must be readily accessible by removing a front cover plate. Windings shall be continuous with terminations brazed or welded. 10kV BIL.

C. Insulation System:
1. Shall be NOMEX-based with an Epoxy Co-polymer impregnate for lowest environmental impact, long term reliability and long life expectancy
   a. Class: 220 degrees C
   b. Impregnate Properties for low emissions during manufacturing, highest reliability and life expectancy
   c. Epoxy co-polymer
   d. VOC: less than 1.65 lbs./gal (low emissions during manufacturing)
   e. Water absorption (24hrs @25C): less than 0.05% (superior insulation, longer life)
   f. Chemical Resistance: Must have documented excellent performance rating by supplier
   g. Dielectric Strength: minimum of 3200 volts/mil dry (for superior stress, overvoltage tolerance)
   h. Dissipation Factor: max. 0.02 @25C to reduce aging of insulation, extending useful life

D. Operating Temperature Rise: Maximum 115 degree C in a 40 degree C maximum ambient

E. Noise levels:
1. 3dB Below NEMA ST-20
2. Production Test every unit. Data to be available upon request.

F. Exceed minimum efficiency requirements of US Department of Energy, 10 CFR Part 431, April 18, 2013, Energy Conservation Program: Energy Conservation Standards for Distribution Transformers: Final Rule which takes effect January 1, 2016, and comply with the table of maximum no Load Loses, efficiency requirements at 1/6 load, efficiency

at 35% load per 10 CFR Part 431, and efficiency at 25% load under the transformer specified K-rating load profile.

G. Maximum losses and minimum efficiency under linear load conditions per Table 1.

Table 1
Max and Min Values for Losses and Efficiency for "High Efficiency" Transformers
Under K1 Linear and Specified K-Rating Nonlinear Loading

kVA Rating	No Load	16.5% Load				25% Load				35% Load			
		K1 Linear		Nonlinear		Linear		Nonlinear		K1 Linear		Nonlinear	
	Max Loss (kW)	Max Loss (kW)	Min Eff. (%)	Max Loss (kW)	Min Eff. (%)	Max Loss (kW)	Min Eff. (%)	Max Loss (kW)	Min Eff. (%)	Max Loss (kW)	Min Eff. (%)	Max Loss (kW)	Min Eff. (%)
15	0.054	0.066	97.38	0.067	97.36	0.082	97.86	0.085	97.78	0.109	97.97	0.117	97.82
30	0.091	0.112	97.79	0.113	97.77	0.138	98.19	0.144	98.12	0.183	98.29	0.200	98.13
45	0.124	0.152	98.00	0.154	97.97	0.187	98.36	0.197	98.28	0.248	98.45	0.276	98.28
75	0.181	0.221	98.24	0.225	98.22	0.273	98.56	0.288	98.49	0.362	98.64	0.404	98.48
112.5	0.245	0.300	98.41	0.305	98.38	0.370	98.70	0.393	98.62	0.490	98.77	0.555	98.61
150	0.303	0.370	98.53	0.377	98.50	0.457	98.80	0.486	98.72	0.605	98.86	0.688	98.71
225	0.410	0.501	98.67	0.510	98.64	0.619	98.91	0.659	98.84	0.820	98.97	0.937	98.82
300	0.509	0.622	98.76	0.636	98.73	0.769	98.99	0.829	98.91	1.018	99.04	1.194	98.88
500	0.741	0.906	98.91	0.928	98.89	1.119	99.11	1.213	99.04	1.482	99.16	1.754	99.01

H. Voltage Taps: For transformers 30kVA-300kVA, provide two 2-1/2% full capacity taps above and below nominal primary voltage. For transformers 15kVA and smaller as well as 500kVA and larger provide one 5% full capacity tap above and below nominal primary voltage.

I. Impedance: Between 3.0% and 6.0% unless otherwise noted.

J. Enclosure type: Ventilated NEMA 2; NEMA 3RX aluminum or stainless steel when located outdoors, or as indicated otherwise

K. Finish Color: Provide light gray ANSI-61 paint finish for transformers located outdoors. Provide manufacturer's standard paint finish color indoors.

L. Transformer Options:
1. Electrostatic Shield: Each winding is independently single shielded with a full-width copper electrostatic shield

M. Closed delta 120/240-Volt secondary, 3-phase, 4-wire with center tap neutral winding transformers:

1. KVA rating indicated shall be for balanced 3-phase loading. Center tap winding shall allow for a maximum nominal 70-percent of three-phase kVA rating for unbalanced single phase neutral connected 120/240-Volt loads. The center tap winding shall be individually rated or constructed at twice the capacity of each of the other delta connected windings. (Example: a 225kVA rated center tap transformer would consist of two 75-kVA windings and one 150-kVA center tap winding).

PART 3 - EXECUTION

3.1 INSTALLATION

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. Transformer enclosures shall make no contact with wall surfaces.

C. 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.

E. Check for damage and loose connections.

F. Set the transformer plumb and level.

G. Provide Seismic restraints where required.

H. Coordinate all work in this Section with that in other sections.

I. Verify all dimensions in the field.

J. Adjust transformer secondary voltages to provide the required voltage at the loads.

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. Performance Validation: To ensure that the products shipped to the job site meet this specification, provide on-site revenue class accurate efficiency and harmonic measurements of transformers once installed and operating at customer's site. Data shall be collected from primary and secondary sides of the transformer simultaneously on a synchronized cycle by cycle basis. The use of two discrete meters that are not synchronized is not acceptable. Sampling shall be of 10% of transformers on the project once installed and operating, as selected by customer. Submit a detailed report to the project engineer.

F. Identify non-compliant products to the engineer and replace at no cost to the Owner.

G. Notification: Notify Engineer in writing of any deviation from manufacturer's pre-shipment test data.

END OF SECTION

SECTION 26 19 13 - COMBINATION MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Motor controller work as required, scheduled and specified.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Schneider Electric - Square D

B. ABB-General Electric Co.

C. Siemens

D. Eaton

2.2 MOTOR CONTROLLERS

A. General: Combination motor controllers shall consist of an integrally mounted, thermal magnetic or magnetic only circuit breaker disconnect or fused disconnect switch as specified in Section 26 24 25. Magnetic, full voltage non-reversing (FVNR) or two speed controller as required, in a heavy duty type, dead front enclosure, surface-mounted; size and number of poles as required. Controllers shall be constructed and tested in accordance with NEMA Standards. Refer to Division 23 for Variable Frequency Inverter furnished by Division 23, installed by Division 26. Minimum controller size shall be NEMA Size 1.

B. Contacts: Magnetic controller contacts shall be silver alloy, and not require any filing, dressing, or cleaning for the life of the controller.

C. Operating Coils: Operating coils shall be 120V, pressure molded and designed so that accidental exposure to excessive voltage up to 480V will not damage the coil. Design controller so that when a coil fails due to over voltage, the controller shall open, and not freeze in the closed position.

D. Overload Relays: Controllers shall have manual-reset, trip-free, solid state, overload relays in each phase conductor. Three phase FVNR controllers shall have three overload relays. Single-phase FVNR controllers shall have an overload relay in each ungrounded conductor. Two speed, full-voltage magnetic controllers shall have overload relays for all six ungrounded conductors. Overload relays shall not be field-convertible from manual to automatic reset. Provide reset button located in front cover to reset all overload relays.

E. LED Pilot Lights: Provide 30.5mm run and stop pilot lights for all motor controllers. Furnish additional pilot lights for motor controllers as shown. Provide FAST and SLOW pilot lights for two-speed controllers. Pilot lights shall be mounted in the controller enclosure cover. Pilot lights shall be operated from an interlock on the motor controllers, and not be wired across the operating coil.
   Green - Stop
   Red - Run
   Yellow - Slow
   Blue - Fast

F. Controls: Controllers shall have 30.5mm HAND-OFF-AUTOMATIC switches. Provide for

FAST-SLOW, REMOTE-LOCAL speed selection from HVAC control system for two-speed controllers. Two-speed controllers shall have deceleration relays between fast and slow speeds. Coordinate motor controller controls with the requirements of Division 23. Motor controller controls shall be mounted in the controller enclosure cover. Control switches shall be un-keyed rotary switches.

G. Control Power: A single phase control power transformer shall be included with each controller for 120V control power. The primary shall be connected to the line side of the motor controller through two fuses; the secondary shall have one leg fused and one leg grounded. Arrange transformer terminals so that wiring to terminals is not located above the transformer.

H. Auxiliary Contacts: Each controller shall have two normally open and two normally closed nonconvertible auxiliary contact in addition to the number of contacts required for the holding interlock and control wiring. One or more additional auxiliary contacts can be field installed without removing existing wiring, or removing the controller from its enclosure.

I. Phase Failure Monitors: Provide a 3-phase failure monitor for each motor controller. Monitor on any or all phases, for phase reversal from A-B-C sequence, under/over voltage, and phase failure. Provide adjustable relay for trip range. Provide automatic reset upon restoration of power to all phases. Where solid state overload relays provide this specified requirement, separate phase failure relays may be omitted.

J. Unit Wiring: Unit shall be completely pre-wired to terminals to eliminate any interior field wiring except for: connection of power supply conductors to switch line side terminals; motor leads to the controller load side terminals; and control conductors to holding coil terminals.

K. Enclosure:
1. Motor Controllers installed in indoor locations shall be NEMA 1 heavy duty enclosures unless shown otherwise.
2. Motor Controllers installed at kitchen and food preparation locations, hose down areas, cooling towers, exterior locations, and in other corrosive areas shall be NEMA 4X, Type 316 stainless steel.

L. Minimum interrupting rating shall be 35KAIC.

2.3 MANUAL MOTOR CONTROLLERS

A. General: Manual motor controllers shall consist of an integral controller and overload protection in a common enclosure, surface mounted. Size and number of poles shall be as shown and required with pilot light.

B. Manual Motor Controller: Manual motor controller with overload protection, 1 HP maximum, 115 or 230V.

C. Enclosures:
1. Manual motor controllers installed in indoor locations shall be NEMA 1 heavy duty enclosures unless shown otherwise.
2. Manual motor controllers installed at kitchen and food preparation locations, hose down areas, cooling towers, exterior locations, and in other corrosive areas shall be NEMA 4X, Type 316 stainless steel.

D. Disconnect Switch: For self-protected motors where one pole toggle motor control switch is allowed, the switch shall be horsepower rated and as specified for toggle switches in Section 26 27 73.

PART 3 - EXECUTION

3.1 INSTALLATION OF MOTOR CONTROLLERS

A. General: Install combination motor controllers where required or indicated and in accordance with the manufacturer's written instructions, requirements of the NEC and NECA Standard of Installation, and industry practices. Do not install motor controllers above ceilings. Do not install motor controllers on roofs.

B. Overloads: Install overload relays with manual reset in each phase of motor controller. Overload adjustable settings shall be based on actual motor nameplate full load amps. Field verify nameplate full load amps and adjust all relay settings accordingly.
1. Set overcurrent at motor service factor x motor nameplate FLA
2. Set high voltage trip to 8.3 percent above nominal voltage
3. Set undercurrent trip to four automatic restarts
4. Set all other trips to zero auto restarts
5. Phase Failure Relay: Adjust phase failure relay to 10 percent over voltage and 10 percent under voltage.

C. Coordination: Motor controllers shall be provided to coordinate with motors furnished by Division 23. Motor controller controls shall be provided to coordinate with controls specified in Division 23.

D. Supports: Provide individual and combination motor controllers with galvanized angle or other suitable supports if mounting on wall or other rigid surface is impractical. Controllers shall not be supported by conduit alone. Where motor controllers are mounted on equipment served, the switch shall not inhibit removal of any service panels or interfere with any required access areas. Manual motor controllers shall be installed plumb and aligned in the plane of the wall where they are installed.

E. Identify each motor controller as specified in Section 26 05 00.

F. Where motor controllers are indicated to be installed as part of a Motor Control Center, refer to the Motor Control Center specification.

3.2 TESTING

A. Provide the field services of the manufacturer to provide initial programming of all variable functions, start-up and commissioning of each motor controller.

B. Pre-Energization Check: Check motor controllers for continuous circuits and short circuits.

C. Post Hook-Up Test: After wire and cable hook-ups, energize motor controller to show it functions as specified.

D. Provide thermal infrared scan of the combination motor controllers 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

SECTION 26 24 13 - SWITCHBOARDS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Work Included: Switchboard work as shown, scheduled, indicated, required, and specified.

1.2 QUALITY ASSURANCE

A. UL Labels: Provide switchboards UL labeled for service entrance and meeting requirements of UL 891.

B. NEMA Compliance: Comply with National Electrical Manufacturers Association (NEMA) Standard PB2, "Dead-Front Distribution Switchboards."

1.3 SUBMITTALS

A. Indicate:
1. Detailed dimensions for equipment foot print, front and side elevations.
2. Conduit entrance locations and requirements and restrictions.
3. Enclosure material, finish, and NEMA classification type.
4. Nameplate legends.
5. Size and number of bus bars
6. Switchboard instrument details.
7. Electrical characteristics including voltage, ampacity, overcurrent device frame size and trip ratings, withstand ratings, and time current curves of all overcurrent devices and components.

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. Except as otherwise indicated, provide switchboard manufacturer's materials and components as indicated and as required for a complete installation.

2.3 DEAD-FRONT DISTRIBUTION SWITCHBOARDS

A. 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.

B. Provide a factory-assembled, dead-front construction, metal enclosed, self supporting, switchboard of voltage, phase, ampacity, and short circuit interrupting rating and bracing shown.
   1. Switchboard shall consist of the required number of front and rear aligned vertical sections bolted together to form one metal enclosed rigid switchboard. The switchboard shall be designed as a free-standing with only front access. Rear and/or side access only where indicated to reduce switchboard depth and where NEC required rear access clearance is available.
   2. Switchboard shall include protective devices and equipment shown with interconnections, instrumentation, and control wiring. Small wiring, necessary fuse blocks, and terminal blocks in the switchboard shall be provided. Groups of control wires leaving the switchboard shall be furnished with terminal blocks with numbering strips.
   3. Factory installed permanent lock-off provision for pad-locking in the off position for all protective devices.

C. Enclosure Construction: The switchboard framework shall be fabricated for floor mounting. The framework shall be formed code gauge steel, welded and bolted together to support cover plates, busing, and component devices.
   1. Each section shall have an open bottom and individually removable top plates for installation and termination of conduit. Top and bottom conduit areas shall be shown and dimensioned on the shop drawings. Front plates used for mounting meters, selector switches, or other front-mounted devices shall be hinged, with wiring installed and laced, and with flexibility at the hinged side. Closure plates shall be screw removable and small enough for easy handling by one technician.
   2. Weatherproof enclosure front door(s) shall be pad-lockable and suitable for the intended environmental conditions. When indicated or specified, rear doors shall also be pad-lockable.

D. Busing: The switchboard busing shall be copper.
   1. The bus bars shall be braced to comply with the integrated equipment rating of the switchboard. The main horizontal bus bars between sections shall be located on the back of the switchboard to permit maximum available conduit entry area. The horizontal main bus bar supports, connections, and joints shall be bolted or welded, as required, so as not to require periodic maintenance. Bolted joint connections shall have at least two bolts per joint per phase. Half lapped bus joint construction is not acceptable.
   2. Buses shall be arranged A-B-C, left-to-right, top-to-bottom, and front-to-rear throughout. A ground bus shall be secured to each vertical section structure and extend the entire length of the switchboard.
   3. The main horizontal bus and incoming line shall be isolated and insulated from outgoing busing and cable connections.
   4. Each group mounted section shall have maximum full height bus. Where space is indicated, space shall be bused to install future switches or future circuit breakers sized as shown or a 600 Amp frame size circuit breaker or switch, whichever is greater.
   5. The main horizontal bus shall be non-tapered, fully rated, extended and drilled for future additions and splice plates.

E. Integrated Equipment Rating: Each switchboard, as a complete unit, shall be given a single integrated equipment rating by the manufacturer. The integrated equipment short circuit rating shall certify that equipment can withstand the stresses of a fault equal to that

shown in RMS symmetrical amperes. Ratings shall have been established by actual tests by the manufacturer on similar equipment construction as the subject switchboard. This test data shall be available and furnished, if requested, with or before the submittal of shop drawings.

F. Indicating Instruments: Switchboard instrumentation shall be digital display, remote mounted, rated for 120V, 60 hertz. The display unit shall be UL listed in accordance with UL 508. The electronic metering device shall have the following features:
1. Voltmeter, phase to phase and phase to ground or neutral.
2. Current, per phase RMS and 3 phase coverage.
3. Demand current per phase.
4. Power factor per phase and 3 phase average.
5. Real power, 3 phase total.
6. Reactive power, 3 phase total.
7. Apparent power, 3 phase total.
8. Frequency.
9. Average demand real power.
10. Adjustable demand interval (5 to 60 minutes).
11. Nonvolatile memory.
12. Password protected set-up and reset.
13. 3 current transformers with primary to match bus size and 5 ampere secondary with metering class accuracy.
14. Full scale readouts with the following accuracy:
    a. Current and voltage measurement +/-0.1%
    b. Power and energy +/-0.2%
    c. Frequency +/-0.5%
    d. Power Factor +/-1.0%
    e. Data update time 0.5 seconds (4 wire)
15. Metering Output.
    a. Pulse output based on kWh, kvarh, or kVAh.
    b. Analog output 4-20mA based on kWh, kvarh, or kVAh.
16. Monitoring:
    a. Harmonic analysis through 63rd with THD and TIF.
    b. Event recorder.
    c. Waveform capture.
    d. Data logger.
    e. Triggered trace memory.
17. Communication:
    a. Front port and dual rear mounted RS485 ports.
    b. BACnet protocol (coordinate with BMCS contractor).
    c. Mini RTU: digital 4 in/4 out.
    d. Analog 1 in/4 out.
    e. Local/remote display of all values.
18. Software:
    a. Windows based software shall be provided to enable setpoint programming.

G. The Main Protective Device(s) shall be individually mounted molded case circuit breaker(s):
1. Adjustable: current, I^2t settings, ground fault (where required), instantaneous trip, and short time trip. Solid state true RMS sensing, without fusible elements, 100-percent continuous current rating.
2. Main protective devices with frame rated at 1000 Amps or greater shall have integral ground fault interrupter and provided with a portable test set or test switch.
3. Circuit breakers with 1,200 Amp frame and above shall have Energy Reducing

Maintenance System switch with local status indicator (ERMS).

4. Provide shunt trip capability and wiring to terminal block for remote shunt trip switch wiring termination weather remote trip device is indicated or not.

H. Feeder and Branch Protective Devices greater than 1,200 Amps shall be individually mounted:
   1. Molded case circuit breakers:
      a. Adjustable: current, I^2t settings, ground fault (where required), instantaneous trip, and short time trip. Solid state trip true RMS sensing, without fusible elements; 100-percent continuous current rating.
      b. Energy Reducing Maintenance System switch with local status indicator (ERMS).
      c. Shunt trip capability and wiring to terminal block for remote shunt trip switch wiring termination weather remote trip device is indicated or not.
   2. Fusible switches:
      a. Each switch shall have an 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.
      b. Fused switches 600 Amps and below, equipped for class J fuses.
      c. Fused switches 601 Amps and above shall be equipped with Class R or L rejection type fuse holders. Class RK1 or L of ampere rating and type as indicated on the plans suitable for application of the system.
      d. When required by the latest edition of the NEC or the AHJ, 1,200 Amp switches regardless of fuse size installed shall have Energy Reducing Maintenance System switch with local status indicator (ERMS).

I. Feeder and Branch Protective Devices 1,200 Amps and below shall be group mounted:
   1. Molded case circuit breakers:
      a. Greater than 250 Amp: Solid state true RMS sensing with adjustable: current, I^2t settings, ground fault (where required), instantaneous trip, and short time trip; 80-percent continuous current rating.
      b. 250 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 frame circuit breakers regardless of trip shall have Energy Reducing Maintenance System switch with local status indicator (ERMS).
   2. 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 rejection type fuse holders.
      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).

J. 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 switchboard manufacturer shall include in the submittal data for the switchboard, the minimum setting of the devices and the recommended setting for normal building operation.
2. The ground fault system shall be factory-tested before shipment as specified:
    a. The switchboard 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.

K. Mimic bus: Indicate busing, connections, and devices in single line form on the front panels of the switchboard using red colored plastic strips, fastened flat against the panel face with screws.

PART 3 - EXECUTION

3.1 INSTALLATION OF SWITCHBOARDS

A. Install switchboards where shown, in accordance with the manufacturer's written instructions, and industry practices to ensure that the switchboards meet the specifications. Provide weatherproof NEMA 3R enclosure housing outdoors, at wet locations, or where indicated on the drawings. Provide NEMA 3RX enclosure housing at corrosive locations of either aluminum or stainless-steel construction suitable for the intended environment when indicated on the drawings.

B. Comply with the requirements of NEMA and NEC, and NECA Standard of Installation, for installation of switchboards.

C. Where switchboard 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 switchboard.

D. Torque bus connections and tighten mechanical fasteners.

E. Install fuses, of ratings shown, in each switchboard. Provide spare fuse cabinet with three fuses of each size provided. Locate in central plant as directed by Owner.

F. Concrete Pads: Install switchboards on a 4" reinforced concrete housekeeping pad. The housekeeping pad shall extend 3" beyond the housing of the switchboard unless shown otherwise. Switchboard shall be bolted to the housekeeping pad using 3/8" minimum galvanized bolts and anchors on 30" maximum centers. Furnish the exact position of any

block outs, dimensions, and location of the housekeeping pads to prevent delay of the concrete work.

G. 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.

H. Indicating Instruments: 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 switchboards for continuous of circuits and for short circuits.

C. Switchboard insulation resistance test: Each switchboard bus shall be insulation resistance tested after installation is complete except for line and load side connections. Tests shall be made using Biddle Megger or equivalent test instrument at a voltage of not less than 1000 vDC. Resistance shall be measured from phase-to-phase and from phase-to-ground. Minimum acceptable value for insulation resistance is 2 megohms.

D. Ground Fault Interrupter (GFI) test: 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 overcurrent device rating or 1,200 Amperes, whichever is lower.

E. Provide thermal infrared scan of switchboard 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.

F. 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 2 hours of dedicated training provided by a factory authorized representative to Owner's personnel regarding programming, operating, and use of switchboard components including all indicating instruments and safety features.

END OF SECTION

SECTION 26 24 16 - 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 confirm to all applicable UL standards and shall be UL labeled.

1.3 SUBMITTALS

A. Indicate:
1. Detailed dimensions.
2. Enclosure material, finish, and NEMA classification type.
3. Location of main circuit breaker.
4. Mounting and trim.
5. Acceptable incoming conductors' size.
6. Electrical characteristics including voltage, ampacity, overcurrent device frame size and trip ratings, bus material and rating, withstand ratings, lugs, and time current curves of all overcurrent devices and components.

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 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.

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.

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, I^2t settings, ground fault (where required), instantaneous trip, and short time trip; 80-percent continuous current rating.
   4. Provide permanent lock-off device for all fire alarm system branch circuit breakers, for all smoke control fans and equipment, and 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.

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 used 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.

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 on the same side as the SPD to allow the shortest and straightest run of conductors 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.

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.

END OF SECTION

SECTION 26 24 25 - 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 horsepower served.

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.

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.
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, I^2t 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.
   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.

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

SECTION 26 24 30 - 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.

END OF SECTION

SECTION 26 26 00 - ELEVATOR POWER MODULE SWITCH

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Work of this section shall conform to the requirements of the Contract Documents.

B. Provide Elevator Power Module Switch, fuses and accessories as required and specified on Contract Drawings to distribute electrical power to all elevators.

1.2 CODES AND STANDARDS

A. All work shall be performed in accordance with the latest edition of applicable standards, codes and laws.
1. NFPA 70 620-51 A-B, 620-62, 645-10, 700-25 (FPN)
2. ANS/ASME A17.1 102.2(4)
3. UL 98, UL 50

B. Except as modified by governing codes, all equipment shall be manufactured in accordance with the latest UL and NEMA applicable standards:

1.3 SUBSTITUTIONS

A. Substitutions shall comply with the requirements of the General Conditions and General Requirement. The names of manufacturers and model numbers have been used to establish types of equipment and standards of quality. A submittal shall contain sufficient information to provide compliance with Contract Documents. This includes compliance with all pertinent sections of codes and standards as specified above.

1.4 SUBMITTALS

A. Submit shop drawings and product data under the provisions of the General Conditions.

B. Product Data: Provide manufacturer’s catalog information showing dimensions, configurations and methods of mounting and installation.

C. Submit listing of all types, sizes and quantity of fuses that will be installed including the location of each.

D. Spare fuses shall be supplied as required by Section 26 24 30.

E. Provide line-by-line compliance of specifications.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Bussmann – Power Module Switch – PS

B. Littlefuse

C. Siemens

2.2 POWER MODULE SWITCH

A. The Power Module Switch shall be constructed, listed, and certified to UL 67 and UL 891. The Power Module Switch shall be 3 phase, 3 wire constructed in a NEMA 1 enclosure with copper bus. The Power Module Switch shall have individual horsepower rated fusible feeder switches with shunt trip capabilities unless noted otherwise. Feeder switches shall have voltage and ampere ratings based upon elevator manufacturer requirements and utilize Class J fuses; minimum rating 100 Amps at 480 Volts, 200 Amps at 208-240 Volts. All shunt trip fusible feeder switches shall have as an accessory a relay, control power transformer and other options noted below. The control power transformer shall be 100VA with primary and secondary fuses, with a 120V secondary. The isolation relay shall be 3PDT, 10A, 120V. The coil of the isolation relay shall be 120VAC. A 5A normally open dry contact shall be provided by the Fire Alarm Safety System to energize the isolation relay and activate the shunt trip solenoid (140VA inrush at 120V). Additional accessories provided for each fusible shunt trip switch include:
   1. Key to Test Switch
   2. Pilot Light (Red – ON)
   3. (2 NO & 2 NC) mechanical Interlock Auxiliary Contacts for hydraulic elevator recall and battery disconnect.
   4. Fire Safety Interface relay, 120 volt dc coil

B. The module shall have been successfully tested to a short-circuit rating with Bussmann LOW-PEAK® Class J fuses at 200,000 amps RMS Symmetrical. All switches shall have shunt trip capabilities at 120 VAC from remote fire safety signal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Provide elevator power module switch as required, including fuses, 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 with conductor and raceway installation work and Elevator Contractor / Manufacturer.

C. Anchoring: Anchor enclosures to walls and structural surfaces ensuring that they are permanently and mechanically secured.

D. Fuses: Install fuses, of the ratings and class shown, in each power distribution and motor control panelboard.

E. Fuses shall not be installed until equipment is ready to be energized.

F. Coordinate and provide elevator battery disconnect with mechanical interlock contacts.

3.2 TESTING

A. Before energizing, energization, check for continuity of circuits and short circuits.

END OF SECTION

SECTION 26 27 73 - 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

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

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.

C. Rotary key operated switch (verify manufacturer and keying with Owner prior to construction).
   1. Single-pole, 120/277V, 20A key operated switch: Leviton #1221-KL
   2. Two-pole, 120/277, 20A key operated, Leviton #1222-2KL.
   3. Three-way, 120/277V, 20A key operated switch: Leviton #1223-3KL
   4. Four-way, 120/277V, 20A key operated switch: Leviton #1224-4KL
   5. Key switches shall be all keyed alike to match the Owner's standard key system. Leviton #WS-35 or as otherwise directed by 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).

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 RECEPTS”, “HOOD RECEPTS”, “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 SJEO cord, white finish, LED hand lamp. Hubbell #HBLI45163LED with #HBL340PB 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.

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.

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, except in any of the following conditions where the grounding pole shall be installed in the up position: healthcare occupancies, if required by local AHJ, if required by Owner's construction standards or if directed by Owner or Architect. 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 PERSONELL

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.

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.

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

SECTION 26 32 02 - DUAL PURPOSE MANUAL TRANSFER SWITCHES WITH INTEGRATED LOAD BANK AND GENERATOR QUICK CONNECTS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install manual transfer switches with 4-poles, amperage, voltage, and withstand current ratings as shown on the plans or as required. Each manual transfer shall consist of a 3-position center off mechanically held power transfer switch unit and a mechanical operating mechanism to provide complete manual operation. Each manual transfer switch shall include integrated load bank and generator quick disconnects. All manual transfer switches and mechanical operating mechanism shall be the product of the same manufacturer.

1.2 RELATED DOCUMENTS

A. The Conditions of the Contract and applicable requirements of Division 1 and Section 26 05 00 govern this Section.

1.3 Acceptable Manufacturers

A. Basis of design: ASCO Series 300.

B. Alternate manufactures:
1. Trystar
2. PSI Power and Controls

1.4 Codes and Standards

The manual transfer switches and accessories shall conform to the requirements of:

A. UL 1008 Listed for Optional Standby Transfer Switches (Manual Transfer Switches)

B. UL 891 Switch Boards

C. CSA C22.2 No.178 –1978

D. EC 60947-6-1 Low – Voltage Switchgear and Controller

E. PA 70 - National Electrical Code

F. FPA 99 – Essential Electrical Systems for Health Care Facilities

G. EEE Standard 446 - IEEE Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications

H. UL 508 Industrial Control Equipment

I. NEC Article 700

J. International Standards Organization ISO 9001

K. RoHs compliant (Restriction of Hazardous Substances)

L. Seismic qualification – International Building Code & OSHPD to SDS level of 2.5

1.5 QUALITY ASSURANCE

A. NEC and NFPA Compliance: Comply with applicable portions of the NEC (NFPA 70) including, but not limited to, emergency and standby power generation systems.

B. IEEE Compliance: Comply with applicable Institute of Electrical and Electronics Engineers, Inc. (IEEE) standards pertaining to generator construction.

C. Supplier: All equipment provided shall be supplied by an authorized distributor of the manufacturer who has been continuously engaged in the distribution of industrial grade Power System products for a minimum of 10-years. The supplier shall provide initial start-up services, conduct field acceptance testing, and warranty service. The supplier is to be authorized to perform warranty service on all products provided.

1.6 SUBMITTALS

A. Submittal drawings and information on the manual transfer switches including installation drawings, wiring diagrams, dimensions, weights, etc. shall be provided. Full descriptive information on accessory items shall be furnished. Indicate:
1. Detailed dimensions for equipment footprint, front, rear, and side elevations.
2. Conduit entrance locations and requirements and restrictions.
3. Enclosure material, finish, and NEMA classification type.
4. Nameplate legends.
6. Metering and control wiring details.
7. Electrical characteristics including voltage, ampacity, overcurrent device frame size and trip ratings, withstand ratings, and time current curves of all overcurrent devices and components.

B. Submit manufacturers' "Installation, Start-Up and Service" instructions, recommended conductors, overcurrent protection, and electrical interlocks.

C. Submit recommended clearance dimensions.

D. Submit sequence of operation in narrative form.

E. Instruction Data and Drawings: Commercial type operating instructions shall be provided consisting of operating and maintenance manuals, parts books, dimensional drawings, and wiring diagrams.

1.7 WARRANTY

A. Provide one-year parts and labor warranty from date of substantial completion.

PART 2 - PRODUCTS

2.1 Mechanically Held Transfer Switch

A. The manual transfer switch unit shall be manually operated and mechanically held. The switch shall be mechanically interlocked to ensure only one of three possible positions, Source 1, Source 2, or Center Off. Fused disconnect type switches shall not be acceptable.

B. The switch shall be positively locked and unaffected by momentary outages so that contact pressure is maintained at a constant value and temperature rise at the contacts is minimized for maximum reliability and operating life.

C. All main contacts shall be silver composition. Switches rated 600 amperes and above shall have segmented blow-on construction for high withstand current capability and be protected by separate arcing contacts.

D. Inspection of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors.

E. Transfer switch designs utilizing components of molded-case circuit breakers, contactors, or parts thereof which are not intended for continuous duty, repetitive switching, or transfer between two active power sources are not acceptable.

F. Neutral conductors shall be switched to electrically isolate the permanent generator from the temporary generator. The manual transfer switch shall be provided with fully- rated neutral transfer contacts.

G. The manual transfer switch shall be tested in accordance with UL 1008 for transfer switches. Switch ratings of 260 Amperes and less shall have endurance rating of 6000 cycles, 400 Ampere shall have endurance rating of 4000 cycles, and 600 – 3000 Amperes shall have endurance rating of 3000 cycles.

2.2 MANUAL OPERATIONS PROVISIONS

A. The manual transfer switch shall be arranged for manually actuated manual operation.

B. The manual transfer shall be actuated via a mechanical operating mechanism.

C. The manual operating handle shall be capable of external operation without opening the enclosure door.

D. It shall have the same contact to contact speed as would be for automatic operation.

E. There shall be three positions for manual operation:
1. Connected to Source 1 (preferred)
2. Connected to Source 2 (alternate)
3. Connected to center off (disconnected position)

F. Switch position when connected to Source 1, or Source 2 shall be pad – lockable.

2.3 ENCLOSURE

A. Manual transfer switches located outdoors shall be furnished in a NEMA type 3RX type 316 stainless steel enclosure. Manual transfer switches located indoors shall be NEMA 3R.

B. Enclosures shall be wall mounted or free-standing floor or pad mounted.

C. NEMA 3R enclosures shall be code gauge steel as per UL 50 with ANSI #61 powder coat finish.

D. 3RX enclosures shall be 316 stainless steel.

E. Provide strip heater with thermostat for Type 3R and 3RX enclosure requirements.

2.4 MECHANICAL AND ELECTRICAL PERFORMANCE

A. Mechanical position indicators (yellow) visible to the operator shall be included for Source

1 (preferred), Source 2, (alternate), and Center Off (disconnected).

B. Auxiliary position indicating contacts, rated 10 amps, 250 Vac shall be provided consisting of one closed when the manual transfer switch is connected to Source 1 (preferred), and one contact closed when the manual transfer switch is connected to Source 2 (alternate).

C. A form A contact shall be provided to indicate switch is in the Center Off (disconnected) position.

D. A Load Dump disconnect circuit breaker shall be provided between source 1 of the manual transfer switch and the 16 Series Outlets for Load Bank Connection. Load Dump circuit breaker shall include shunt trip and be sized for the full rating of the manual transfer switch and capable of carrying, at minimum, the full kW rating of the permanent generator for a minimum of 4-hours. Provided ground fault (GFI) protection for circuit breakers rated 800 Amperes or larger. Load dump disconnect circuit breaker shall be Square D, or the same manufacture as the building's main service disconnect equipment.

E. Auto Start Destination Toggle Switch shall be provided to allow for the user to select which generator the ATS will start when the engine start signal is sent from the building automatic transfer switch.

F. The Dual-Purpose Manual Transfer Switch integrated quick connects shall provide a connecting means for connecting a portable generator or a load bank.

G. Generator quick connects:
1. For 400A and below models, there shall be one (1) row of up to five (5) single pole connections.
2. For 600A - 800A models, there shall be two (2) rows of up to five (5) single pole connections.
3. For 1000A-1200A models, there shall be three (3) rows of up to 5 single pole connections.
4. For 1600A models, there shall be four (4) rows of up to 5 single pole connections.
5. For 2000A models, there shall be five (5) rows of up to 5 single pole connections.
6. For 2500A models, there shall be seven (7) rows of up to 5 single pole connections.
7. For 3000A models, there shall be eight (8) rows of up to 5 single pole connections.

H. Neutral connections are not required for Load Bank connections:
1. For 400A and below models, there shall be one (1) row of up to four (4) series single pole connections.
2. For 600A - 800A models, there shall be two (2) rows of up to four (4) single pole connections.
3. For 1000A-1200A models, there shall be three (3) rows of up to four (4) single pole connections.
4. For 1600A models, there shall be three (3) rows of up to 4 single pole connections.
5. For 2000A models, there shall be five (5) rows of up to 4 single pole connections.
6. For 2500A models, there shall be seven (7) rows of up to 4 single pole connections.
7. For 3000A models, there shall be eight (8) rows of up to 4 single pole connections.

I. All electrical quick connectors shall be 16 Series cam type single pole connectors; color

coded as per local industry standard practice:

1. 240V and below: phase 1 = black, phase 2 = red or orange for hi-leg, phase 3 = blue (if required).
2. 480V: phase 1 = brown, phase 2 = purple or orange, phase 3 = yellow.
3. Ground shall always be green.
4. Neutral shall always be white.
5. A minimum of 25% phase ampacity shall be provided for ground connections for portable generator and load bank connections.

2.5 ACCESSORIES

A. Enclosure Heater(s): A 125-watt enclosure heater with transformer and thermostat (adjustable from 30° to 140 degrees F) shall be provided for outdoor installations where type 3R or 3RX, enclosures are specified. (This feature shall be equal to ASCO accessory 44G and shall be capable of being added to existing switches). Thermostat shall be set to 40-degrees F.

B. Surge Suppression – A SPD with a surge current rating of 65kA shall be provided with individually matched fused metal oxide varistors (MOVs). It shall include LED status indication of normal operation, under voltage, power loss, phase loss or component failure. Shall include form C dry contacts for external alarm or monitoring. The unit shall be enclosed in a Noryl housing rated NEMA 4, 12, and 4X. Shall comply with UL 1449 latest edition. (This feature shall be equal to ASCO accessory 73).

C. Shunt Trip Option on the Load Bank Breaker- 119LC - 24VDC Shunt Trip on the manual transfer switches load bank breaker to integrate with building automatic transfer switch. Load dump upon loss of utility source or automatic generator start signal from the automatic transfer switch. Circuit breakers 800 Amps and larger shall include GFI, Ground Fault Interrupter.

D. Power Meter - ASCO 5210 Power Meter Connected to Load Side (135L)

E. Accessory 171EP Base Package Bundle – Two form C contacts shall be connected to a terminal block that operate when Source 1 and Source 2 voltage is present at manual transfer switch terminals. The following indicators shall be provided:
   1. Load Connected to Source 1 (Green).
   2. Load Connected to Source 2 (Red).
   3. Source 1 Available (Green).
   4. Source 2 Available (Red).
   5. Load Disconnect (Yellow)
   6. Phase Rotation Monitor
   7. Maintained Engine Start Switch and Common Alarm LED/Contact

2.6 WITHSTAND AND CLOSING RATINGS

A. The Manual Transfer Switch shall be rated to close on and withstand the available RMS symmetrical short circuit current at the terminals with the type of overcurrent protection shown on the plans.
   1. Source 1 WCR ratings @ 480v shall be as follows when used with specific circuit breakers or current limiting fuses:

MTDQ Size	Source 1 Withstand & Closing Rating MCCB	Source 1 W/CLF
150A - 600A	50,000A	200,000A
800A - 1200A	50,000A	200,000A
1600A - 2000A	65,000A	200,000A

MTDQ Size	Source 1 Withstand & Closing Rating MCCB	Source 1 W/CLF
2500A - 3000A	100,000A	200,000A

2. Source 2 WCR ratings @ 600V shall be as follows when used with any molded case circuit breaker:

MTDQ Size	Source 2 Withstand & Closing Rating MCCB at Source Wired to Quick Connects
105A - 600A	22,000A
800A - 1200A	22,000A
1600A - 2000A	65,000A
2600A - 3000A	100,000A

2.7 TESTS AND CERTIFICATION

A. The manual transfer switch shall be factory tested to ensure proper operation of the individual components and correct overall sequence of operation and to ensure compliance with the specification requirements.

B. Upon request, the manufacturer shall provide a notarized letter certifying compliance with all of the requirements of this specification including compliance with the above codes and standards and withstand and closing ratings. The certification shall identify, by serial number(s), the equipment involved. No exceptions to the specifications, other than those stipulated at the time of the submittal, shall be included in the certification.

C. The manual transfer switch manufacturer shall be certified to ISO 9001: 2008 International Quality Standard and the manufacturer shall have third party certification verifying quality assurance in design/development, production, installation and servicing in accordance with ISO 9001: 2008.

2.8 SERVICE REPRESENTATION

A. The manual transfer switch manufacturer shall maintain a national service organization of company- employed personnel located throughout the contiguous United States. The service center's personnel must be factory trained and must be on call 24 hours a day, 365 days a year.

B. The manufacturer shall maintain records of switch shipments, by serial number, for a minimum of 20 years.

C. For ease of maintenance, the manual transfer switch nameplate shall include drawing numbers and serviceable part numbers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install manual transfer switches where shown, in accordance with the equipment manufacturer's written instructions and recognized industry practices to ensure that the transfer switch complies with the specified requirements and serve the intended purposes. Provide and install complete operating instructions in a Plexiglas enclosure for each type of transfer switch inside the enclosure.

B. Standard: Comply with NEMA standards, requirements of the NEC, and applicable portions of NECA Standard of Installation pertaining to installation of manual transfer

switches.

C. Concrete Pad: Install free-standing floor or pad mounted manual transfer switches on a reinforced concrete pad. The pad shall extend 6" beyond the manual transfer switch base, unless shown otherwise. Furnish the exact position of any block outs, mounting bolts, and the dimensions and location of the manual transfer switch pad in a timely manner so as to prevent delay of the concrete work. Refer to Section 26 05 00 for housekeeping pads and Division 3 for Concrete Work.

D. Provide circuits, conductors, and raceways as required for manual transfer switch options and accessories as required or specified. Provide separate dedicated circuits from the emergency branch circuit panel board to the manual transfer switch when required for indicated options or accessories. Provide control circuits from building automatic transfer switch to load bank shunt trip circuit breaker for load bank dump upon loss of building utility power.

E. Provide shunt trip control of load bank circuit breaker to dump the load bank load if the building automatic transfer switch loses utility power.

3.2 GROUNDING

A. Ground the manual transfer switch to the building grounding system and provide a driven ground electrode at the manual transfer switch location or bond to the building grounding system ground rod(s) if in close proximity.

3.3 CONTROLS

A. Provide manual transfer switch load dump control wiring and raceway from the automatic transfer switch to the load bank shunt trip circuit breaker to dump the load bank load upon generator start signal from the building automatic transfer switch(es).

3.4 TESTING

A. Notify Owner’s Commissioning Authority (CxA) prior to performing any tests so the CxA may witness tests at his/her discretion. Refer to Section 26 01 00 Commissioning of Electrical Systems. Testing shall be witnessed by owner and Engineer.

B. Coordinate testing of manual transfer switch with the testing of the permanent generator source and associated automatic transfer switches, including the generator load bank test.

C. Contractor shall furnish all instruments, load banks, and personnel required for test. Submit 4 copies of certified test results to Architect/Engineer for review. Test reports shall include date and time of test, relative humidity, temperature, and weather conditions.

D. Pre-energization checks: Before energizing, check for continuous of circuits and for short circuits.

E. Ground Fault Interrupter (GFI) test for load bank circuit breakers 1,000 Amps and larger: 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 20 percent of overcurrent device rating or 600 Amperes, whichever is lower.

E. Provide thermal infrared scan of the manual transfer switch 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 close out and make corrections prior to close-out.

F. 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.

3.5 TRAINING

A. Provide four hours training, one hour each for four persons, four separate days. Coordinate with the Owner for manual transfer switch training which may coincide with any other related or required generator or automatic transfer switch training.

END OF SECTION

SECTION 26 32 13 - NATURAL GAS STANDBY GENERATOR SETS and TRANSFER SWITCH

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Conditions of the Contract and applicable requirements of Division 1 and Section 26 05 00 govern this Section.

1.2 WORK INCLUDED

A. Furnish and install standby engine-driven generator system, complete with wiring and controls as shown on the drawings and as specified herein.

B. The standby emergency system shall consist of an engine-driven generator set designed and sized for project site ambient conditions and project site altitude, complete for outdoor installation where specified or required outdoors, automatic transfer switches and associated fuel system.

1.3 QUALITY ASSURANCE

A. Acceptable Manufacturers:
   1. Engine-Driven Generator Sets:
      a. Cummins
      c. Generac Industrial
      d. Caterpillar
   2. Automatic Transfer Switch.
      a. Cummins
      b. ASCO
      c. Caterpillar
      e. Standby electric generating system manufacturer (as an integral part of a complete system).

B. NEC and NFPA Compliance: Comply with applicable portions of the NEC (NFPA 70) including, but not limited to, emergency and standby power generation systems (NFPA 99 & 110), and with NFPA 37 Installation and Use of Stationary Combustion Engines and Gas Turbines.

C. IEEE Compliance: Comply with applicable Institute of Electrical and Electronics Engineers, Inc. (IEEE) standards pertaining to generator construction.

D. EPA Compliance: Comply with all EPA Standards for permanently installed natural gas emergency generators.

E. Testing: The generator set shall receive the manufacturer's standard factory load testing.

F. Supplier: All equipment provided shall be supplied by an authorized distributor of the manufacturer who has been continuously engaged in the distribution of industrial grade Power System products for a minimum of 15 years. The supplier shall provide initial start-up services, conduct field acceptance testing, and warranty service. The supplier is to be authorized to perform warranty service on all products provided. Within 50 miles of the job site, the supplier shall maintain; a minimum of 6 factory-trained and qualified field technicians; a proper supply of spare parts for the supplied equipment; a shop with overhaul capabilities; and be able to provide 24 hour, 7 day per week, 365 day per year field service capability.

1.4 SUBMITTALS

A. Submit manufacturer's certified computer-generated performance and capacity data in accordance with specification requirements. Indicate and include all ambient and altitude de-ratings and calculations.

B. Submittal drawings and information on the transfer switches including installation drawings, wiring diagrams, dimensions, weights, etc. shall be provided. Full descriptive information on accessory items shall be furnished.

C. Submit manufacturers' "Installation, Start-Up and Service" instructions, recommended conductors, overcurrent protection, and electrical interlocks.

D. Submit recommended clearance dimensions.

E. Submit sequence of operation in narrative form.

F. . Instruction Data and Drawings: Commercial type operating instructions shall be provided consisting of operating and maintenance manuals, parts books, dimensional drawings and wiring diagrams.

1.5 WARRANTY

A. Provide five-year parts and labor warranty from date of substantial completion for generator set(s) and transfer switch(es).

PART 2 - PRODUCTS

2.1 ENGINE-GENERATOR SETS

A. The engine-generator set shall be furnished as a complete working system. The model provided shall be a standard model that is quality assurance tested and prototype tested, not one of a kind without supporting literature.

B. Engine shall be liquid cooled, reciprocating engine, 12V DC electric start, natural gas fueled, electronic isochronous governed with manual speed adjustment plus/minus 5%, with belt-driven battery charging alternator.

C. The set shall provide the following performance:
1. Rated power for the duration of any utility power outage, in ambient conditions to 500-feet altitude and an outside air ambient temperature of 10 degrees F to 110 degrees F. Liquid coolant system ratings for natural gas sets through 140KW shall be rated at 122 degrees F ambient.
2. Start and accept rated load within 10 seconds of utility power outage.
3. Voltage regulation of plus/minus 2% no load to full load with random voltage variation, at any constant load, less than plus/minus 1%.
4. Isochronous frequency regulation, less than plus/minus 0.5% at any steady state load from no load to full load.

D. Engine Coupling: Engine shall be directly connected to the generator through a suitable flexible coupling.

E. Generator:
1. The generator shall be a standard make, 4-pole, revolving field, single bearing, synchronous, brushless type with the following characteristics:
a. Capacity as shown on the drawings and shall operate at 1800 rpm.

b. Dripproof, self-ventilating, permanently aligned and complete with rotating brushless exciter and shall be of ball bearing construction and connected to the engine with flexible disc coupling.
c. Conform to the latest applicable IEEE and NEMA standards.
d. Provided with generator overload protection or generator manufacturer's overload protective circuitry.
e. Output main circuit breaker(s) with adjustable LIS trip for cable protection shall be provided when shown on drawings. Circuit breaker manufacturer shall be the same as switchgear manufacturers specified and submitted to be used on this project.
f. Voltage Regulator: Include a full wave rectified automatic digital voltage regulation system matched and prototype tested by the engine manufacturer with the governing system provided. It shall be immune from mis-operation due to load-induced voltage waveform distortion and provide a pulse width modulated output to the alternator exciter. The voltage regulation system shall be equipped with three-phase RMS sensing and shall control buildup of AC generator voltage to provide a linear rise and limit overshoot. The system shall include a torque-matching characteristic, which shall reduce output voltage in proportion to frequency below an adjustable frequency threshold. Torque matching characteristic shall be adjustable for roll-off frequency and rate, and be capable of being curve-matched to the engine torque curve with adjustments in the field.
g. Alternator: The generator shall be capable of withstanding a three phase load of 300% rated current for 10 seconds, and sustaining 150% of continuous load current for 2 minutes with field set for normal rated load excitation.

2. Provide the generator with the following:
a. Minimum 130°C rise stand-by rating
b. NEMA Class F or H insulation as defined by NEMA MG1.65
c. Temperature rise by resistance and embedded detector measurements at rated load within NEMA MG1-22.40 definition.
d. Pre-lubricated, maintenance free ball bearing, lubricated for life.
e. Direct drive centrifugal blower cooling.
f. RFI filters on the exciter to eliminate radio frequency interference on electronic equipment.
g. Thermostatically controlled block strip heater mounted for condensation control.

F. Sub-Base: The engine power plant shall be mounted on an I beam, box type sub-base of fabricated steel construction. The assembly shall be installed on a vibration-absorbing base on a concrete pad as shown on the drawings.

G. Automatic Starting Sequence of Events:
1. Upon drop in normal source voltage to 65 to 70% of rated voltage, or upon failure of the normal source of electrical supply, the engine shall be automatically cranked and brought up to the full operating speed.
2. The cranking motor circuit shall be instantly broken when the engine starts.
3. Within 10 seconds the generator shall be brought up to operating speed; the generator voltage shall operate the automatic transfer switch, disconnecting the load from the normal source of supply and connecting the emergency power to the load.
4. Upon restoration of the normal source voltage to 92 to 95% of rated voltage or restoration of normal source of supply, the sequence shall be reversed, restoring the transfer switch to the automatic normal operating position, disconnecting the load from the emergency generator and reconnecting the load to the normal

source of supply. The emergency generator set will continue to operate for a period of from 1 to 5 minutes after the restoration of the normal source of supply. Should the engine fail to start upon the first crank, there shall be two additional cranking attempts made with a 15 second rest between cranks, after which the cranking cycle shall cease and an alarm shall sound to indicate malfunctioning of the system.

5. The controls shall automatically stop the engine in the event the cooling water temperature becomes too high, if the coolant level becomes too low, if the oil pressure drops below a pre-determined pressure, or if the engine overspeeds. Upon the failure of the engine for any of the above reasons, an indicating lamp will operate indicating the condition under which the engine was shut down. Also, the alarm signal shall be energized.

H. Engine Control Panel & Accessories:

1. Provide a comprehensive monitoring and control system integral to the Generator Set control to guard the electrical integrity of the alternator and power system. Provide single and 3-phase fault current regulation, so that downstream protective devices have the maximum current available to quickly clear fault conditions, without subjecting the alternator to potentially catastrophic failure conditions. Include provisions to either prevent over voltage due to single phase faults, or to shut down the generator set if line to neutral voltage on any phase exceeds 115% for more than 0.5 seconds. Acceptable methods are a fully rated (100%) 600 volt Circuit Breaker, mounted in the generator enclosure, Schneider Electric - Square D Programmable Micrologic of size as indicated on drawings with handheld programmer or inherent protection provided by microprocessor-based GenSet AmpSentry protection. Submittals shall demonstrate that the protective device provides proper protection for the alternator by a comparison of the trip characteristic of the breaker with the thermal damage characteristic of the alternator. Field circuit breakers shall not be acceptable for generator overcurrent protection. The control system shall actively control the fuel rate and excitation as appropriate to the state of the generator set. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed, accelerating to rated speed. The governing system shall include a programmable warm up at idle and cool-down at idle function. While operating in idle state, the control system shall disable the alternator excitation system. An electronic governor system shall provide automatic isochronous frequency regulation. The governing system dynamic capabilities shall be controlled as a function of engine coolant temperature to provide fast, stable operation at varying engine operating temperature conditions. The Control Panel shall include, but is not be limited to, the following instruments and protective devices:
    a. AC Ammeter.
    b. Phase Selector Switch.
    c. Current Transformers.
    d. AC Voltmeter.
    e. Automatic Solid State Voltage Regulator with immunity to severe induced waveshape distortion from nonlinear leads.
    f. Rheostat for Adjusting voltage ± 5% of Rated Voltage.
    g. Engine Malfunction Warning Lights/Audible Alarm:
        1) Anticipating High Engine Temperature.
        2) Anticipatory Low Oil Pressure.
        3) Low Fuel.
        4) Control Switch not in Automatic Position.
        5) Low Water Temperature.
        6) Low Oil Pressure.
        7) High Water Temperature.
        8) Engine Overcrank.

9) Engine Overspeed.

h. Frequency Meter.

i. Non-resettable Elapsed Time Meter with a 9,999.9 Hour Maximum Indication.

j. Coolant Temperature Gauge.

k. Oil Pressure Gauge.

l. Provisions for Remote Emergency Shutdown.

m. Combination alarm shutdown system with manual reset and indicating lights for high engine temperature, low oil pressure, engine overspeed, and engine failed to start. Include an additional set of contacts for remote alarms.

n. Manual run/off/automatic selector switch for control of engine with flashing red light, and shall allow manual starting of plant without assuming load.

2. Provide low coolant level shutdown, which shall activate high engine temperature lamp and shutdown.

3. Solid-state cranking cycle device preset at 15 second cranking cycle and 15 second rest cycle followed by a 15 second cranking cycle. If engine fails to start after 3 crank cycles and 2 rest cycles, an overcranking alarm shall sound and cranking cycle shall stop. Provide adjustments in accordance with manufacturers recommendations, but cumulative crank-rest timing shall not be less than 75 seconds.

4. In the event of engine failure, the panel shall close alarm circuit, indicate the fault on the appropriate lamp and shut down the engine. The panel shall include a manual reset switch so that the panel can be reset immediately after a fault condition. Reset devices that require a waiting period are not acceptable.

I. Options and accessories shall include the following:

1. Housing: The complete engine generator set shall be enclosed in a free-standing weather protective, aluminum (0.063-inch) panel construction housing with lockable, removable hinged door panels, hinged instrument panel door and panel light. Housing shall be wind rated to a minimum150 mph.

a. All parts shall be adequately protected against oxidation and corrosion and finish painted with durable machinery enamel, minimum of 3 mils applied in a maximum of 1-1/2 mils per application.

b. Include within the enclosure a switched 12 or 24-Volt LED luminaire on each side of the engine and a GFCI receptacle.

c. The enclosure must maintain the engine and generator at 40°F or be equipped with space heaters to maintain starting batteries between 50°F and 90°F.

2. 12V or 24-volt battery starting with maintenance free lead acid batteries with dual rate solid state automatic battery charger, with equalize timer, low and high battery voltage indicators and alarm terminals, charger malfunction indicator and alarm. Batteries shall be capable of providing two 45 second continuous cranking cycles. Provide battery racks, and charger shall be protected from any other charging source.

3. Muffler, critical silencing, with condensation drain; stainless steel flexible exhaust connector. Silencer shall mount horizontally on structural support inside of housing with 90° elbow termination with rain cap.

4. Premium exhaust rain cap, cast aluminum, stainless steel hardware, brass bushing hinge.

5. Gas line accessories as required for the set to include but not limited to gas line strainer, 12" braided metallic flexible fuel line, battery power operated gas line shut-off solenoid valve, pressure reducing regulator fuel pressure gauge.

a. Contractor shall provide natural gas fuel piping for the emergency generator set. Contractor shall install natural gas line fittings obtained

from electrical contractor (as supplied with the engine generator). Plumbing line work for natural gas for the engine generator shall be with as few elbows and bends as possible (as near a straight line run from the gas supply tee-off as possible).

6. Coolant heater, 120VAC, 1 phase, 1000-2500 watts.
7. Unit mounted emergency shut-off mushroom type pushbutton switch.

J. Testing: The unit shall be given a complete shop test before shipment. It shall be installed on the job under supervision of the manufacturer's representative and shall receive start-up / commissioning service from that representative.
1. The unit shall be started cold and run for a one-hour test with building load connected. Provide additional load bank as required to achieve 100 percent loading.
2. Retransfer the load after test.
3. After this test, the set shall cool for five minutes, then must start and carry full building load for four hours.
4. Demonstrate the cranking cycle and all engine safety devices. The Owner’s authorized representative shall be instructed in the operation and maintenance of the unit.

K. Instruction Data and Drawings: Commercial type operating instructions shall be provided consisting of operating and maintenance manuals, parts books, dimensional drawings and wiring diagrams. Three copies of dimensional drawings and wiring diagrams shall be provided as specified.
1. Operating Instructions: Provide and install in a suitable enclosure operating instructions for the engine generator set.
2. Contractor shall fill the radiator with a combination of water and ethylene-glycol to protect the radiator to -20°F after completion of the test.

2.2 AUTOMATIC TRANSFER SWITCHES

A. Rating and Construction:
1. Refer to the project drawings for specifications on the sizes and types of transfer switch equipment, withstand and closing ratings, voltage and ampere ratings, enclosures and accessories. All transfer switches shall have switched neutrals and shall be electrically operated and mechanically held.
2. Automatic transfer switches shall be included in a factory assembly with bypass-isolation switch equipment for the emergency life safety branch, two-source type for bypassing to normal or emergency. Bypass isolation not required for equipment branch.
3. All transfer switches and accessories shall be UL listed and labeled, tested per UL Standard 1008, and CSA Approved, and comply with NEMA ICS 2-447. When protected by molded case breaker withstand and closing ratings shall not be less than the following RMS symmetrical amps at 600 VAC:

Switch Size in Amps	WCR @ 480 Volts
Up to 260	30,000
300 to 1000	65,000
1200	85,000
1600 and larger	100,000

4. Provide one of the following standard products:
a. Cummins OTPC Series as required
b. Standby Generator System Manufacturer, provided as a complete system
c. ASCO 300 Series
d. Russelectric RMT/RMTD Series
e. Zenith ZTSD Series

5. Electrical operation shall be accomplished by a momentarily energized single solenoid operating mechanism which receives power from the source to which the load is being transferred. Fuse or thermal protection of the main operator is prohibited. The operating transfer time shall be 1/6 of a second or less. Mechanical locking in each position shall be accomplished without the aid of permanent magnets, latching solenoid, or motor operators.
6. Operation shall be inherently double-throw whereby all contacts move simultaneously and with no programmed delay in a neutral position. Electrical spacing shall be equal to or exceed those listed in table 15.1 of UL 1008. Only those main contact structures specifically manufactured for transfer switch service shall be acceptable. An overload or short circuit shall not cause the switch to go to a neutral position.
7. Inspection of all contacts (movable and stationary) shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. A manual operating handle shall be provided for maintenance purposes. The maintenance handle shall permit the operator to stop the contacts at any point throughout the entire travel to properly inspect and service the contacts when required.
8. All switches for systems with switched neutrals shall have fully rated neutral transfer contacts that momentarily interconnect the neutrals of the sources and load for 100 milliseconds maximum, during the transfer/retransfer operation. The neutrals shall remain so interconnected until the line contacts close on the alternate source. Line and neutral contacts shall be driven by a single main operator.

B. Controls and Accessories:
1. Controls shall provide for the automatic starting sequence of the generator set.
2. Automatic controls shall signal the engine-generator set to start upon signal from normal source sensors. Solid state time delay start, adjustable from 0 to 5 seconds (factory set at 2 seconds) shall avoid nuisance start-ups. Battery voltage starting contacts shall be gold, dry type contacts factory wired to a field wiring terminal block.
3. The switch shall transfer when the emergency source reaches the set point voltage and frequency. Provide a solid-state time delay on transfer, adjustable from 0 to 120 seconds.
4. The switch shall retransfer the load to the normal source after a time delay retransfer, adjustable from 0 to 30 minutes. Retransfer time delay shall be immediately bypassed if the emergency power source fails.
5. Control shall be solid state and designed for a high level of immunity to power line surges and transients, demonstrated by test to IEEE Standard 587-1980. The control shall have optically isolated logic inputs, high isolation transformers for AC inputs, and relays on all outputs. Control shall be quick disconnect for ease of service.
6. Automatic transfer switches shall have inherent phase balance protection logic to detect a ‘single phasing’ Solid state undervoltage sensors shall simultaneously monitor all phases of both sources. Pick-up and dropout settings shall be adjustable. Voltage sensors shall allow for adjustment to sense partial loss of voltage on any phase. Voltage sensors shall have field calibration of actual supply voltage to nominal system voltage. The transfer switch controller shall be equipped with a fault output terminal interconnected to a 24Vdc shunt trip, integral to the transfer switch and with built-in time delay, that functions to disconnect the utility source from the load should the standby emergency source fail to start.
7. For transfer switches serving non-disconnected motor loads, equip with a field adjustable time delay during switching in both directions, during which time the load is isolated from both power sources, to allow load residual voltage to decay

before closure to the opposite source. The delay feature shall have an adjustable range covering 0 to 7.5 seconds. Transfer switches serving life safety equipment shall have this time delay set at 0 at startup/commissioning.

8. Controls shall signal the engine-generator set to stop after a time delay, adjustable from 0 to 10 minutes, beginning on return to the normal source.
9. Power for transfer operation shall be from the source to which the load is being transferred.
10. The control shall include latching diagnostic indicators to pinpoint the last successful step in the sequence of control functions, and to indicate the present status of the control functions in real time.
11. The control shall include provisions for remote transfer inhibit and area protection.
12. Provide front panel devices mounted on cabinet front consisting of:
    a. A key operated selector switch to provide the following positions and functions:
        1) Test - Simulates normal power loss to control for testing of generator set. Refer to Part 3 for programming requirements.
        2) Normal - Normal operating position.
        3) Retransfer - Momentary position to override retransfer time delay and cause immediate return to normal source, if available.
13. Exerciser Clock: Provide solid state exerciser clock to set the day, time, and duration of generator set exercise/test period. Provide a with/without load selector switch for the exercise period. Refer to Part 3 for programming requirements.
14. Provide Phase Sequence Monitor/Balance Module to protect against inadvertent phase rotation hookup and monitor for voltage phase imbalance between phases.
15. Each transfer switch shall be provided with a control panel to allow the operator to view the status and control operation of the transfer switch. The control panel shall be a sealed membrane panel rated NEMA 3R/IP53 or better (regardless of enclosure rating) that is permanently labeled for switch and control functions. The control panel shall communicate with the engine generator, including display of all engine and alternator data, and other transfer switch data in the power system. The control panel shall allow starting and stopping of the generator set via the transfer switch control panel in both test and emergency modes.
16. Where elevator loads or load disconnect of motor controls are shown on the plans, provide in switches serving elevators or motors the following:
    a. Signal module to delay the transfer and retransfer of the switch for up to 50 seconds to provide a pre-transfer warning or load disconnect signal contact. Provide signals for the following conditions:
        -- source 1 available
        -- source 2 available
        -- test/exercise
        -- backup source available
        Contacts for these functions are to be Form C type, rated for 120 VAC or 30 VDC at 4 amps.
17. Provide a load shed relay, to move the transfer switch from the emergency position to a neutral position, on receipt of a signal from a remote device.

2.4 REMOTE ANNUNCIATION PANEL

A. Locate next to ATS. Provide flush mounted with stainless steel plate containing the following:
    1. Trouble sonnet horn with silence switch.
    2. Illuminated annunciators with nameplates in accordance with the following table:

Lamp Legend	Generator Set Condition Indicated	Light	Audible Alarm
High Battery Voltage	Battery charger too high	Red	No
Low Battery Voltage	Battery voltage too low	Red	No
Normal Battery Voltage	Battery voltage ok	Green	No
Generator Running	Generator has output voltage	Green	No
Normal Utility Power	Utility power supplying the load	Green	No
EPS Supplying Load	Genset supplying the load	Green	No
Pre-Low Oil Pressure	Oil pressure approaching low limit	Yellow	Yes
Low Oil Pressure	Engine has shut down due to low oil pressure	Red	Yes
Pre-High Coolant Temp.	Temperature of coolant approaching high limit	Yellow	Yes
High Coolant Temp.	Genset has shut down due to high coolant temp.	Red	Yes
Low Engine Temp.	Engine heater has malfunctioned	Red	Yes
Overspeed	Engine has shut down due to overspeed	Red	Yes
Overcrank	Engine failed to start	Red	Yes
Not In Auto	Engine control switch not in AUTO position	Flashing Red	Yes
Battery Charger Malfunction	Charger is signaling a failure	Red	Yes
Low Fuel	Fuel level below preset minimum	Red	Yes
Fault	Customer preselected condition	Red	Yes

B. Name plates shall be laminated black with white letters engraved. Letter size shall be a minimum of 3/8” high.

C. Illuminated annunciators shall be 1 inch minimum.

2.5 ELECTRICAL AND MECHANICAL PERFORMANCE

A. The switch must comply with UL 1008 and NEMA Standard Publication ICS 2-447. In addition, the switch must meet or exceed the following requirements and if so requested, be verified by certified laboratory test report.
   1. Temperature Rise: Measurements shall be made after the overload and the endurance tests.
   2. Withstand: UL listed to withstand the magnitude of fault current available at the switch terminals when coordinated with respective protective devices at an X/R ratio of 6.6 or less. The main contacts of the transfer switch shall not trip open or weld when subjected to fault currents.
   3. Dielectric: Test, following the withstand current rating test, at 1960 volts AC rms minimum.
   4. Transient Withstandability: Control panel voltage surge withstand capability test per IEEE Standard 472-1974 and voltage impulse withstand test per NEMA Standard publication ICS-1-109.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install standby engine driven generator set where shown, in accordance with the equipment manufacturer's written instructions and recognized industry practices, to ensure that the set complies with the specified requirements and serve the intended

purposes. Provide and install in a Plexiglas enclosure complete operating instructions for each type of transfer switch.

B. Standard: Comply with NEMA standards, requirements of the NEC, and applicable portions of NECA Standard of Installation pertaining to installation of standby engine-driven generator sets and accessories.

C. Vibration Isolation:
1. Outside Mounted: Ribbed Neoprene Vibration Isolation
2. Roof Mounted: Install units on properly sized spring-type vibration mounts and ribbed Neoprene vibrations isolators.
3. Generator installed inside building: Install units on properly sized spring-type vibration mounts and ribbed Neoprene vibration isolators.

D. Concrete Pad: Install generator set on a reinforced concrete pad. The generator pad shall extend 6" beyond the generator set base, unless shown otherwise. Furnish the exact position of any block outs, mounting bolts, and the dimensions and location of the generator pad in a timely manner so as to prevent delay of the concrete work. Refer to Section 26 05 00 for housekeeping pads and Division 3 for Concrete Work.

E. Options and Accessories: Provide circuits, conductors, and raceways as required for generator options and accessories as required and specified. Provide separate dedicated circuits from the emergency branch circuit panel board to the generator for (1) engine/ coolant heaters, (2) GFCI convenience receptacle(s), (3) battery charger (LED work lights on battery), etc. Provide additional circuits as required, for a fully operational system.

F. Provide remote alarm annunciator. Coordinate final location of annunciator with Owner / Architect prior to installation. It shall be installed near ATS.

G. Provide dry contacts and outputs to monitor transfer switch and generator alarm conditions and notify Owner’s Police or security personnel, and building management controls system and personnel, both when transfer to emergency occurs and when transfer to normal occurs.

H. Adjust main output circuit breaker(s) adjustable trip setting based on manufacturer’s fault current and coordination analysis or as directed by Engineer.

3.2 GROUNDING

A. Install the generator as a separately derived system. Ground the generator neutral to the generator frame. Ground the generator frame to the building grounding system and provide a driven ground electrode at the generator location.

3.3 CONTROLS

A. Provide generator start-up control wiring and raceway from each automatic transfer switch to the respective standby generator set as required.

3.4 TESTING

A. Notify Owner’s Commissioning Authority (CxA) prior to performing any tests so the CxA may witness tests at his/her discretion. Refer to Section 26 01 00 Commissioning of Electrical Systems. Testing shall be witnessed by owner and Engineer.

B. Provide testing in accordance with NFPA 110. Upon completion of installation of engine-driven generator set and after building circuitry has been energized with normal power

source. Provide manufacturer's start-up service to test emergency power system to demonstrate standby capability and compliance with specified requirements, including automatic start-up, controls and full load acceptance. Test shall include operation of standby power system with voltage check while the system is loaded to ensure proper operation of the emergency generator, transfer switches, and other system components. Operation of the system shall simulate standby power conditions, that is, loss of main electrical power to the building. Test period shall be trouble-free operation with at least four automatic transfer switch operations (each switch) within the period of operation.

1. The unit shall be started and run for 30-minute break-in period at no-load unless recommended otherwise by manufacturer.
2. The unit shall be started cold and run for a four-hour test with building load connected and load bank to achieve 90 percent of rated generator capacity. Monitor and record available natural gas pressure and verify supply is adequate and stable during the entire test.
3. Retransfer the load after test.
4. After this test, the set shall cool for five minutes, then must start and carry 90% rated capacity load for four hours.
5. Provide additional Owner witnessed testing for all ancillary equipment on generator. Demonstrate all specified functions and alarms.
6. Demonstrate the cranking cycle and all engine safety devices. The Owner's authorized representative shall be instructed in the operation and maintenance of the unit. Provide minimum 4-hours training at each campus for 4-persons; one hour on four separate days

C. Contractor shall furnish all instruments, load banks, and personnel required for test. Submit 4 copies of certified test results to Architect/Engineer for review. Test reports shall include date and time of test, relative humidity, temperature and weather conditions.

3.5 MISCELLANEOUS

A. Provide circuits and receptacles to serve loads as directed by Owner / Architect, including, but not limited to:.

1. Telecommunications equipment
2. Public Address Communication & Master Clock System
3. Fire Detection Alarm and Signaling Systems including remote transponder panels and alarm power supply panels
4. Security Systems including remote power supplies (except for battery powered access control door hardware)
5. Video Surveillance CCTV System including remote camera power supplies
6. All receptacles and outlets in MDF/IDF rooms.
7. Technology MDF/IDF room dedicated HVAC equipment
8. Walk-in coolers/freezers and selected reach-in refrigeration equipment
9. Clinic refrigerator and selected clinic receptacles
10. Building Access control System including remote power supplies, except do not power door electric strike or hinge hardware on emergency power.
11. Owner's Radio Base Station and handset charging equipment / Radio Repeaters / Distributive Antennae Systems (DAS)
12. Elevators, ADA chair/personnel lifts
13. Point of Sale Stations
14. Kitchen Manager's Workstation
15. Building Management and Control System (BMCS)
16. Special education receptacles, minimum one in each room.
17. First responder Bi-Directional Distributive Antennae System (DAS) Systems

B. Mount annunciator alarm as directed by Owner / Architect. Coordinate final location of ATS with Owner / Architect prior to installation. Install next to ATS.

3.6 PROGRAMMING

A. Program automatic transfer switches for delayed transfer to emergency and sequential operation to transfer loads by priority based on manufacturer recommendation or as indicated below:
   1. Life Safety Loads – less than 10 seconds
   2. Critical Loads – more than 15 seconds, less than 30 seconds
   3. Equipment Loads – more than 40 seconds, less than 60 seconds
   4. Non-Legally required loads – more than 75 seconds, less than 120 seconds

B. Program automatic transfer switch voltage and frequency pick-up and drop out for load shedding based on load priority for voltage and frequency based on manufacturer recommendations or as indicated below:
   1. Life Safety pick-up 10%; drop out 20%
   2. Critical Loads pick-up 10%; drop out 15%
   3. Equipment Loads pick-up 8%; drop out 15%
   4. Non-Legally required loads pick-up 5%; drop out 10%

C. Exerciser clock: Program automatic transfer switch exerciser clock for generator to run every Tuesday, 8:00 AM, for 15-miniute run time, without load. Verify with Owner.

D. Test switch: Program automatic transfer test switch for generator to run with load, for minimum 30-miniutes to comply with NFPA 110 requirements for monthly testing. Maximum test time shall not exceed 35-miniutes unless directed otherwise by Owner.

E. Program engine cooldown time as recommended by the manufacturer.

3.7 TRAINING

A. Provide 4 hours training, one hour each for four persons, four separate days.

END OF SECTION

SECTION 26 43 00 - SURGE PROTECTION DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

A. The Surge Protection Device (SPD) covered under this section includes service entrance type surge protection devices suitable for use as Type 1 or Type 2 Devices per UL1449 5th Edition, applied to the line or load side of the utility feed inside the facility. SPDs 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 Fifth 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

B. When requested for verification, provide copies of the following:
1. 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.
2. 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.

1.3 SUBMITTALS

A. Submit shop drawings complete with all technical information for specific unit dimensions, let through voltage data, detailed installation instructions, maintenance manual, and wiring configuration.

B. Provide detailed marked-up copy of this specification with line-by-line compliance or exception statements to all provisions of this specification.

C. Copies of Manufacturer’s catalog data, technical information and specifications on equipment.

D. 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 5th Edition and UL 1283.

F. Copy of warranty statement clearly establishing the terms and conditions to the building/facility owner/operator.

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 extended 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 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. DEHN Current Technology PX3-050-VVV- #X-SF-X-F- # series.
      c. SST Southern Tier Technologies T45-VVVV-50-AWAJ2-C-RKSS (stainless steel front).
      d. PSP H#C200-04NT1-H4-FMCSS series (stainless steel front).
      e. SSI Surge Suppression, Inc. CSMx12-FMPxSS series.
   2. Branch panelboard surface mounted:
      a. ACT Communications 455 series.
      b. DEHN Current Technology CG3 60 series.
      c. SST Southern Tier Technologies T45-VVVV-50AWAJ2-C
      d. PSP H#C200-04NT1 series
      d. SSI Surge Suppression, Inc. CSMx12 series.

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. DEHN Current Technology CGP3 125 series.
   3. SST Southern Tier Technologies T45-VVVV-120A series
   4. PSP H#C200-04NT1 series
   5. SSI Surge Suppression, Inc. CSMx24 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. DEHN Current Technology TG3 200 series.
   3. SST Southern Tier Technologies T45-VVVV-200A series
   4. PSP H#C200-04NT1 series
   5. SSI Surge Suppression, Inc. CHLxM series.

D. Very high exposure at service entrance 1,201 Amps and above: Minimum 20-year parts warranty; minimum 300k Amps per mode; 600k Amps per phase, Type 1 and 2 SPD:
   1. ACT Communications 471 x300 SEL series.
   2. DEHN Current Technology SEL3 300 series.

   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: Values Depicted are based on a system Without Disconnect / With Disconnect

System Voltage	Mode	MCOV	UL 1449 VPR Rating
120/240	L-N	150	700/1200
120/208	L-G	150	700/1200
	N-G	0	900/1200
	L-L	300	1000/1200
277/480	L-N	320	1000/1200
	L-G	320	1200/1200
	N-G	0	1200/1500
	L-L	550	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.

E. Each Unit shall provide the following features:
1. Phase Indicator lights easily visible in high ambient light conditions, Form C dry contacts, counter and audible alarm.
2. Field testable while installed.

3. High performance interconnecting cable for hard wired non-pigtail units.
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 for hard wiring and shall have mechanical lugs that can accept up to #2 AWG wire on High and Very 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 high and very-high SPDs and switchgear shall be high performance interconnect system “Low Z Cable” cables with Ultra Low impedance characteristics at 10kHz and above.

B. High Performance Low Impedance cable for hard wired SPDs shall be #6 AWG minimum for Very High, High, and Medium Exposure SPDs and #10 AWG minimum for Low Exposure SPDs. Low exposure pig tail units shall utilize the factory provided cables, cut to shortest and straightest run, without splices, wiring through conduit nipple only.

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 device for disconnect shall be provided as 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 material and finish. Provide brushed stainless-steel front at kitchens and food processing areas.

3.2 UNIT SELECTION BASED ON EXPOSURE LEVEL

A. (SPDSEL) Provide very-high exposure SPDs with Selenium and TPMOV technology for the following new electrical or where indicated:

1. Service entrances with very high transient exposure and/or subject to utility temporary over voltages and/or projects deemed Mission Critical.

B. (SPDH) Provide high exposure SPDs for the following new electrical equipment or where indicated:
   1. Service entrance rated above 800 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, shortest cable connection, and initiate factory warranty. The technician will be required to do the following as a minimum:
   1. Verify the installation follows applicable national / local electrical codes related to SPDs and the manufacturer's Installation, Operation and Maintenance Instructions and recommendations.
   2. 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.

END OF SECTION

SECTION 26 51 13 - 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 luminaries 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.

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
      Acuity
      Signify
      Cooper Lighting Solutions
      Pinnacle
      HE Williams
      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
      Lithonia
      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.
      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.

i. Color Rendering Index (CRI): ≥ 80 Indoor; ≥ 65 Outdoor

j. 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, cafetoriums 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 (±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 µs, 10kA/8 x 20 µs) 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): ≤ 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.

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, cafetoriums and kitchens.

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.

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.

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.

END OF SECTION

SECTION 26 55 61 – THEATRICAL LIGHTING SYSTEM

GENERAL

1.1 INTENT

A. The intent of this specification is to define parameters for furnishing and installing a complete and working new theatrical dimming and control system. Performance deviations will not be accepted.

B. All work must be done in compliance with the National Electric Code and applicable local codes.

C. Contractor is responsible for providing a complete working system. All items needed for a complete working system meeting the design intent of the plans and specifications are to be included, even if not specifically listed.

1.2 APPROVED EQUIPMENT

A. Dimming and control equipment: Approved manufacturers:
   a. Basis of design: Electronic Theatre Controls
   b. Lehigh

B. Distribution: Approved Manufacturers:
   a. Electronic Theatre Controls
   b. Lehigh

C. Lighting Fixtures: Approved manufacturers:
   a. Electronic Theatre Controls
   b. Lehigh

1.3 SUBSTITUTIONS

A. Specific items of equipment are listed by trade names. It is neither the purpose nor intent of these documents to eliminate competitive proposals. In order to allow proper and fair comparison of pricing, each contractor is required to submit his base bid price on the specified equipment.

B. A substitution will not relieve the contractor from the responsibility of meeting all specification criteria. If an approval of a substitution is granted, the Contractor shall be fully responsible for any and all changes such substitution shall require.

C. Equipment physical dimensions and weights indicated are nominal and any substitution shall be similar in size and weight to fit the required space and present similar aesthetics if in public view.

D. Electrical and other performance specifications shall be reasonably the same withing a 10-percent tolerance or exceed the performance parameters specified acceptable to the Architect, Engineer, and Owner.

1.4 QUALITY ASSURANCE

A. To ensure a uniform installation and single responsibility, one manufacturer shall provide all dimming and control system components. Mixing of equipment brands will not be accepted.

B. Manufacturer shall provide local on-site service for the system for a period of two years from date of acceptance by the Owner. This person or firm must be regularly engaged in the service of dimmers. A salesperson or sales agent or distributor without dedicated service personnel does not meet this requirement.

C. This specification details specific operational and functional needs of the system. Deviations from the performance requirements will not be accepted from any supplier. Contractor assumes the responsibility of removing any non-complying material discovered during the warranty period and replacing it with specification compliant equipment.

D. Due to the specialty nature of theatrical lighting equipment, a Theatrical Systems Contractor shall provide the theatrical dimming and control equipment to the Project Electrical Contractor, as well as providing support and coordination services to ensure a complete working system.

E. Riggers shall be ETCP Certified Riggers for Theatre.

F. The Theatrical Systems Contractor shall be an authorized dealer of the specified manufacturers and have been actively engaged in the sales, installation, repair and maintenance of theatrical lighting equipment for no less than five full (5) years. Evidence of experience for projects of similar size and scope shall be submitted if requested. This evidence shall include a reference list for a minimum of five projects including: job name, contact name and phone number, scope and contract value.

1.5 SERVICES

A. Services of a qualified technician, representing the manufacturer, and employed full-time in the service of control systems, shall be provided. This technician shall terminate all low voltage control wiring, inspect the installation, and energize the system. He shall also instruct the Owner in proper operation and maintenance of the system.

B. During the warranty period, the manufacturer shall provide a 24-hour per-day number for telephone technical support and service requests.

C. The Theatrical Systems Lighting Contractor shall be responsible for the following due to the specific technical nature of theatrical lighting control systems:
1. Provide all dimming, control, and distribution equipment as detailed and required in these specifications and associated drawings
2. Provide shop drawings indicating system layout, control wiring, physical mounting locations, and mounting techniques of all equipment
3. Provide and install dead hung pipes, pipe mounted circuit boxes, and raceways as required. Provide rated mounting hardware as required for hanging positions.
4. Provide Factory Authorized Service Technician to perform system commissioning, low voltage terminations, installation of control plates, system programming, and minimum 4 hours dedicated system training to Owner’s Representative.
5. Provide all lighting fixtures and accessories as indicated or required. All fixtures shall be unboxed, addressed, hung, and focused.
6. Setup the controls with several basic looks appropriate for the following: (a) Assembly or speaking event (b) Choir concert or orchestral performance (c) a theatrical performance. Provide training to the Owner on how to adjust the light levels and colors, and how to create record additional looks into control system.
7 The theatrical lighting control console shall be set up, patched, and sample cues written as part of the training.

D. The Project Electrical Contractor shall be responsible for the following:
   1. Installation of all dimming and control racks and equipment, including mounting of racks on walls, power feeds as required, and installation of custom back boxes.
   2. Provision and installation of all standard back boxes
   3. Provision and installation of all 120 Volt distribution circuits, and all 120/208 Volt feeder circuits for the theatrical lighting system
   4. Terminating of all 120 Volt and 120/208 Volt power and distribution circuits, both in the dimmer cabinet, and at the circuit distribution.
   5. Provision and installation of all conduits, junction boxes, electrical wire ways, and cable trays as required for the lighting systems, including low voltage control systems conduits.
   6. Pulling all high and low voltage cables into conduit
   7. Clean all racks, panels, and boxes of dirt, dust, and debris, reassemble all equipment, and replace all panels, covers, and screws prior to time of system factory energization and training
   8. Coordination with the Theatrical Systems Lighting Contractor on all aspects of the rigging and electrical installation and low voltage cable runs. Follow all manufacturer submittal plans and installation recommendations. Actively facilitate coordination with the General Contractor and Structural Engineer for all structural attachment needs. Schedule adequate time at the end of the job for Theatrical Systems Contractor to commission the system prior to project substantial completion.
   9. At time of System Commissioning, Project Electrical Contractor is responsible for providing access to all low voltage termination points for termination and testing to the Service Technician. This includes lifts, ladders, and personnel required to reach any position the Service Technician needs access to. Electrical Contractor shall also provide personnel as needed to the Service Technician for troubleshooting and any needed wiring changes, terminations, or testing. These personnel shall be made available whenever the service technician is on the job site.
   10. Electrical Contractor is responsible for advanced scheduling with the Theatrical Systems Contractor. Theatrical Systems Contractor shall be given at least 21 days' notice of request for system startup. Electrical Contractor is responsible for having all equipment installed and wiring pulled & terminated prior to the arrival of the Theatrical Systems Contractor Service Technician for commissioning.

1.6 DRAWINGS

A. Submittals shall be in .pdf format and consist of:
   1. Specification section line-by-line compliance, refer to Electrical Shop and Coordination Drawings specification section for additional requirements.
   2. Detailed bill of materials and services
   3. Control riser showing system layout and point to point wiring diagrams
   4. Scaled drawing indicating system layout, control wiring, physical mounting locations off all fixtures.
   5. Manufacturer data sheets with provided equipment and accessories marked.
   6. ETCP Certifications for individuals installing rigging.

B. Submittal drawings will be updated with "As Built" conditions after installation and turned over at the close of the project in .pdf format shall be provided with the Operations and Maintenance Manuals.

C. Operations and maintenance manuals, covering all major items installed, shall be provided with the Operations and Maintenance Manuals.

D. All Drawing requirements for submittals and as built detailed general sections of specification shall apply.

1.7 WARRANTY

A. The dimming manufacturer shall provide a two (2) year warranty on the entire theatrical lighting system from date of acceptance.

B. The dimming manufacturer shall provide a five (5) year warranty on all LED light fixtures. The LED light array shall have a ten (10) year warranty.

PART 2 - PRODUCTS

2.1 DIGITAL MINI PANELS

A. Product: Unison Foundry DMX Mini Control Panels by ETC, Inc. DMX controlled lighting. Fully rated 20 Amp relays and optional 0 to 10 Volt control per zone. Demand Response input for energy saving integration and UL 924 emergency lighting control bypass with power loss sense. Flush or surface mount.
   1. Model UFMP4: 4-zone DMX Mini Panel.
      a. Relays: 4. For switching for lighting and plug loads.
      b. Dimming Outputs 0 to 10 Volt.
   2. Model UFMP8: 8-zone DMX Mini Panel.
      a. Relays: 8. For switching for lighting and plug loads.
      b. Dimming Outputs 0 to 10 Volt.
   3. Standards Compliance: cULus and UL 924 Listed. Rated for plenum installation.
      a. Suitable for plug load control.
   4. Functional:
      a. Emergency Lighting Control: UL 924 via contact closure and power loss sense feed terminal.
      b. Demand Response Input.
      c. Supports USITT DMX512-A; ANSI E1.11.
      d. Supports RDM; ANSI E1.20.
   5. Mechanical:
      a. Finish: Black powder coat.
      b. Mounting: Wall, Flush-mount. Rated for installation in plenum air space.
      c. Mounting: Wall, Surface-mount. Rated for installation in plenum air space.
      d. Voltage Divider: Allows for separation of normal and emergency circuits in a single controller were allowed by local codes.
   6. Electrical:
      a. Power Input: 100 to 277 VAC, 50/60 Hz per circuit with support for passing thru to multiple circuits.
      b. Single Phase Sense Feed Input: 100 to 277 VAC.
      c. Supports 120 VAC and 277 VAC circuits within the same panel.
      d. Fully Rated Bi-State Latching Relay per Output: 20 A.
      e. Control Rated: 0 to 10 VDC for up to 100 mA sink per output.
         1) Outputs 0 to 10 V: Fully isolated from ground to 2500 V RMS.
      f. Demand Response input supports Normally Open (NO) operation.
      g. UL 924 contact closure input supports normally open (NO) or normally closed (NC) operation.
      h. Onboard status indicators for controller power, DMX signal, Demand Response input, and UL 924 emergency lighting control.
      i. Slide Switch Configuration For:
         1) UL 924 operation; NO/NC.
         2) UL 924 inclusion per circuit; On/Off.

7. Relays: Mechanically held.
8. DMX Input Port:
    a. Integrated DMX/RDM termination.
9. Thermal: Operating range limits.
    a. Temperature: 32 to 122 degrees F (0 to 50 degrees C).
    b. Humidity non-condensing: 5 to 95 percent

2.2 FIXTURE-MOUNTING TRACK System

A. Track System
1. The track system shall be OneTrack by ETC and OneTrack Backbone as supplied by ETC, Inc.
2. Track system shall provide two 20-Amp circuits with discrete neutrals and a data bus that supports DMX, DALI, or 0-10V control.
3. System shall allow for power and data to be supplied via end feeds our couplers
4. Track shall support up to 35 pounds per foot of connected equipment when properly supported.
5. System shall include rigid Backbone mounting option:
    a. OneTrack shall mount securely into Backbone
    b. Backbone shall support suspension mounting with a maximum unsupported span of 10’
    c. Backbone shall support maximum point loads of 100 lbs.
    d. Backbone shall support a maximum distributed load of 800 lbs. if supported at a minimum of 2’ on center
    e. Backbone shall support installation of non-track-mounted luminaires; track within Backbone shall support installation of track-mount luminaires and pigtail adapters

B. Mechanical - Track
1. Tracks shall be constructed out of extruded aluminum.
2. Track sections shall be available in various lengths and shall support being cut in the field if required
3. Track shall have pre-punched holes for surface mounting
4. Track shall be UL Listed for wall mount, vertical mount, and angled mount applications
5. Tracks shall be available in black and white. Custom color options shall be available

C. Mechanical - Backbone
1. Backbone shall be constructed out of extruded aluminum alloy.
2. Backbone sections shall be available in various lengths and shall support being cut in the field if required.
3. Backbone shall support standard Unistrut mounting hardware for installation
4. Backbone shall be available in black, white, and silver. Custom color options shall be available

D. Accessories – Track
1. A variety of track feeds and couplers shall be available including:
    a. End Feed
    b. I-Coupler
    c. L-Coupler
    d. T-Coupler
    e. X-Coupler
    f. Flex-Coupler
    g. Current Limiting End Feed
    h. Current Limiting I-Coupler

i. Electrical Straight Coupler

2. Track fixture adapters and couplers shall be made of a polycarbonate material and shall be available in black and white
   a. Track fixture adapters shall support up to 11 lbs. on standard track or 22 lbs. when used on Backbone with a retaining collar
   b. Track fixture adapters shall provide a mechanical lock to the track and shall provide a set screw for securing fixture stems within the adapter collar
   c. Track feed and coupler accessories shall provide a set screw to hold the part securely in the track after installation
3. Installation kits and accessories shall be available including:
   a. Wire Rope suspension mounting kits
   b. Pendant stem suspension mounting kits
   c. Threaded rod suspension mounting adapters
   d. T-bar mounting clips
   e. Canopy covers

E. Accessories - Backbone

1. Coupler Housings:
   1) L-Coupler
   2) T-Coupler
   3) X-Coupler
2. Coupler Housings with Pull Boxes
   1) End Feed
   2) I-Coupler
   3) T-Coupler
   4) X-Coupler
3. Fixture Hanger Brackets
4. Straight locking joint
5. Fixture Pigtail Adapters to include 24” cables in the following plug combinations:
   1) powerCON and 5-pin XLR for DMX data transmission
   2) TRUE1 TOP and 5-pin XLR for DMX data transmission
   3) TRUE1 TOP only for use with luminaires that have integrated wireless DMX capability
6. Track adapters fitted with general-purpose receptacles that violate NEC requirements shall not be accepted.

F. Electrical

1. Track shall be rated for 120VAC power input of two 20 A circuits with a maximum load of 16 A per circuit.

G. Circuits shall have individual neutral conductors

1. Track shall support a low voltage circuit up to 60 Volt for low voltage control.
2. Fixture adapters shall be capable of supplying both power and low voltage control circuits from the track to the fixture.
3. Track system low voltage circuit shall support DMX-512A and bi-directional RDM data transmission:
   1) Up to 32 DMX devices on up to 60-foot of track
   2) Up to 20 DMX/RDM devices on up to 60-foot of track
   3) A DMX terminator accessory with a 120 Ohm resistor shall be available.

2.3 ECHO TOUCH CONTROLLER STATION

A. Touchscreen Control Stations to be Unison Echo EchoTouch Controller Mk2 by ETC, Inc. Controls 512 DMX addresses on up to 80 control zones.

1. Standards Compliance: cULus Listed and CE Compliant. FCC Compliant.

2. Operation: Graphic buttons, faders, and images on at least 7 user programmable default and fully graphical control pages.
3. Touchscreen: Integrated with ETC Unison Echo Controls.
    a. Seven-inch, backlit liquid crystal display. Resolution: 800 by 400 pixels minimum, with capacitive multi-touch interface.
    b. Bezels: Cast aluminum. Finish: Fine texture powder coat.
        1) Four colors: Cream, Gray, Black, or Signal White.
        2) No visible means of attachment.
    c. Supports Surface, Flush and Rack Mounting.
        1) Flush-mount: To industry standard 3 gang back box.
        2) Surface Back Box as required.
        3) Rack Mounting: Fit in standard 19 inch (483 mm) racks, no taller than 3 EIA rack units.
4. Electrical:
    a. RJ45 Ethernet Port: Connection to lighting system and Power over Ethernet.
    b. Control Wiring: EchoConnect Connection terminals.
        1) Low-voltage, Class II unshielded twisted pair, type Belden 8471 and one No. 14 ESD drain wire, when not installed in grounded metal conduit.
        2) Topology free. Point-to-point, bus, loop, home run, or any combination.
    c. Power Input, Non-PoE: Two, No. 16 AWG stranded wires for 24 VDC.
    d. Typical Power Draw: 400 mA.
    e. Firmware Maintenance: USB type A connector.
    f. Network:
        1) Network Cabling: Category 5 or better. Conform to TIA-568A/B. Installed by qualified network installers.
    g. Functional System:
        1) Presets: Contained in non-volatile electronic memory.
        2) Internal sequences: Record user-selected zone levels.
        3) Touchscreen: Equipped with on-board help system.
        4) Software upgrades: Via USB drive only.
        5) USB Port: Show data to be saved for archival or transfer to other consoles or a personal computer.
    h. Patching: Facilities for dimmers and multi-parameter devices via built in library of fixture definitions.
        1) Fixture Library: Updated via software-based updates. Create custom fixture definitions using offline application.
        2) Touchscreen: Support patching, address setting, and mode changes using Remote Device Management (RDM) on local DMX/RDM port.
    i. Playback Control: Customizable zone display. Rearrange graphical representations for control channels to mimic fixture positions in installation.
        1) Seven user customizable interactive pages.
        2) Color and white pickers.
        3) Touch-based parameter controls with reference-based palettes.
        4) Virtual level wheel.
    j. Layout and Configuration: View and modify layout of user pages.
        1) Add, remove, or edit the following items: Preset buttons, Off buttons, Sequence buttons, Zone and space modifier button, Space combine buttons, and Zone fader.
        2) Three Options for Inactivity: dim screen to low run of show brightness level, turn screen off, or display user chosen inactivity image.

3) Multiple Configurations: May be stored within an LCD Station.

5. Time Clock: Touchscreen built-in astronomical and real time event engine allowing presets and sequences activation.
   a. Support 80 Events: Astronomical, real-time, and manual control events in 16 control spaces.
   b. Timed Events: Programmable via Touchscreen.
      1) Assigned to day types.
         a) Day Types: everyday, weekday, weekend, and day of week.
      2) Activation: Based on sunrise, sunset, time of day, opened and closed events and configurable state-based engine.
      3) Compensate for regions using daylight saving time.
      4) Assignment to events via time clock user interface.
      5) Resumes automatically after power loss.
   c. Support timed event hold. Meet CA Title 24 requirements.
6. External Control: Control of lighting system through built-in UDP integration.
   a. Supports full control of lighting systems using UDP strings.
      1) Security settings to limit incoming control strings to subscribers-only.
   b. Supports up to two subscribers for receiving status messages.
   c. Control and status integrations from 3rd party systems include:
      1) Zones.
      2) Channels.
      3) Presets.
      4) Spaces.
      5) Sequences.
      6) Lockout.

2.4 DATA PLUG-IN STATIONS

A. Provide Data Plug in stations as indicated.

B. General
1. The Plug-in Stations shall consist of the appropriate connectors required for the functional intent of the system. These stations shall be available with DMX input or output, network, architectural control connectors, or diplex outlet. Custom control connectors shall be available.

C. Connector Options
1. The following standard components shall be available for Plug-in Stations:
   5-Pin male XLR connectors for DMX input
   5-Pin female XLR connectors for DMX output
   RJ45 connectors for Network connections - Twisted Pair
   6-Pin female DIN connectors for Unison connections
   DB9 female serial connector for architectural control from a computer
   NEMA 5-15 duplex receptacle for power connection
2. Custom combinations and custom control connections shall be available.

D. Physical
1. Station faceplates shall be aluminum, finished in fine texture, scratch-resistant black powder coat. Silk-screened graphics shall be white.
2. The station panel shall mount into an industry standard back box. Depending on size and quantity of connectors, a terminal block shall be supplied for contractor termination.
3. When AC Power is present, a voltage divider shall be provided

4. Optional Backbox and U-bolt kit shall be provided for installations where mounting to pipes

2.5 DISTRIBUTION

A. Connectors shall be available as 20A, 50A and 100A grounded stage pin, 20A twist lock and 20A “U” ground (dual rated “T-slot”); other connectors shall be available as specified.

B. Pigtails shall be three-wire type “SOW” rubber jacketed cable sized for the maximum circuit ampacity.

C. Pigtails with 20-Amp stage pin connectors shall be terminated using 12-gauge 4 way indent crimp (with inspection window) type where the wire is inserted and crimped directly in the socket.

D. Terminations for pigtail connectors shall utilize feed- through terminals individually labeled with corresponding circuit numbers. Terminals that place a screw directly on the wire are not acceptable.

E. Outlet and pigtail boxes shall be supplied with appropriate brackets and hardware for mounting as shown on the drawings

F. A low voltage distribution system shall be available to incorporate DMX, Ethernet or other protocols as specified in the power distribution box. A voltage barrier shall be used to separate the low voltage wiring for the electrical circuits.

G. Power distribution equipment shall be listed by a nationally recognized test lab.

H. Outlet and pigtail boxes shall be 6.25” H x 3.3” D and fabricated from 18-gauge galvanized steel and finished in black fine-texture powder coat paint. Covers shall be fabricated from 16-gauge galvanized steel

I. Outlet and pigtail boxes shall be available in any length specified in increments of 3-inches with a maximum length of up to 3-foot.

J. Pigtails and outlets shall be spaced on 18” centers, or as otherwise specified.

K. Outlets shall be mounted on individual 3” panels.

L. Circuits shall be labeled with 1.25” lettering.

M. Wiring devices shall be Listed by UL Laboratories.

2.6 ENTERTAINMENT CONTROLS - RESPONSE

A. Gateway Series:
1. Product: Response Mk2 DIN Gateways by ETC Inc. DIN Gateway provides data distribution using the quality and reliability of ETC's network technology. Built for Net3 using industry-standard sACN, DMX and RDM.
   a. Model: RSN-DMX1-DIN Response MK2 1-port Gateway - DIN Rail.
   b. Model: RSN-DMX2-DIN Response MK2 2-port Gateway - DIN Rail.
   c. Model: RSN-DMX4-DIN Response MK2 4-port Gateway - DIN Rail.
   d. Standards Compliance: cETLus Listed, CE compliant, UKCA compliant, RoHS compliant, WEEE.

e. Functional:
1) Supports Net3/ACN (ANSI E1.31 and E1.17), RDM (ANSI E1.20), and USITT DMX512-A (ANSI E1.11).
2) Compliance: USITT DMX512 and ANSI E1.11 DMX512-A.
3) Flexible Output Patch: Allows a 512-address universe to begin at any output address.
4) Advanced Input Patch.
5) Support for per-address- or per-universe-level priority.
6) Delay Time from Input to Output: Not greater than one packet time.
7) Selectable DMX Refresh Rate: Maximum of 40 Hz.
8) Supports 255 total RDM devices.

f. Mechanical:
1) Intuitive four-button interface.
2) Onboard display for identification, status, and configuration.
3) Molded plastic enclosure.
4) Mounting: Complies with DIN43880 (35/7.5 rail).
5) DIN installation enclosure available.
6) Network, power, and data activity LED indicators.
a) Blue power indicator, green network activity indicator.
b) Bi-color DMX activity indicator.
7) RJ45 connector for connection to lighting network.
8) Reset button for hard reset or forced reboot.

g. Environmental:
1) Ambient operating temperature: 32 to 104 degrees F (0 to 40 degrees C).
2) Operating Humidity: 5 to 95 percent non-condensing.
3) Storage temperature: Minus 40 to 158 degrees F (Minus 40 to 70 degrees C).

h. Electrical:
1) Compliant with IEEE 802.3i for 10BASE-T, 802.3u for 100BASE-TX and 802.3af for Power over Ethernet.
2) Power Input: 12-24 VDC for use with non-PoE systems.
3) Pluggable terminals for solid and stranded cable provided.

i. Configuration:
1) Local configuration options.
2) Remote configuration by Net3 Concert.
a) Supports 512 DMX addresses per port.
b) Supports 63,999 Streaming ACN universes.
3) DMX data input or output configurable by user.
4) Multiple sources may be combined to the network with each source or address allowed an independent priority.
5) Individual port start addresses and offsets.
6) User-configurable labeling.

B. Opto-Splitter Series:
1. Product: Response Opto-Splitter by ETC Inc. Provides quality and reliable DMX data distribution using industry-standard DMX and RDM.
a. Model: RSN-OPTO-8DIN. 8 Port DIN rail - Terminal.
b. Standards Compliance: cETLus Listed, CE compliant, UKCA compliant, RoHS compliant, WEEE.
c. Functional:
1) No configuration required.
2) Supports DMX512, DMX512 (1990), DMX512-A, ANSI E1.20 Remote Device Management (RDM).
3) Supports 256 total RDM devices.

d. Mechanical:
   1) Rack-mount form factor:
      a) Fabricated from aluminum.
      b) Black, Fine-textured, powder-coat finish.
      c) Full 19-inch equipment rack width.
      d) Front or rear facing mounting options.
   2) DIN rail form factor:
      a) Molded plastic enclosure.
      b) Mounting complies with DIN43880 (35/7.5 rail).
      c) Unit is 9 DIN units wide.
      d) DIN installation enclosure available.
   3) Power and data activity LED indicators.
      a) Blue power indicator.
      b) Green DMX activity indicator.
e. Environmental:
   1) Ambient operating temperature: 32 to 104 degrees F (0 to 40 degrees C).
   2) Operating Humidity: 5 to 95 percent non-condensing.
   3) Storage temperature: Minus 40 to 158 degrees F (Minus 40 to 70 degrees C).
f. Electrical:
   1) Supports DMX input and DMX thru.
   2) Provides optically isolated DMX/RDM outputs.
   3) Rack-mount form factor:
      a) Power Unit: 100-240 VAC 50/60 Hz.
      b) User configurable front or rear IEC C13 power connector position.
      c) Power Draw: 35 W max
      d) XLR, RJ45 and Terminal connector options.
   4) DIN rail form factor:
      a) Power Input: 12-48 VDC power input.
      b) Power Draw: 8 W max
      c) Wiring connections use pluggable clamp style terminals for solid and stranded cables.
   5) DIN Box form factors include a suitable power supply.

2.7 ENTERTAINMENT CONTROLS (COLORSOURCE)

A. Product: ColorSource Consoles manufactured by ETC Inc.
   1. Model CS40: 40 Fader ColorSource console; 80 Channels or Devices.
      a. 80 channels / multi-parameter devices.
      b. 40 Channel / Playback faders with color indication.
      c. DMX/RDM Port: One.
      d. USB Port: One.
      e. Onboard Storage for Show Files: 2 GB.
   2. Mechanical:
      a. One home and five configurable soft key buttons.
      b. Four configurable function faders.
      c. Color Multi-Touch Touchscreen: 7 inch.
   3. Playback Controls:
      a. One cue list with 999 cues.
      b. 10 pages of 20 or 40 playbacks.
         1) Static memories or sequences.
      c. Playback Toy for filtered and timed execution of playbacks.
      d. Multiple bump modes: Flash, Solo, Solo Change, Move/Go.

e. Full-history rubber banding for playbacks.
f. On-board help system.
g. Extensive library for controlling moving lights.

4. Media:
   a. Audio Input Type:
      1) 1/8-inch (3.5 mm) TRS, Stereo, unbalanced.
      2) Line in: -10 dBV (316 mV RMS).
      3) Input Impedance: 29k ohms.
   b. Audio Output Type:
      1) 1/8-inch (3.5 mm) TRS, Stereo, unbalanced.
      2) Line Out: -10 dBV (316 mV RMS) at 10k ohms "Line Level".
      3) Load Impedance: 10k to 200k ohms.
   c. Supported Media File Formats: Visual output is limited to still images and effects from the VideoToy feature of the ColorSource AV console. Movie files are not supported.
      1) Audio: mp3, aac and wav files. 44.1 kHz sample rate, 4 GB max file.
      2) Image: jpg, png, tiff, and bmp files. 1280 x 720 max resolution.
5. Regulatory and Compliance: cETLus Listed. CE Compliant.
6. Programming Tools:
   a. Color and white pickers.
   b. Reference based Position, Color and Beam palettes.
   c. Innovative touch-based parameter controls.
   d. Auto fixture selection on fader moves.
   e. Virtual Level/Rate wheel.
   f. Customizable Channel display using Stage Map.
   g. Effects: Intensity, color, shape, and parameter.
   h. Fixture Tags for Quick Selects.
   i. 27 Quick Select groupings.
   j. Two independent channels.
   k. Virtual keypad for level entry.

2.8 COLOR MIXING LIGHT EMITTING DIODE PROFILE

A. Basis of Design: ColorSource Spot V and ColorSource Spot VXT as manufactured by ETC Inc. Brings together a five-color light engine with the build-quality and support of an ETC product. Uses a mix of red, green, blue, indigo and lime LED emitters. ETC optics, adapters, and accessories.

B. Standards Compliance:
   1. Listed: cETLus, UL 1598, UL 924, CSA C22.2 No. 250.0.
   2. Compliance: CE.

C. Model ColorSource Spot V with shutter barrel, black.

D. Source:
   1. LED Details: 60 Lumileds LUXEON Rebel and LUXEON C LEDs.
   2. Max Lumens: 9300.
   3. Lumens per Watt: 47.2.
   4. L70 Rating: Greater than 54000 hours.

E. Colors:
   1. Colors Used Spot: Red, green, blue, indigo, lime.
   2. Color temperature Range: Color mixing.
   3. Calibrated Array: Yes.

4. Red Shift: No.

F. Optical:
1. Beam Angle Range: 5 to 90 degrees. Swappable lens tubes.
2. Gate Size: 80 mm.
3. Aperture Size: 6.25 to 14 inches depending on lend tube.
4. Pattern Projection: Yes.
5. Pattern Size: A or B.
6. Camera Flicker Control/Hz Range: 5 kHz and 25 kHz.

G. Control:
1. Input Method
   a. DMX-512 via 5-pin XLR connector. Protocols: DMX512, RDM.
   b. City Theatrical Multiverse. Protocols: DMX512, RDM.
2. NFC Configuration: Yes, via Set Light app.
3. RDM Configuration: Yes.
4. User Interface Type:
   a. ColorSource Spot V: 7-segment 3 button interface.
   b. ColorSource Spot VXT: No UI on Fixture.
5. Local Control: Yes. ColorSource Spot V only.
6. Onboard Presets: Yes, 12. Onboard Sequences: Yes, 5. Onboard Effects: No.
7. Fixture-to-Fixture Control: Yes.
8. 15-bit virtual dimming engine.

H. Electrical:
1. Voltage: 100 to 240 VAC, 50 to 60 Hz.
2. Input Method: powerCON TRUE1 TOP in and thru.
3. Inrush First Half Cycle: 55 A at 120 V. 59 A at 240 V.
4. Fixtures per Circuit: Eight. (R20 module or similar).
5. Wattage: Typical: 197. Standby: 2 at 120 V.
6. Current Draw at 120 VAC: Typical: 1.65 A. Standby: 0.08 A.

I. Thermal: Operating Temperature: 32 to 104 degrees F.
1. Fan: Yes. Controllable.
2. Droop Compensation: Yes.
3. BTUs/hour: 671.77.

J. Physical: IP Rating: ColorSource Spot V: IP20. ColorSource Spot VXT: IP65.
1. Materials: Die-cast aluminum. Colors: Black, white, silver, or custom.
2. Mounting Options: Yoke.
3. Included Accessories: Hanging yoke, 39-inch power cable, soft-focus diffuser in an A-size gobo holder.

2.9 COLOR MIXING LIGHT EMITTING DIODE WASH FIXTURE

A. Basis of Design: ColorSource PAR V Zoom as manufactured by ETC Inc. RGBIL color system.

B. Standards Compliance:
1. Listed: cETLus, UL 1573, CSA C22.2 No. 166.
2. Compliance: CE and EAC.

C. Model ColorSource PAR V Zoom: Black.

D. Arrays:

1. RGBIL (Red/Green/Blue/Indigo/Lime).

E. Source:
1. LED Details: 34 Lumileds LUXEON C LEDs.
2. Max. Lumens: 5,780.
3. Lumens per Watt: 36.
4. L70 rating: Greater than 54,000 hours.

F. Color:
1. Color temperature Range: Color mixing.
2. Calibrated Array: Yes.
3. Red Shift: No.

G. Optical:
1. Beam Angle Range: 19.1 to 40.8 degrees; Manual zoom.
2. Gate Size: N/A.
3. Aperture Size: 7 inches.
4. Pattern Projection: No.
5. Pattern Size: N/A.
6. Camera Flicker Control/Hz Range: Default: 5kHz. RDM: 25,000 Hz.

H. Control:
1. Input Method: DMX-512 via 5-pin XLR connector. Protocols: DMX512, RDM, City Theatrical Multiverse, NFC.
2. RDM Configuration: Yes.
3. NFC Configuration: Yes.
4. User Interface Type: 7-segment 3 button, single encoder interface.
5. Local Control: Yes.
6. Onboard Presets: Yes, 12. Onboard Sequences: Yes, 5. Onboard Effects: No.
7. Fixture-to-Fixture Control: Yes.
8. 15-bit virtual dimming engine.

I. Electrical:
1. Voltage: 100 to 240 VAC, 50 to 60 Hz. Input Method: powerCON TRUE1 in and thru.
2. Inrush First Half-Cycle:
3. Fixtures per Circuit:
1. 20 Amp Power-Thru Connector: Quantity of 5.
2. R20 Module or Similar: Quantity of 6.
3. Wattage at 120 Volts: 162 W.
4. Current Draw at 120 Volts: 1.27 Amps.

J. Thermal: Operating Temperature: 32 to 104 degrees F.
1. Fan: Yes. Not controllable. dB Range: 21.2 dBA average at 39 inches.
2. Droop Compensation: Yes.

K. Physical: IP Rating: IP-20.
1. Materials: Die-cast aluminum. Colors: Black, white, silver, or custom.
2. Mounting Options: Yoke.
3. Included Accessories: Power cable and hanging yoke.
4. Seven-segment, three-button Interface.

2.10 RIGGING

A. All rigging shall be performed by ETCP Certified Riggers for Theatre, no exception.

B. Stage Contractor shall install lighting positions as shown on plans, which may include FOH (front of house) 1st electric, 2nd Electric, and Pipe Grid.

C. Pipe shall be 1.5” ID Schedule 40. Pipe shall be mounted to structure such that pipe will not twist or turn

D. Contractor shall coordinate all pipe positions with curtain locations and any other equipment locations to ensure stage lighting meets the intent of the design.

E. Pipe Battens:
1. Pipe battens shall be 1-1/2" in diameter schedule 40 pipe.
2. All battens shall be painted black to prevent rusting.
3. Where splicing is required, a pin, 18" long and the same diameter as the inside diameter as the pipe shall be used. This pin shall be held in place with no less than four (4) rivets or bolts. Threaded couplers are not acceptable.
4. Mark the center of each batten with a 1” wide yellow stripe

F. DEAD HUNG RIGGING Standards
1. All turnbuckles, clips, tracks, chains and other items of incidental hardware shall be furnished, plated or painted. Wire rope shall be galvanized aircraft cable. Fasteners, chains, and other miscellaneous hardware shall be either cadmium or zinc plated.
2. All materials used in this project shall be new, unused and of the latest design. Refurbished materials are not permitted.
3. In order to establish minimum standards of safety, a minimum safety factor of 5 shall be used for all equipment and hardware used on this project
4. Minimum design load rating for a hang point shall be 350 lbs.
5. Top hanging hardware shall be either beam clamp sized for the beam, or 3/16” Proof Coil chain wrap
6. Connections to chain or bottom hanging hardware shall be made with ¼-inch screw pin shackle. Pin shall be wired to prevent loosening.
7. Batten Clamps shall be sized for the pipe batten. Chain wrapping the batten is not acceptable.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all new equipment and rewire existing equipment, all in compliance with national and local electrical codes. Auxiliary equipment required to make this installation comply with codes, even if not listed in the specification, is the responsibility of the bidder and must be included in the bid price.

B. All wiring shall be done in a craftsman-like manner. When conductors must be spliced to extend length, it shall be done with a terminal strip or suitable type compression fittings.

C. Equipment shall be kept clear of all metal shavings, wire scraps, and miscellaneous trash. Any abandoned holes in the floor shall be patched.

D. Any existing conduit emanating from the floor shall be dressed in such a manner as to eliminate any trip hazard. Conduits shall be re-routed or terminated into wire-ways to ensure a neat installation.

E. All equipment shall be installed in compliance with applicable local and national codes. It shall also be installed in accordance with the manufacturer's recommendations. Prior to

initial energizing, a factory certified technician shall inspect the system, and any errors shall be corrected.

END OF SECTION

SECTION 26 56 00 - 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

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

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.

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 (±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 µs, 10kA/8 x 20 µs) 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): ≤ 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 150 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 ½” 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.
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.

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-feet #4 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.

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 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.

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

SECTION 27 05 00 - 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*
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.

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.

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.

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.

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.

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 *(A.K.A. Main Antenna Television)*
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 *(Now referred to as TR)*
T.O.	Telecommunications Outlet
TR	Telecommunications Room *(A.K.A. TC - Telecommunication Closet)*
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.

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.

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.

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.

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.
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.

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.

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.

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.

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.

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 not rime 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.

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 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 communications (voice, data, video) cabinet or rack.
      a. Identifying nameplates shall have 1/2-inch high, engraved letters. For equipment designation and ¼-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 ½-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”.

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.

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.

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: 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 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.

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 ad 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.

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 cam 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.
   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

SECTION 27 05 07 - 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

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.

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

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

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

SECTION 27 05 09 - 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.

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

SECTION 27 05 10 - 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.

END OF SECTION

SECTION 27 05 50 - TELECOMMUNICATIONS GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Work covered by this Section shall consist of furnishing labor, equipment, supplies, materials tools and testing unless otherwise specified, and in performing the following operations recognized as necessary for the installation, termination and labeling of ground and bonding infrastructure as described on the drawings and/or required by these specifications.

1.2 REFERENCES

A. IEEE C2-2007 National Electrical Safety Code.

B. ANSI/TIA-07-B-2011 Commercial Building Grounding and Bonding Requirements for Telecommunications.

C. NFPA 70™-2011 National Electrical Code

D. NFPA 70E*-2004 Standard for Electrical Safely in the Workplace

E. ANSI/NECA/BICSI-607-2011 Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings

F. UL 467 Standard for Grounding and Bonding Equipment.

1.3 QUALIFICATIONS

A. Products specified in this Section shall be manufactured by a company with a minimum of three years' documented experience specializing in manufacturing such products.

1.4 DEFINITIONS

A. Backbone: A facility (e.g. pathway, cable or conductors) between telecommunications rooms, or floor distribution terminals, the entrance facilities, and the equipment rooms within or between buildings.

B. Bonding: The permanent joining of metallic parts to form an electrically conductive path that will assure electrical continuity and the capacity to conduct safely any current likely to be imposed.

C. Common Bonding Network (CBN): The principal means for effecting bonding and grounding inside a telecommunication building. It is the set of metallic components that are intentionally or incidentally interconnected to form the principal bonding network (BN) in a building. These components include structural steel or reinforcing rods, plumbing, alternating current (ac) power conduit, ac equipment grounding conductors (ACEGs), cable racks, and bonding conductors. The CBN always has a mesh topology and is connected to the grounding electrode system.

D. EMI (Electromagnetic Interference): The interference in signal transmission or reception resulting from the radiation of electrical or magnetic fields.

E. Entrance Facility (telecommunications): An entrance to a building for both public and private network service cables (including antennae) including the entrance point at the building wall and continuing to the entrance room or space.

F. Equipment Room (telecommunications): A centralized space for telecommunications equipment that serves the occupants of the building. An equipment room is considered distinct from a telecommunications room because of the nature or complexity of the equipment.

G. Exothermic Weld: A method of permanently bonding two metals together by a controlled heat reaction resulting in a molecular bond.

H. Ground: A conducting connection, whether intentional or incidental, between an electrical circuit or equipment and the earth, or to some conducting body that serves in place of the earth.

I. Grounding Electrode Conductor: The conductor used to connect the grounding electrode to the equipment grounding conductor, to the grounded conductor, or to both, of the circuit at the service equipment, or at the source of a separately derived system.

J. Grounding Equalizer (GE): A bonding conductor that interconnects TGBs on the same floor, (formerly TBBIBC).

K. Mesh Bonding Network (Mesh-BN): A bonding network to which all associated equipment (e.g., cabinets, frames, racks, trays, pathways) are connected using a bonding grid, which is connected to multiple points on the common bonding network.

L. Primary Protector: A surge protective device placed on telecommunications entrance conductors in accordance with ANSI/NFPA 70 and ANSI/ATIS 0600318 and listed under ANSI/UL 497.

M. Rack Bonding Conductor (RBC): A bonding conductor used to connect the rack/cabinet directly to the TMGB/TGB/Mesh

N. Room (telecommunications): An enclosed space for housing telecommunications equipment, cable terminations, and cross-connect cabling, that is the recognized location of the cross-connect between the backbone and the horizontal facilities.

O. Telecommunications Bonding Backbone (TBB): A conductor that interconnects the telecommunications main grounding busbar (TMGB) to the telecommunications grounding busbar (TGB).

P. Telecommunications Equipment Bonding Conductor (TEBC): A conductor that connects the telecommunications main grounding busbar (TMGB) or telecommunications grounding busbar (TGB) to equipment racks or cabinets.

Q. Telecommunications Grounding Busbar (TGB): The interface to the building telecommunications grounding system generally located in telecommunications room. A common point of connection for telecommunications system and equipment bonding to ground and located in the telecommunications room or equipment room.

R. Telecommunications Main Grounding Busbar (TMGB): A busbar placed in a convenient and accessible location and bonded, by means of the bonding conductor for telecommunications, to the building service equipment (power) ground.

S. Unit Bonding Conductor (UBC): A bonding conductor used to connect u rack/cabinet mounted equipment unit to the grounding structure (i.e... conductor, busbar) utilized in that rack/cabinet.

PART 2 - PRODUCTS

2.1 CABLE

A. THHN: The telecommunications backbone shall be a copper conductor.
1. Shall be rated, plenum-riser, depending on the environment, or bare copper may be acceptable in approved applications.
2. Jacket color shall be green.
3. Cable size per table in Part 3.

2.2 BUSBARS

A. Telecommunications Main Grounding Busbar (TMGB).
1. Predrilled copper with holes to accommodate lug mounting holes
2. 0.25” thick x 4” wide with varying length
3. Sized for current applications and future growth
4. Insulated from its support
5. The TMGB use a copper plated busbar
6. Maintain a 2” min clearance from wall
7. Size
a. 4” X 6” – Copper – Hubbell Part Number HBBB14416H
b. 4” X 6” – Copper – Hubbell Part Number HBBB14420J

B. Telecommunications Grounding Busbar (TGB)
1. Pre-drilled copper with holes to accommodate lug mounting holes
2. 0.25” thick x 2” wide with varying length
3. Sized for current applications and future growth
4. The TGB use a copper plated busbar
5. Maintain a 2” min clearance from wall
6. Size & material
a. 4” X 6” – Copper – Hubbell Part Number HBBB14210A
b. 4” X 6” – Copper – Hubbell Part Number HBBB14416H

C. Horizontal Cabinet or Equipment Rack Busbar - 19”
1. Mounts to standard 19” Rack or Frame
2. Capacity: 6 Double hole lugs
3. Size & material
a. 0.75” x 19” x 0.25” – Copper - Hubbell Part Number HBBBHR19KT

D. Vertical Cabinet or Equipment Rack Busbar – 36 to 72”
1. Mounts to vertical rail or inside of cabinet in 19” or 23” Rack or Frame
2. Capacity: 9 Double hole lugs
3. Size & material
a. 0.75” x 36” x 0.25” – Copper - Hubbell Part Number HBBBVR36KT

2.3 COMPRESSION LUGS

A. Shall be UL & CSA listed

B. Shall be able to accept 6 AWG to 3/0 AWG

C. Compression type

D. Two holes with various hole spacing to fit the busbar

E. Long barrel that will allow a minimum of two crimps with standard industry colors

F. An inspection window to verify that the conductor is fully seated in the lug

G. Have a traceable feature to ensure proper die size was used to make the crimp

H. Crimped according to manufacturer's recommendation

I. Size (XX – specify AWG)
1. 0.250" holes X 0.625" spacing
   a. 0 degrees – Hubbell Part Number HGBLXXD
2. 0.250" holes x 0.750" spacing
   a. 0 degrees – Hubbell Part Number HGBLXXDA
3. 0.375" holes x 1.000" spacing
   a. 0 degrees – Hubbell Part Number HGBLXXDB.

2.4 TAPS

A. Connections to the Conductor shall be made with irreversible compression connectors.

B. Shall be UL & CSA listed

C. Shall be able to accept 6 AWG to 3/0 AWG

D. Have a traceable feature to ensure proper die size was used to make the crimp

E. Requires a minimum of (2) crimps for C Tap and H Tap, 1 crimp for I-Beam and busbar Tap

F. Crimp according to manufacturer's recommendation.

G. C Taps:
1. Main Run 6-4 AWG - Tap 6 AWG
   a. Hubbell Part Number HYC4C6
2. Main Run 6-4 AWG – Tap 4 AWG
   a. Hubbell Part Number HYC4C4
3. Main Run 2 AWG – Tap 8-4 AWG
   a. Hubbell Part Number HYC2C4
4. Main Run 2 AWG – Tap 2 AWG
   a. Hubbell Part Number HYC2C2
5. Main Run 1/0-2/0 AWG – Tap 8-2 AWG
   a. Hubbell Part Number HYC26C2
6. Main Run 1/0-2/0 AWG – Tap 1/0-2/0 AWG
   a. Hubbell Part Number HYC26C26

H. I-Beam Tap
1. I-Beam steel with a Standard Flange
   a. Hubbell Part Number HYGIBS####
2. I-Beam steel with a Wide Flange
   a. Hubbell Part Number HYGIBW####

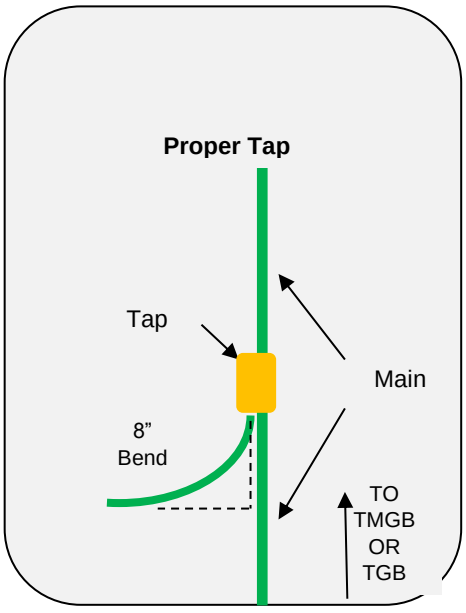


Illustration 1

I. Busbar Tap
1. Busbar thickness 0.25", Main Run 2 AWG - Tap 6 AWG

a. Hubbell Part Number HYG14B2TC2C6C
2. Busbar thickness 0.25”, Main Run 2 AWG – Tap 2 AWG
a. Hubbell Part Number HYG14B2TC2C2C
3. Busbar thickness 0.25”, Main Run 4/0 – 1/0 AWG
a. Hubbell Part Number HYGBTC28

2.5 LADDER RACK BONDING CONDUCTORS

A. Ground cord assembly
1. Stranded THHN
2. Color: green
3. #6 AWG insulated bonding jumper
4. Length: 9” - 12”
5. Each end terminated with a two-hole compression lug or listing approved terminal
6. Hubbell Part Number HGRKTD12D, HGRKTKLU9KLU5

B. Braided Jumper
1. 0.94” Braid width
2. Hole diameter 0.375”
3. Hole Spacing 1.25”
4. Length: 12”
5. Hubbell Part Number HGBBD12

2.6 BASKET TRAY CONDUCTORS

A. Mounts to the basket tray metal runner

B. Accepts #6 AWG cable that spans the gaps between sections of basket tray

C. Hubbell Part Number HGBKS17, HGRKTWC45, HGRKTWB5

2.7 WRIST STRAP ESD PORT

A. Lug w/ 4mm banana plug to attach ESD wrist strap.

B. Two (2) hole lug

C. Placed inside cabinet or on equipment rack

D. Must be identifiable as an ESD connection point

E. Hubbell Part Number HGBESDKT10

2.8 RAISED FLOOR GROUNDING CLAMP

A. Ability to do both parallel and grid configurations
1. HGBGXP1828RF - Grid or Parallel

B. Attached to the stringer of the raised floor
1. HGBGXP1828RF - 0.75”-1.5” Round or Square

C. Wire Range
1. HGBGXP1828RF 6 – 4/0 AWG

PART 3 - EXECUTION

3.1 TELECOMMUNICATIONS MAIN GROUND BUSBAR (TMGB)

A. The TMGB shall be:
1. Pre-drilled copper with holes to accommodate lug mounting holes
2. 0.25” t x 4” w with varying length
3. Sized for current applications and future growth
4. Insulated from its support
5. Maintain a 2” min clearance from wall
6. Installed to maintain clearances required by applicable codes
7. In an accessible location
8. As close to the panelboard as practicable min 36”
    a. Where a panelboard (electrical power panel) is located in the same room or space as the TMGB that panelboard’s alternating current equipment ground (ACEG) bus (when equipped) or the panelboard enclosure shall be bonded to the TMGB.
9. Be listed by a nationally recognized testing laboratory
10. 36” from active electronics or the panelboard

B. The TMGB should:
1. Be located in the telecommunication entrance facility
    a. The ideal location of the TMGB is in the telecommunications entrance facility.
2. Have a mounting height adjusted to accommodate overhead or underfloor cable routing.
3. Minimize the length of bonding conductor for telecommunications
4. Provide for the shortest and straightest routing of the primary
5. Be located near backbone cabling and associated terminations
6. Serve telecommunications equipment that is located within the same room or space.

C. The TMGB use a copper plated busbar.

D. Attachments to TMGB:
1. Bonding Conductor – Electrical Distribution Panel
2. Primary protector
3. Building Steel
4. Outside plant cables
5. Backbone cables that incorporates a shield or metallic member
6. All metallic pathways for telecommunications cabling located within the same room or space as the TMGB.
7. Cable tray
8. Ladder rack
9. Conduit
10. Telecommunications equipment located in the TEF (e.g., multiplexer or optical fiber termination equipment).
11. TBB
12. TEBC
13. Primary protector grounding conductor
    a. A minimum of 1 ft. separation shall be maintained between this insulated conductor and any dc power cables, switchboard cable, or high frequency cables, even when placed in rigid metal conduit or EMT.

3.2 TELECOMMUNICATION GROUND BUSBAR (TGB)

A. The TGB shall:

1. Be a predrilled copper busbar provided with holes for use with standard sized lugs,
2. Have minimum dimensions of 6 mm (0.25 in) thick x 50 mm (2 in) wide and variable length to meet the application requirements and with consideration of future growth.
3. Be insulated from its support attachment a minimum of 2”.
4. Be listed by a nationally recognized testing laboratory (NRTL).
5. Maintain 36” separation from active electronics.

B. It is acceptable that the busbar be electro-tin plated for reduced contact resistance. If not plated, the busbar shall be cleaned prior to fastening the conductors to the busbar, and an antioxidant should be applied to the contact area to control corrosion and reduce contact resistance.

C. The TGB is the grounding connection point for telecommunications systems and equipment in the area served by that telecommunications room or equipment room.

D. Where a panelboard is located in the same room or space as the TGB that panelboard’s ACEG bus (ac electrical ground when equipped) or the panelboard enclosure shall be bonded to the TGB. When a panelboard for telecommunications equipment is not in the same room or space as the TGB, that TGB should be bonded to the panelboard that feeds the distributor.

E. The TBBs and other TGBs within the same space shall be bonded to the TGB with a conductor the same size as the TBB.

F. Where a grounding equalizer (GE) is required, it shall be bonded to the TGB.

3.3 TELECOMMUNICATIONS BONDING BACKBONE (TBB)

A. The intended function of a TBB is to reduce or equalize potential differences between telecommunication systems. While the TBB will carry some current under ac power ground fault conditions, it is not intended to provide the only ground fault return path.

B. The TBB shall:
1. Be connected to the TMGB & TGB.
2. Be a continuous copper conductor that should be sized no less than 6 AWG to a maximum of 3/0 AWG. The TBB shall be sized in accordance to the conductor table.

TABLE 1
CONDUCTOR LENGTH VS AWG

Linear length – ft.	Size (AWG)
Less than 13	6
14 – 20	4
21 – 26	4
27 – 33	2
34 – 41	1
42 – 52	1/0
53 – 66	2/0
Greater than 67	3/0

3. Be consistent with the design of the telecommunications backbone cabling system.

4. The TBB conductors shall be installed and protected from physical and mechanical damage.
5. TBB conductors should be installed without splices.
    a. Where splices are necessary, the number of splices should be a minimum and they shall be accessible and located in telecommunications spaces.
    b. Joined segments of a TBB shall be connected using exothermic welding, irreversible compression-type connectors, or equivalent.
    c. Permit multiple TBBs as dictated by the building size.
    d. The metallic cable shield not be used as a TBB.

3.4 GROUNDING EQUALIZER (GE)

A. The GE shall be a continuous copper conductor that should be sized no less than 6 AWG to a maximum of 3/0 AWG. The GE shall be sized in accordance to the conductor table.

B. The GE connects the telecommunications grounding busbar(s) in the same-floor telecommunications rooms (TRs) on the first, top, and every third floor in a multistory building.

C. Cable shields do not satisfy the requirements for a GE.

3.5 TELECOMMUNICATIONS EQUIPMENT BONDING CONDUCTOR (TEBC)

A. Connects the TMGB/TGB to equipment racks/cabinets.

B. Shall be a continuous copper conductor that should be sized per the length of cable.

C. Shall be separated from ferrous materials by 2” or be bonded to the ferrous metal.
    1. May be routed within cable trays or suspended 2” under or off the side of the cable tray or ladder rack.

D. Shall be supported every 3ft.

E. 8” Bend radius – with no less than a 90-degree bend.

F. May come in contact with other cable groups at a 90-degree angle only.

G. Cable shields do not satisfy the requirements of a TEBC.

H. There may be more than one TEBC within each telecommunication room.

3.6 RACK BONDING CONDUCTOR

A. A bonding conductor used to connect the rack/cabinet directly to the TMGB/TGB/Mesh.

B. Metallic enclosures, including telecommunications cabinets and racks, shall be bonded to the mesh-BN, TGB, or TMGB using a minimum sized conductor of No. 6 AWG.

C. Cabinets, racks, and other enclosures in computer rooms shall not be bonded serially; each shall have their own dedicated bonding conductor to the mesh-BN, TGB, or TMGB.

3.7 ELECTRICAL DISTRIBUTION PANEL (EDP)

A. When located in the same room as the TMGB/TGB the EDP's equipment grounding bus or the panel board enclosure shall be bonded to the TMGB/TGB.

B. Using a bonding conductor for telecommunications (BCT) minimum 6 AWG to a maximum of 3/0 AWG depending on the length of cable required.

C. Use same AWB as TBB.

D. A qualified electrician shall make all connections within an AC electrical panel.

E. Outside of the scope of ANSI/TIA-607B.

3.8 CONDUCTIVE FIBER OPTIC CABLES

A. The metallic components of a conductive cable are capable of transmitting current.

B. Conductive fiber-optic cables should be bonded and grounded as specified in NEC Article 770.100

3.9 LADDER RACK AND/OR CABLE TRAY

A. To achieve the objective of potential equalization in the TR, all cable runway sections are bonded together and bonded back to the TMGB/TGB

B. Maintain a 8” Bend Radius on the TEBC

C. Keep a 2” separation from other cables, power and telecommunications

D. Remove any paint, oxidation, etc. from the runway surfaces that are being bonded

E. Drill two holes as required to accommodate the 2-hole compression lug

F. Apply a thin coat of antioxidant around the holes and on the surface where the lug will be in contact.

G. Attach straps to the runway using stainless steel hardware sized for the lug holes.

H. Tighten the hardware

I. Wipe off any excess antioxidant after installation of the lug.

3.10 LABELING

A. The format for the telecommunications main grounding busbar shall be FS-TMGB, while the format for the TGBs shall be FS-TGB.
   1. FS is the TS identifier for the space containing the busbar; Floor & space
   2. TMGB is the portion of an identifier designating a telecommunications main grounding busbar;
   3. TGB is the portion of the identifier designating a telecommunications grounding busbar.

IF THIS CONNECTOR OR CABLE IS LOOSE OR MUST BE REMOVED, PLEASE CALL THE BUILDING TELECOMMUNICATIONS MANAGER

B. Each telecommunications space or room shall be assigned an identifier unique within the building. The TS shall be labeled with the TS identifier inside the room so as to be visible to someone working in that room. The TS identifier shall have a format of FS.

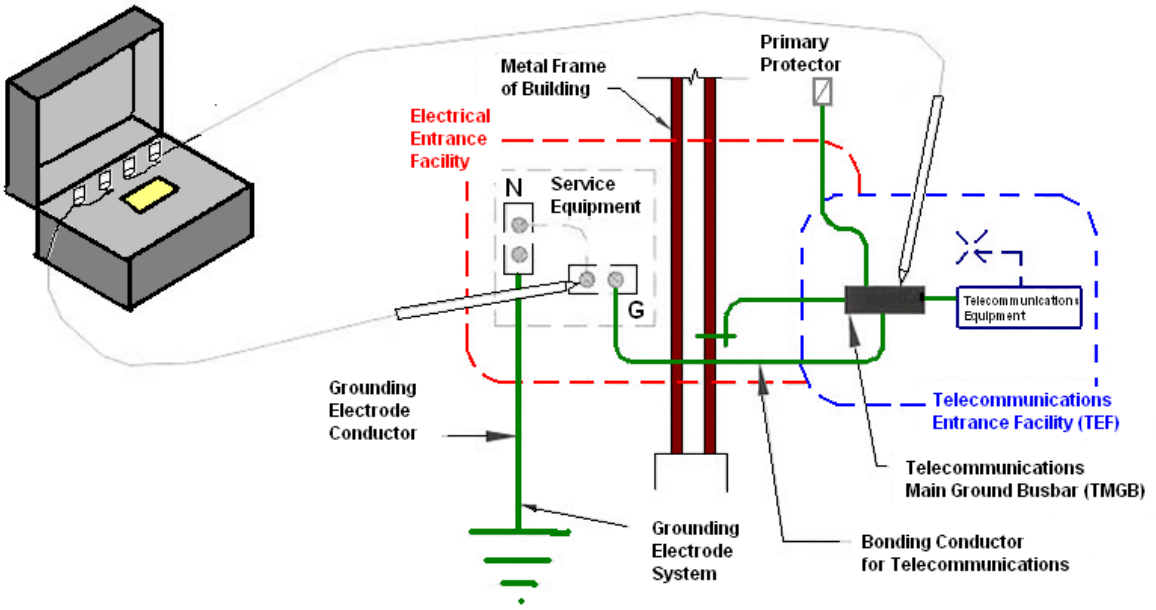
C. All busbars and cables will have the label in Illustration 2 attached, and it will be visible .and readable.

3.11 TESTING

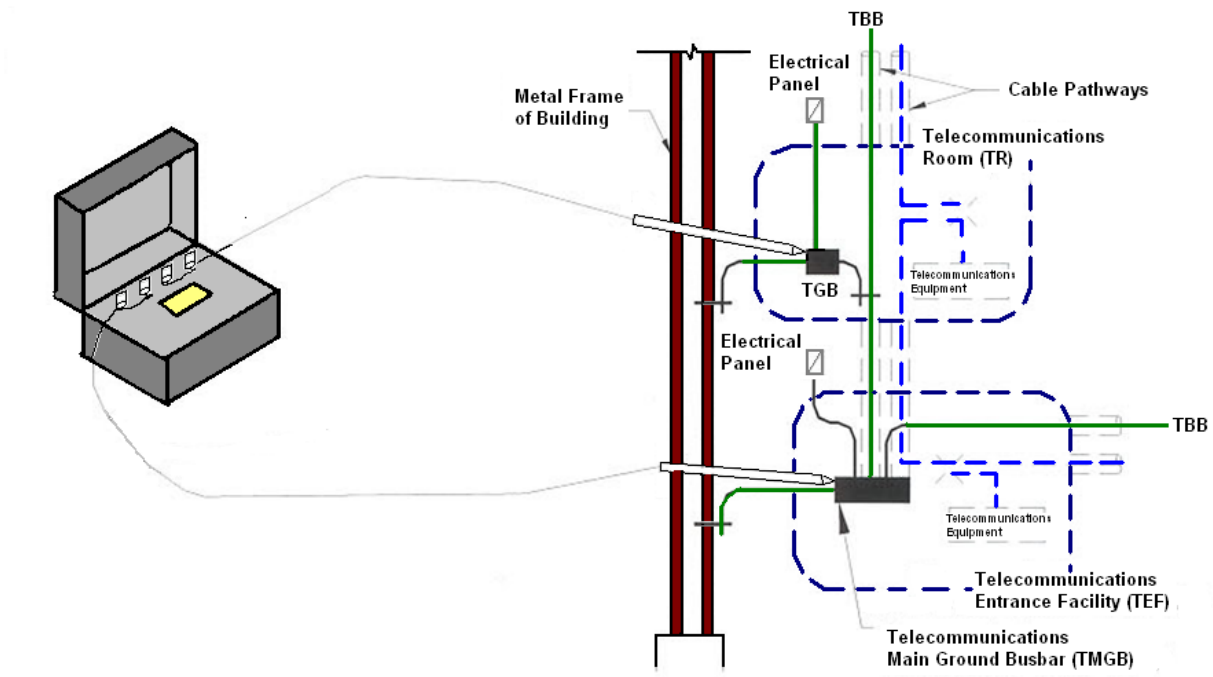
A. Earth ground resistance tester:
1. The earth ground resistance tester generates a specific test current: this current is less susceptible to the influences of stray currents on the grounding system. This makes the ground resistance tester a more accurate testing devise that a standard Volt-Ohm-multimeter.

B. Two-point ground continuity testing:
1. Maximum value 100 milliohms

C. Follow manufacture instructions on setup and how to perform the test.



D. Care should be taken and safety precautions in place.



END OF SECTION

SECTION 27 10 00 - STRUCTURED CABLING SYSTEM (SCS)

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 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 termination classrooms 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 most costly scenario and obtain clarification during the course of 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.
5. This project consists of the provision and installation of a Structured Cabling System (SCS) to furnish a Network Cabling Infrastructure as required to support network connectivity to workstations, telephones, video surveillance, access control, building automation, electrical lighting, and any other system requiring network connectivity.
6. 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
7. 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.

8. 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.
9. SCS contractor to provide network drops for all locations shown on the drawings, plus:
    a. Communications System
        1. IP Speakers
        2. Controllers/Headend
        3. Administration Station
    b. Video Surveillance System
        1. Local storage server
        2. IP Video Surveillance Cameras
    c. Access Control System
        1. Controllers
        2. Doors

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. Manufacturer substitution 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.

B. Installer Qualifications:
1. The Data Cable System Installer shall be licensed and shall meet all applicable regulations of the State of Texas and 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 sub-contractor 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.

D. Acceptance:
1. 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 nCompass and hold current certification. Contractor shall provide a 15-year 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 2 or better tester, per TSB-67, and that all test results conform to the most current TIA/EIA-568-A and/or TSB-67 Link values.
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 ISO/IEC 11801, ANSI/TIA/EIA-568-A, or EN 50173. Quality and workmanship evaluation shall be solely by the Owner/Designer and designated representatives.
4. nCompass Premium Limited Lifetime warranty will be required as described below for the following systems or system components.
   A. nCompass Category 6A CMP/CMR Copper and Fiber Cabling, Fiber and Copper Connectivity Hardware, and Patch Cables shall be covered by a, nCompass Limited Lifetime warranty labor, and application assurance warranty. The application assurance portion shall provide coverage for the cabling system to support the applications that are designed for the specifications outlined in TIA/EIA 568. These applications include, but are not limited to 10BASE-T, 100BASE-T, 1000BASE-T,10GBASE-T and 155 Mb/s ATM.
5. Telecommunication Contractor must submit the following to manufacturer
   A. Warranty Application properly completed online using the DAT contractor dashboard.
   B. Test results submitted only in the field tester's native, electronic format for both the copper and fiber optic systems. The test results must be submitted in original native tester format.
      Note: Hard copies, WORD document formats, EXCEL spreadsheet formats and PDFs will not be accepted.
   C. All tests must result in a PASS. Pass* (marginal pass) and Fail are not acceptable test results.
   D. Each permanent link or channel in the network must be field tested in accordance with the TIA-568 industry standard AND nCompass testing requirements in force at the time of purchase (nCompass testing requirements take precedence over TIA when differences exist). The installed permanent links and channels must have passed all applicable TIA and nCompass performance requirements.

E. Minimum testing for copper systems includes Wire Map, Length, Attenuation, Near End Crosstalk, Far End Crosstalk, Return Loss, PS NEXT, ELFEXT, and PS ELFEXT.
    a. Field terminated plugs shall be tested in a permanent link configuration with the appropriate test equipment for field terminated plugs.
F. Minimum testing for Fiber Optic links includes horizontal and backbone, Bi-Directional Dual Wavelength, Insertion Loss and Length.

6. Once the submitted materials are reviewed, the Telecommunications Contractor will be notified in writing of acceptance or rejection. If the project is accepted, the contractor will receive a copy of the signed warranty certificate for the Owner. If rejected, contractor must fix identified issues and resubmit using DAT contractor dashboard.
7. Telecommunication Contractor shall forward the signed warranty certificate to the Owner.

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
    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. TIA/EIA TSB40
    21. Current BICSI Telecommunications Distribution Methods Manual
    22. NFPA 70 – National Electrical Code (NEC).

23. 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 ABBREVATIONS

A. The following abbreviations are used in this document:

IDF Intermediate Distribution Frame
MDF Main Distribution Frame
UTP Unshielded Twisted Pair
STP Shielded 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 indicated 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.
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 expirer 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 projected.
    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 and 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:
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 Revit CAD. 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.

B. Materials: Materials shall be as listed.

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.

G. Fire Wall Sealant:

1. Any penetration through firewalls (including those in sleeves) will be resealed with an Underwriter Laboratories (UL) approved sealant.

2.2 APPROVED MANUFACTURERS

A. Copper Channel
   1. Data/Voice, Wireless AP Cables
      a. Superior Essex (Datagain)
   2. Jacks, Patch Panels
      a. Legrand (Ortronics)
B. Fiber Channel
   1. Superior Essex (TeraFlex)
C. Data/Ladder Racks, Grounding, Wire Management
   1. Legrand (Cablofil)
D. Power Strips
   1. Tripp Lite
   2. Legrand
E. PoE Surge Protection for exterior devices
   1. Ditek
F. Fire Wall Sealant
   1. Legrand (Wiremold)
G. Powered Fiber Solution
   1. Leviton OneReach POE Extender System
   2. CommScope

2.3 MATERIALS

A. Horizontal Cabling
   1. Category 6A, 4P, 23 AWG, CMP
   2. Datagain Series
   3. Refer to PART 3 – EXECUTION for colors
B. Patch Panels – Copper
   1. 24/48 Port
   2. Rack Mount
   3. Flat
   4. Modular
   5. Rear cable management bars
C. Data Jacks
   1. Category 6A
   2. Modular
   3. Refer to PART 3 – EXECUTION for colors
D. Faceplates
   1. Single gang
   2. Minimum 4-port
   4. Coordinate color with owner
E. Patch Cords/Station Cables – Copper
   1. Flat Pack Reduced Diameter Category 6A
   2. Factory terminated
   3. Refer to PART 3 – EXECUTION for colors
   4. Refer to PART 3 – EXECUTION for lengths
F. Backbone Cabling – Copper
   1. Category 6A, 4P, 23 AWG, CMP
G. Wireless Access Point Cabling
   1.. Category 6A, 4P, 23 AWG, CMP
H. Backbone Cabling – Fiber
   1. Single-mode, OS-2
   2. 12-Strand
   3. Plenum rated.
   4. Armored
   5. TeraFlex Series

I. OSP Cabling – Copper
   1. Category 6A, 4P, 23AWG
   2. U/UTP, Outdoor Rated
J. OSP Cabling – Fiber
   1. Single-mode, OS-2
   2 12-Strand
   3. Indoor/Outdoor Rated
K. Patch Panels – Fiber
   1. Modular
   2. Rack mounted
L. Connectors – Fiber
   1. LC
M. Patch Cords – Fiber
   1. Single-mode, OS-2
   2. LC-LC
   3. Duplex
   4. Factory terminated
   5. Refer to PART 3 – EXECUTION for lengths
N. Bonding and Grounding
   1. Primary bonding bus bar
   2. Secondary bonding bus bar
   3. Telecommunications bonding conductor
   4. Equipment bonding conductor
   5. 2-hole compression lug
   6. Grounding jumper
O. Data Racks
   1. Floor mounted
      a. 2 or 4-post
      b. 84” tall
      c. Floor Mounted
      d. Black
      e. Shall accept 4”-16” wide vertical managers
   2. Vertical Wire Management
      a. 6”-14” wide
      b. Black
   3. Ladder Rack
      a. Wire mesh cable management system
      b. Carbon Steel wire, ASTM A 510, Grade 1008
      d. Continuous Safe-T-Edge T welded top side to protect cable insulation
      c. Black in color
P. Power Strips
   1. Input Plug 5-20P
   2. 20A breaker
   3. 6’ cord
   4. (24) receptacles, 5-20R
   5. Orientation – vertical
   6. Height – 60”
Q. Rack Ground Bar Kit
   1. Shall be 1” x 19.25”.
   2. Shall be 1-1/4” thick electrolytic 110 copper alloy bar.
   3. Kit shall have 3” bar splice plate
R. PoE Surge Protection
   1. Rack Mount
      a. 24-Channel
      b. STP Category 6A
      c. 10-GbE
      d. Ditek DTK-RM24NETS

2. In-line Surge Protection
   a. DTK-110C6A
3. Provide Surge Protection on both ends of outdoor category cables

S. Powered Fiber Solution

Provide following equipment as necessary for a complete and functional system

1. Rack Mounted DC Power Supply & Chasis
2. Fiber Optic/Low-Votage DC Power Cabling – sized accordingly for distance
3. Min 60W 2-Port POE Extender with IP68 rated enclosures

2.4 CABLE ROUTING/PATHWAY

A. Cable Support System:
   1. Cable supports shall not connect to any ceiling grid wire or on any support attached to the ceiling grid.
   2. Cable supports shall not exceed a serviceable height of more than 5', but no closer than 2', above the finished ceiling.
   3. Cable supports can be attached to vertical walls or the building's structure.
   4. 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.

B. All cable bundles shall be grouped together using plenum rated Velcro for the entire run above and below the ceilings.

C. Conduit Bushings shall be installed prior to the installation of any cable. No cut bushings will be accepted.

D. Installer shall coordinate all conduit requirements with the electrical contractor to ensure that all conduit sizes and locations are correctly installed. Conduit fill shall not exceed 40% fill ratio.

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.

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 projects electrical Contractor provides the appropriate back box and conduit for the project.
2. One (1) 1" conduit will be required each outlet that serves (6) cables or less. Provide addition 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.
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.
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
G. Distribution Cabinet/Cabinet Grounding
    1. All Cabinets and/or Cabinets shall be grounded using minimum 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.
H. Fiber Optic Patch Panels:
    1. ALL fiber strands must be terminated in fiber housing.
I. Rack Electrical:
    1. A power strip shall be installed vertically at the back of each data relay rack.
    2. Plug power strip into owner provided UPS
J. Cable Management Panels:
    1. Provide Velcro straps for cable dressing in MDF/IDF rooms
K. MDF/IDF Patch Cables:
    1. Cabling Contractor shall provide owner with patch cable for each data drop on entire project.

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.
4. Outlet Patch Cables: Cabling Contractor shall provide owner with patch cable for each data drop on entire project.

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 Routing:
1. All low voltage cabling shall be installed and supported using a J-hook style modular cable support system at maximum 60” intervals unless installed in conduit. Do not exceed manufacture 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 connect to any ceiling grid wire or on any support attached to the ceiling grid.
4. Cable supports shall not exceed a serviceable height of more than 5’, but no closer than 2’, above the finished ceiling.
5. Cable supports can be attached to vertical walls or the building’s structure.
6. 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.
7. All cable bundles shall be grouped together using plenum rated Velcro for the entire run above and below the ceilings.
8. Conduit Bushings shall be installed prior to the installation of any cable. No cut bushings will be accepted.
9. Installer shall coordinate all conduit requirements with the electrical contractor to ensure that all conduit sizes and locations are correctly installed. Conduit fill shall not exceed 40% fill ratio.
10. 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.
11. 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.
12. 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.

13. Provide a 5’ service loop at each workstation outlet properly supported above ceiling
14. Provide minimum of 10’ service loop at all headend locations properly supported above ceiling
15. 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.

E. Rating: Cable shall be plenum rated if installed in plenum space

3.4 STATION HARDWARE

A. Flush mount jacks shall be mounted in a faceplate with back box.
   1. Placement:
      a. 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.

B. 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).

C. Information Outlet / Jack Modules:
   1. Provide additional qty. 25 of each Jack Module for owner’s future use.

D. Faceplates:
   1. Provide qty. 10 of each faceplate for owner’s future use.

3.5 STRUCTURED CABLING SYSTEM

A. Each connectivity solution shall be a complete Channel Solution, consisting of jacks, patch panels, and patch cables.

B. Each channel solution shall be color coded to the system in which it serves.

3.6 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. Coordinate exact colors with owner prior to installation.

Item	Description	Horizontal Cable	Insert	Patch Cables
1	Data	Blue	Blue	Blue
2	VoIP Telephone	Blue	Blue	Blue
3	Wireless Access Points	Green	Green	Green
4	Security	Purple	Purple	Purple
5	Audiovisual/PA Systems	Black	Black	Black
6	POTS	Grey	Grey	Grey
7	Access Control	Orange	Orange	Orange

3.7 COPPER PATCH PANELS

A. 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. Wireless Access Points, LAN, IP Telephones, and Video Surveillance Cameras

3.8 COPPER AND FIBER OPTIC PATCH CABLE LENGTHS

A. Provide copper and fiber optic patch cables as per the instructions below. All patch cables shall be factory terminated and warrantied for the copper and fiber solutions specified. Patch cable color shall match termination jack. Provide one patch cable and station cable for each port on the entire project.
   1. For each termination in the MDF:
      a. Patch cable lengths
         (1) 100% shall be 1’
   2. For each termination in a wall jack:
      a. Patch cable lengths
         (2) 100% shall be 10’
   3. For each termination for video surveillance cameras:
      a. Patch cable lengths
         (1) Interior Cameras: 100% shall be 10’
         (2) Exterior Cameras: 100% shall be 15’
   4. For each termination in a 6-port surface mount box:
      a. (1) 3’ patch cord shall be green (AV)
      b. (2) 15’ patch cord shall be yellow (WAP)
      c. (1) 15’ patch cord shall be white (IP Speaker)
      d. (1) 21’ patch cord shall be blue (Display/Projector)
   4. Fiber Optic Patch Cables:
      a. Provide quantity sufficient for connecting all network equipment plus 20% for growth.
      b. Patch cable lengths:
         (1) 100% shall be 3 meters.

3.9 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 should be used when labeling data/voice jacks:
      a. All cables being served by MDF closet shall begin with ‘1’ all IDF served cables shall begin with a numerical digit (2 thru 25 ….) designating the specific ADF’s identification.
      b. Next identification letter shall refer to patch panel that is serving outlet (A, B, C ….).
      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: 2-C-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: 1-B-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 3/4" round dot sticker.

3.10 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.
    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:
    1. 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.
5. Singlemode: Singlemode fibers shall have a maximum attenuation of 1.0 dB/km at 1310 nm and 1.0 dB/km at 1550 nm.

3.11 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.
      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

SECTION 27 41 16.10 - A/V DISTRIBUTION SYSTEMS FOR INSTRUCTIONAL AND OFFICE SPACES

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 DESCRIPTION

A. Summary of Work:
   1. Provide a complete and tested integrated audio-video system in various spaces. The video display system shall include:
      a. Provide and install all cable and components designated on the project drawings and within this specification section to furnish a complete audio-visual solution in instructional spaces, work rooms, conference rooms, offices, and any other locations shown on the contract drawings. These spaces shall have a fully integrated audiovisual solution.
      b. Locations with projectors shall have local sound reinforcement.
      c. Video displays and projectors shall be Owner Furnish/Contractor Furnished and Owner/Contractor installed, reference Part 2 of these specifications and project drawings for locations and materials
   2. The installation shall comply with all applicable codes and standards in effect at the job site and as indicated in the Drawings and Specifications.
   3. Reference project drawings for locations, quantities unless specified herein, and coordination with other trades.
   4. The drawings and specifications are to be considered conceptual in nature and are intended to establish system standards insofar as manufacturer type and system configuration. The contractor shall provide pricing of a complete engineered system based on the issued conceptual documentation. The engineered system is to be submitted to the project's consultant for review prior to installation.

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.
   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. Mock-up 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:
1. 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.

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:
1. 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.	PS	Audiovisual input station / Presentation Station
2.	CMP	Ceiling Mounted Projector
3.	LCD / FSD / LED	Flat Screen Display / TV / Monitor

1.6 SUBMITTALS

A. Project Initiation:
1. Within fourteen (14) days of Notice to Proceed, the projection 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, 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.
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 test result forms, and a list of instrumentation to be used for systems testing.
e. The contractor shall provide a letter from the manufacturer stating that the dealer is an authorized service center.
f. The resume and contact information of the full-time service personnel responsible for the installed projection system.
g. 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.
h. 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 expirer any sooner than 12 months after substantial completion of the project.

1) One (1) individual, employed by the installing firm, shall possess and maintain throughout the course of the project, an Avixa Certified Technology Specialist – Design (CTS-D) certification.
2) One (1) individual, employed by the installing firm, shall possess and maintain, an Avixa Certified Technology Specialist – Installer (CTS-I) certification. This certified individual will be required to onsite during any installation, modification, testing, configuration, and/or programming of any portion of the AV system.

i. Provide specification with line by line acknowledgement of compliance.

B. Shop Drawing:

1. Submit the following items, for Owner review and approval, within twenty-eight (28) days of notice to proceed:
   a. Proposed wiring and connectivity diagram of the proposed projection system including all faceplates and sound reinforcing equipment
   b. 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:
      1) Location of wall penetrations (all penetrations shall be sleeved and contain protective bushings at both ends)
      2) Location of sleeved wall pass-thru
      3) Size of sleeve at each location installed
      4) Quantity of cable passing through each sleeve
      5) 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)
      6) Conduit routing, size, quantity, and stub-up locations for all floor mounted outlets.
   c. 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:

1. As a condition for project acceptance, the Contractor shall submit the following for review and approval:
   a. 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.
   b. 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.

c. 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).
d. 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. The following list is not intended to be a complete list of required equipment, components, hardware, and/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:
1. CM Communications Cable
2. CMP Plenum Rated Communications Cable
3. 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
b. American Polywater

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 Pre-approved Equal

2.2 FLAT SCREEN DISPLAY

A. The contractor shall mount a video display monitor (FSD / LCD / LED / TV / IVD or any variation of) at all locations shown on Architectural and Technology plans.

B. Flat Screen Displays shall be owner furnished.

C. Mounts
1. Provide the following at each wall mounted flat screen display (65” – 86”) location on the entire project
a. Universal Articulating Wall Mount: Peerless Product No. PLAV70-UNLP or current equivalent.
b. Provide Triple Stud Wall Plate for each, stud-wall, wall mounted solution: Peerless Product No. WSP(716 or 724). Coordinate exact model with stud-wall construction. Coordinate desired finish color with architect and owner at each location.

2.3 PROJECTORS

A. Wall Mounted Projector:
1. Wall Mounted Projector
a. Owner furnished, contractor installed.
2. Accessories and Mounts:
a. One (1) Ultra-Short Throw Wall Mount Epson Product no. ELPMB62

B. Apple TV box shall be owner furnished; contractor installed.

2.4 STANDALONE AV SYSTEM CABLING AND COMPONENTS

A. Provide and install the following Cabling and components from all locations with a local audio video input to their associated video display or projection device.
1. Components:
a. The following shall be provided and installed at each AV Input Wall Plate (AV-1, PS, AVI, etc.):
1) Two (2) HDMI F/F Keystone Insert C2G Product no. 03345
2) One (1) 3.5mm 3-Conductor Keystone Insert C2G Product no. 37036
3) One (1) double gang, 4 port keystone faceplate Leviton Product no.43080-2L4, one (1) blank keystone insert, grey in color.
b. Provide the following at each AV Output Wall Plate associated with a video display (IVD, FSD, Monitor, or Digital Signage) and wall mounted projector (WMP) devices.
1) Two (2) HDMI F/F Keystone Insert C2G Product no. 03345
2) One (1) 3.5mm 3-Conductor Keystone Insert C2G Product no. 37036.
3) One (1) double gang, 4 port keystone faceplate Leviton Product no.43080-2L4, one (1) blank keystone insert, grey in color.
2. Cabling:
a. Two (2) HDMI Cable, from AV input (AV-1) plate to the AV device location.
1) For runs 40’ or less, provide Liberty Product No. P-HDM-M-*
2) For runs over 40’, provide Liberty Product No. PF-HDM-M-*M
b. Two (2) 3.5mm Stereo Audio Cable, Liberty Product No. P221P-3.5TRSM-M-* (one shall route from the AV input to the audio amplifier, and the second shall provide connection from the device audio output to the audio amplifier)
c. The (*), at the end of each product number above, shall be replaced with a numerical value depicting the length as required per location.

2.5 AUDIO VISUAL PATCH CABLES

A. Provide and install the following Patch Cables
   1. Provide the following at each AV input Outlet:
      a. Two (2) 10’ HDMI Patch Cable, Liberty Product No. HDPMM10F
      b. One (1) 10’ 3.5MM Stereo Audio Cable, Liberty Product No. CMM-110
   2. Provide the following at each AV Output Outlet.
      a. Two (2) 6’ HDMI Patch Cable, Liberty Product No. HDPMM06F
      b. One (1) 6’ 3.5MM Stereo Audio Cable, Liberty Product No. CMM-106

2.6 STANDALONE VENUE LOCAL SOUND SYSTEM

A. Provide and install a local sound distribution system dedicated to individual spaces that are standalone and not part of a larger distribution system. Each space shall consist of the equipment specified below, including programming and training.
   1. One (1) Audio Amplifier, Roemtech Product No. PMA-350H+
   2. One (1) Amplifier Mounting Bracket, Roemtech Product No. MK-2N
   3. 2’ x 2’ In-Ceiling, Tile Replacement Loudspeakers, JBL Product No. LCT 81C/T (provide quantity as shown on drawings)
   4. Connect video device audio out to the amplifier input.
   5. Provide a circuit from PA system speaker to each amplifier for auto PA override, sound ducking.
   5. Connect all speakers to amplifier output as required to deliver stereo audio.
   6. Provide a 12’x12’ plenum rated enclosure that shall accommodate the amplifier, 120v electrical receptacle or the junction box, and all audio cabling. Enclosure shall be wall mounted, installed above drop ceiling.

2.7 CABLING ROUTING/PATHWAY

A. Cable Support System: All audio-video cabling shall be installed and supported, using a pre-approved 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.

C. Any cable routing through open ceiling spaces or solid ceiling spaces shall be installed in conduit for the entire path through the space.

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:

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).

F. The Contractor shall replace any damaged ceiling tiles that are broken during cable installation.

G. Clean Up:
1. 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:
1. 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 Category 6 UTP cable at either the wiring USB Transmitter or Receiver.

B. Exposed Cable:
1. 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.

D. Cable Routes:
1. All cabling placed in ceiling areas must be in conduit, cable tray or PANDUIT® Corp. J-MOD™ modular 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-1’ 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, except for the associated USB extender receiver outlet, which shall be installed at 18” A.F.F. in the center of the presentation wall.

3.5 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.

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 me 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. Additional test requirements may be required at the Owner and/or Consultant’s request.

3.6 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 competition.

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

SECTION 27 41 16.20 - 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 all Venues:
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.
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.

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.
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 expirer any sooner than 12 months after substantial completion of the project.
   a. 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.
   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

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 GYM D100 – AUDIO AND VIDEO DISTRIBUTION

A. Contractor to provide and install a complete video and 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			
1	Q-Sys	Core 24F	Digital Signal Processor
2	Q-Sys	CX-Q 4K4	1000W, 4-Channel Network Amplifier
1	Q-Sys	CX-Q 8K4	1250W, 4-Channel Network Amplifier for Subwoofers
1	Bluesound	B100S	Network Music Player
1	Yamaha	MG10XU	10-channel Audio Mixer
Ref.	Q-Sys	AD-S12	12" 2-Way 250W Surface-Mount

Plans			Loudspeaker, Tap at 8 Ohm
2	Q-Sys	PL-SUB15	Passive 15-inch installation subwoofer
1	Symmetrix	xIO Bluetooth	Bluetooth 5.0 PoE Audio Dante/AES67 Network Interface (White)
1	Q-Sys	TSC-70-G3	7” Touch Screen AV Controller
1	FSR	WB-TSC-FM-7	Touchscreen Wall Plate Cover
VIDEO DISTRIBUTION			
1	Epson	EB-PU2113B	13,000 Lumens Large Venue Laser Projector With 4K Enhancement – Connect Projector Audio Output to DSP.
1	Chief	PG4A	Extra-Large Venue Projector Guard
1	Epson	ELPLW08	Projector Lens
1	Liberty AV	DL-1H1A1UC-WPKT-W	HDMI & USB-C HDBaseT Wall Plate Extension Set w/USB
AV NETWORK EQUIPMENT			
1	Netgear	GSM4230PX	24x1G PoE+ 480W 2x1G and 4xSFP+ Managed Switch
WIRELESS MICROPHONE			
2	Shure	SLXD124/85M	Combo Wireless Handheld and Lavalier Microphone System
4	Shure	SBC203	Dual Docking Charging Station
4	Shure	SB903	Rechargeable Lithium-Ion Battery
1	Shure	UA844+	Antenna Distribution System
2	Shure	UA864US	Wall-Mounted Wideband Antenna

2.3 DINING C100 – AUDIO AND VIDEO DISTRIBUTION

A. Contractor to provide and install a complete audio and video 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			
1	Q-Sys	Core 24F	Digital Signal Processor
2	Q-Sys	CX-Q 4K4	1000W, 4-Channel Network Amplifier – Stage Monitor and Ceiling Speakers
1	Q-Sys	CX-Q 8K4	1250W, 4-Channel Network Amplifier
1	Bluesound	B100S	Network music player
	Yamaha	MG10XU	10-channel Audio Mixer
Ref. Plans	JBL	VTX M22	12" Professional Stage Monitor Speakers
Ref. Plans	JBL	CBT 1000 + CBT 1000E System	Line-array Column Speaker
Ref. Plans	Q-Sys	AD-C8T-ZB	8-Inch, 2-Way, Zero Bezel Ceiling Speaker
1	Symmetrix	xIO Bluetooth	Bluetooth 5.0 PoE Audio Dante/AES67 Network Interface (White)
3	Shure	MX202	Overhead Omnidirectional Microphones. Provide pre-amp kits.
VIDEO DISTRIBUTION			
1	Epson	EB-PU2113W	13,000 Lumens Large Venue Laser Projector With 4K Enhancement –

			Connect Projector Audio Output to DSP.
1	Epson	ELPLW06	Projector Lens
1	Liberty AV	DL-1H1A1UC-WPKT-W	HDMI & USB-C HDBaseT Wall Plate Extension Set w/USB
1	Q-Sys	TSC-101-G3	10” Touch Screen AV Controller
AV NETWORK EQUIPMENT			
1	Netgear	GSM4230PX	24x1G PoE+ 480W 2x1G and 4xSFP+ Managed Switch
WIRELESS MICROPHONE			
2	Shure	SLXD124/85M	Combo Wireless Handheld and Lavalier Microphone System
2	Shure	SBC203	Dual Docking Charging Station
4	Shure	SB903	Rechargeable Lithium-Ion Battery
1	Shure	UA844+	Antenna Distribution System
2	Shure	UA864US	Wall-Mounted Wideband Antenna

2.4 BAND C102 – 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			
1	Q-Sys	Core 8 Flex	Digital Signal Processor – Connect Projector audio output to DSP input
1	Q-Sys	MP-A40V	200W, 4-Channel Network Amplifier
1	Symmetrix	xIO Bluetooth	Bluetooth 5.0 PoE Audio Dante/AES67 Network Interface (White)
Ref. Plans	Q-Sys	AD-C8T-ZB	8-Inch, 2-Way, Zero Bezel Ceiling Speaker
1	Q-Sys	TSC-70-G3	70” Touch Screen AV Controller
AV NETWORK EQUIPMENT			
1	Netgear	GSM4210PD	8x1G PoE+ 110W 1x1G and 1xSFP Managed Switch
WIRELESS MICROPHONE			
1	Shure	SLXD124/85M	Combo Wireless Handheld and Lavalier Microphone System
1	Shure	SBC203	Dual Docking Charging Station
2	Shure	SB903	Rechargeable Lithium-Ion Battery
2	Shure	UA864US	Wall-Mounted Wideband Antenna

2.5 DANCE B127 – 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			
1	Extron	XPA U 1004 SB	Two 200 watt bridged channels into 70V or 100V – Install at Storage Room B128,

QTY	MFR	PRODUCT NUMBER	DESCRIPTION
			above finished ceiling. Provide Plenum rated enclosure.
Ref. Plans	Q-Sys	AD-C8T-ZB	8-Inch, 2-Way, Zero Bezel Ceiling Speaker

2.8 MEDIA B131 – AUDIO AND VIDEO DISTRIBUTION

A. Contractor to provide and install a complete audio and video 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			
1	Extron	XPA U 1004 SB	Two 200 watt bridged channels amplifier – Install at Office B132, above finished ceiling. Provide Plenum rated enclosure.
2	JBL	SLP14/T	Low-Profile On-Wall Loudspeaker, White

2.9 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)
d. Provide any additional hardware or lacing strips to make a complete installation
e. Provide blank panels necessary to enclose rack completely.

C. Miscellaneous Equipment
1. Provide the following equipment for each venue, unless noted otherwise. (excluding the Advanced Culinary Lab, Weight Room, and Wrestling Room)
a. (2) Shure SM58S-LC Microphones, per venue
b. (1) 25’ Microphone cable, per venue
c. (1) 50’ Microphone cable, per venue
d. (2) Atlas MS20E Mic Stand, per venue
e. (1) Atlas TL34-15E Boom Stand, 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)

2.10 DISPLAY AND PROJECTOR MOUNTING HARDWARE

A. Wall Mounted Monitors: Provide the following at each wall mounted flat screen display location on the entire project
1. Universal Articulating Wall Mount: Peerless Product No. PLAV70-UNLP or equivalent
2. Provide Triple Stud Wall Plate for each, stud-wall, wall mounted solution: Peerless Product No. WSP(716 or 724). Coordinate exact model with stud-wall construction. Coordinate desired finish color with architect and owner at each location.
3. In-Wall Storage Box Chief Product No. PAC525FW.

B. Ceiling Mounted: Provide the following at each ceiling mounted flat screen display location on the entire project
1. Universal Ceiling Mount Kit for 43" to 90"+ Displays Peerless Product No. PCM150

C. Provide the following mounting hardware at each Ceiling Mounted Projector location (
1. One (1) 2'x2' Above Suspended Ceiling Storage Box with Column Drop, Chief Product No. CMS492C
2. One (1) Adjustable Extension Colum, Chief Product No. CMS####*
a. Height adjustment in 1" increments
b. 1.5" NPT, threaded on both ends
c. '####' to be replaced with a numeric value depicting the minimum and maximum adjustment capabilities. The center setting shall be equivalent to the height at the top of the projection surface but shall not exceed a maximum extension capability of 5'.
d. '*' to be replaced with a 'W' if required in white.
3. One (1) Universal projector mount with keyed locking, Chief Product No. RPM#U*

a. '#' shall be replaced with an alphabetical character that shall depict the product version
b. '*' to be replaced with an alphabetical character depicting the mount color.

4. All product finish colors shall be coordinated with the architect. Color should match the color of the mounted device and the finish of the surface it is mounted to.

2.11 AUDIO VISUAL PATCH CABLES

A. Provide and install the following Patch Cables
1. Provide the following at each AV Input Outlet:
a. One (1) 10' HDMI Patch Cable, C2G Product No. 56784
2. Provide the following at each AV Output Outlet:
a. One (1) 6' HDMI Patch Cable, C2G Product No. 56783
b. One (1) 6' 3.5MM Stereo Audio Cable, C2G Product No. 22601

2.12 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.

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.

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)

B. Contractor to provide a minimum of 25 additional hours of AV system programming in the project to be used for final owner adjustments and unforeseen circumstances. A written notification to the architect/engineer will be sent when this programming time is used, noting the use of contingency programming time and quantity of hours expected to be used.

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.

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 me 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 competition.

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

SECTION 27 51 13 - SCHOOL COMMUNICATIONS SYSTEM

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. Furnish and install a complete Building Intercommunications and Paging System.
   1. A complete system includes items such as wiring, push/call buttons, handsets, control consoles, and main distribution equipment.
   2. Integrate all components to provide a complete and functioning system.

B. Locate equipment to accommodate millwork, fixtures, marker boards and other room equipment at no additional cost to the Owner.

C. Integrate the communications system with the following systems:
   1. Clock and Bell System
   2. Owner’s IP Telephone System
   3. Local sound reinforcement sound systems

D. Return air plenum cable shall be used. Wherever cabling is run exposed, conduit shall be used to cover and protect wiring.

E. Contractor to field verify and replace all existing call stations and remote program source in their entirety.

F. All functioning head end equipment and field devices shall be returned to the owner or disposed of upon the Owner’s request.

G. 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.

H. The proposed system shall be a traditional intercom system, wired for 25v/70v configuration. A system with IP based field devices will not be acceptable. All head end equipment is to be located in the building MDF, with cross-connect fields located in IDF

(as required) and all termination fields shall connect to the MDF via Multi-Conductor (minimum of 25-pair per remote termination field).

I. Any category 6 network cabling for this system shall be provided by the Structured Cabling System installers. Patch cables within the closet can be provided by the intercom installer and coordinated with the owner for patching into the Owner's network. Since this is a traditional intercom system, there should be no requirement for category 6 cable to be routed out of the MDF, for network connectivity purposes. In the event that there is any requirement, the installer of the cabling shall meet the requirements and qualifications specified in the Structured Cabling System specification.

1.3 QUALITY ASSURANCE

A. Provide the system by a company that has been designing and supplying similar systems for a period of 3 years. Provide, upon request by Owner or Architect / Engineer names and addresses of similar installations.

B. Provide central processing control console wiring connections by factory engineers or authorized factory trained personnel.

1.4 WARRANTY

A. Warranty equipment for a period of 1 year, from date of substantial completion.

B. Correct defects in material or workmanship with a minimum loss of operating time at no cost to Owner.

C. On-site service within 24 hours of notification.

1.5 SUBMITTAL

A. The installing contractor and/or equipment supplier shall provide complete and detailed shop drawings and include:
1. Wiring and interconnection schematics.
2. Complete point-to-point wiring diagrams
3. Riser diagrams.
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, and project name adequately identified.

C. Minimum size drawings: 11" x 17".

1.6 COORDINATION

A. It shall be the responsibility of the installing contractor to coordinate all requirements surrounding installation of the Building Intercommunications and Paging System with all

other trades.

B. Pre-installation meeting: Schedule a pre-installation meeting specifically for the Building Intercommunications and Paging System with Owner and Architect.

1.7 REFERENCES

A. National Electrical Code.

B. UL

C. Building Intercommunications and Paging System connected to a telephone utility company shall comply with the Federal Communications Commission rules Section 68 and the corresponding UL listing.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. School Communications Head-End/Console Equipment
1. Carehawk CH1000

B. Speakers/Attenuators
1. Quam
2. Atlas Sound

C. Cable
1. Windy City Wire
2. Tappan
3. Approved Equal

D. UPS
1. Tripplite

2.2 HEAD-END EQUIPMENT

A. The central equipment is existing to remain and to be expanded. Provide the following as needed:

1. Zone circuit boards as required to meet the system requirements for remote stations and/or communications linkage.
3. All necessary equipment to incorporate into existing Starcall equipment, shall be provided.

B. Admin Phones
1. Carehawk AP1

2.3 ZONED PAGING AMPLIFIER

A. External paging amplifiers shall be provided as required to meet the load requirements of expanding the system when activated in the all-page mode. The system shall be equipped with equipment required for (one) program channel.

B. Program/paging amplifiers shall have the following:
   1. Power output shall provide sufficient power for the speakers required to the project and include an additional 25% capacity.
   2. Maximum .5% harmonic distortion from 20-20KHz.
   3. Frequency response of 20Hz to 20KHz +/-1 dB.
   4. 90 dB signal to noise ratio at 20Hz to 20 KHz.
   5. 1V RMS input sensitivity at 1KHz.
   7. Master volume control.

2.4 SPEAKERS

A. Ceiling speakers:
   1. 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 Atlas Sound AT-SD72WV, or approved equivalent by Quam.

B. Exterior Speakers:
   1. The speaker shall be an 8” with recessed box and baffle
   2. 25/70V transformers shall have primary taps of 0.25, 0.5, 1, 2 and 5 watts. Tap speaker at 0.25 watt.
   3. Aluminum alloy grille, white finish, neoprene gasket. Atlas APF-15T.

C. Volume Attenuators:
   1. Atlas Sound AT10 or approved equal by Quam.

2.5 NETWORK INTEGRATION

A. VoIP Integration
   1. The provided system shall have the capability of integrating with the owner’s VoIP System.

2.6 UPS BATTERY BACK-UP

A. Provide UPS Battery backup for the communications system to operate a minimum of 24 hours stand-by then 20 minutes of operation upon loss of power.

B. Acceptable Manufacturers: Tripplite SmartPro 1500VA.

2.7 MASTER CLOCK SYSTEM

A. The system shall contain an integral Master Clock and Programmer that shall be capable of performing the following functions:
   1. Provide 500 discrete time event entries for programming functions based upon:
      a. The time of day in hours and minutes
      b. The day or combination of seven days of the week on which the event is to occur
      c. The selection of any one or any combination of 32 zones or (8) outputs to be activated
      d. The selection of any one or combination of 16 schedules to allow for maximum flexibility due to special circumstances or seasonal changes.

e. The selection of 16 user-programmable Event Tones

1) Any combination of time schedules may be active simultaneously

2) Event Tones are programmable from a library of 25 Tone Types

B. Provide for Automatic Daylight Savings Time adjustment with Leap Year programming.

C. Provide momentary contact closures for external device operation. Provide four inputs, four outputs and four flex-puts.

1. Inputs shall be programmable by the user to initiate any desired system activity (e.g. Page, Tone, Program, Event, System Reset, etc.)

2. Outputs shall be programmable by user to activate during any desired system activity (e.g. Page, Tone, Program, Time of Day, etc.)

a. Display the time of day in either 12 or 24-hour format at each Administrative telephone

b. Master clock shall correct compatible secondary clocks, analog, digital, or both

D. The system shall provide for an editing and review routine to permit the user to change and edit time events, zones, and schedules.

E. The system shall allow pre-selected program material to be distributed according to pre-programmed schedules, i.e. March to Music, National Anthem, etc.

2.8 SECONDARY CLOCKS

A General

1. Provide secondary clocks at locations shown on drawings.

2. Digital Clock: Microprocessor-controlled unit with red LED digital time display of hours and minutes.

a. Digital Clock: Microprocessor-controlled unit with red LED digital time display of hours, minutes, and seconds.

b. Display Height

1) Offices: 2.5-Inch

2) Corridor: 4-Inch

3) Gymnasium: 4-Inch

c. Display Format: Selectable between 12-hour (with “PM” indicator on LED display) and 24-hour formats.

3. Connections for Power and Correction:

a. Wired synchronous connection to master clock for both operating

power and correction.

4. Clock Circuit Power Booster

a. Transformer power supply, mounted in steel cabinet with hinged door, and having fuse-protected input and output circuits.

5. Back Boxes

a. 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.

6. Guards

a. Formed-steel wire, shaped to fit around guarded device, with 1-inch (25-mm) maximum clearance.

b. Mounting Provisions: Fixed tabs welded to guard and arranged for screw attachment to mounting surface.

c. Finish for Indoor Devices: Clear epoxy lacquer over zinc plating or powder coat painted finish.

2.9 UPS BATTERY BACK-UP

A. Provide UPS Battery back up for the communications system to operate a minimum of 24 hours stand-by then 20 minutes of operation upon loss of power.

B. Acceptable Manufacturers: TrippLite

PART 3 - EXECUTION

3.1 INTERCOM SYSTEM DESCRIPTION

A. The intercom system shall consist of a central equipment cabinet, microprocessor control unit, power supply, zone modules, administrative control stations (ACSs), amplifiers, and station loudspeaker assemblies. Provide all associated material hardware, wiring, and options as described herein to provide a complete working system, which shall meet the specified requirements.

B. The intercom system shall provide the following communications paths and functions.
1. ACS to remote loudspeaker station (provide two channels).
2. Administrative control station to administrative control station.
3. Remote speaker to administrative control station.
4. Zone paging.
5. Network IP Mass Notification

C. The system shall be designed so as to accomplish any combination or all of the above functions simultaneously.

D. The system shall provide the facilities for the paging or sounding emergency signals or time event signals to selected groups or all remote speakers.

E. The system shall provide facilities for the control and distribution of up to two program channels to individual, selected groups, or all remote speakers, as well as intercom

communications and class change signals.

F. The system shall include the facilities of a built-in master clock and programmer capable of correcting appropriate secondary clock displays and controlling events based on user programmed time schedule programs.

G. Provide remote control of program distribution. Distribution of the program source shall be possible from any administrative control station (ACS).

H. Zone system as follows:
1. CLASSROOMS - ZONE 1
2. OFFICES - ZONE 2
3. EXTERIOR - ZONE 3
4. CORRIDORs - ZONE PER AREA
5. RESTROOM - ZONE WITH ASSOCIATED AREAS.

3.2 INTERCOM SYSTEM FUNCTIONS

A. The base system shall provide one simultaneous open voice speech paths between administrative control station and station loudspeakers within each 24-zone group.
1. The speech channels shall be true multiple, simultaneous, UNRESTRICTED, amplified voice channels requiring no automatic queue or call stacking to access the intercom amplifier.
2. The system shall come equipped to provide modular expansion to eight (8) simultaneous open voice speech paths and a minimum expansion capability of 128 additional stations.
3. An intercom amplifier shall be provided integral with each ACS.

B. The system shall provide the capacity for both a loudspeaker station and a pushbutton at each remote location. Each remote station shall be assigned an architectural or ID number to communicate with its assigned ACSs. The system shall permit user selection of 2, 3, 4, or 5-digit architectural dialing.

C. The system shall allow preselected coverage of calls from remote station to ACS on a remote station basis. A remote station shall be able to report to multiple administrative control stations simultaneously. Functions of an unattended ACS may be forwarded by the user to an attended ACS. This provides overlapping or distinct coverage of remote stations by administrative control stations. Systems not allowing programmable flexibility of remote station coverage shall be unacceptable.

D. The system shall incorporate all necessary circuitry to prevent monitoring of remote stations equipped with call origination switches with privacy mode.

E. The system shall have 8 user assignable groups of stations for zoned audio paging with any remote station belonging to more than one group. A separate group/zoning shall be user assignable for 8 zones of class change signals.

F. The system shall allow for user definable pre-selective access to "zone" and "all-page" functions. This feature will prevent unauthorized paging from designated ACSs.

G. The system shall provide facilities so that the user has access for sounding selected tones from any ACS on either all-page or by zone basis for use as emergency or other alarm signals.

H. Provisions shall be provided inherent to the system, to allow for the use of a priority override inputs (i.e. principal's microphone and telephone extension). This circuit, when activated by an external source, shall gather all speakers for distribution of the signal information provided by the external source. This priority override input shall preempt other functions currently under way in the system. Upon conclusion of the priority override function, all pre-empted functions shall be automatically restored.

I. The system shall have the capability to operate with external paging amplifiers to increase the audio output available for paging. Adequate audio amplification shall be provided as required.

J. The system shall be equipped with control point outputs and activate outboard devices such as priority override muting relays on remote local sound reinforcement systems. The control point outputs shall be activated when the system is placed in the emergency page mode or if the emergency tone generator is activated and shall mute the output of the local sound reinforcement system.

K. The system shall be equipped with RS-232 ports to allow for the following:
1. Diagnostics via a standard computer terminal.
2. Modem interface to allow remote factory engineering assistance. Systems not providing a port of access to the system shall not be acceptable.

L. System must allow simultaneous operation of both diagnostic and functional routines (paging, zone page, time events, call-in, etc.).

M. The system shall have the ability to perform scan functions from the administrative control stations or computer terminal for:
1. Review of call-in coverage assignments to an ACS.
2. Review ID numbers of remote stations assigned to either of the two program channels.
3. Review that ACSs are forwarding coverage.
4. Edit and review master clock time programs.

N. Higher priority calls shall not cancel when the "Clear All Calls" routine is used. Only normal calls shall clear and cancel.

O. Line loss on two-way communications circuits to be no greater than .5dB per 500 feet of circuit length.

P. The system shall be provided with the capability to activate an emergency tone / signal / wav file from remote emergency pushbuttons located throughout the building. Deactivation shall require password protected access from an ACS.

3.3 INSTALLATION

A. General: Install new Building Intercommunications and Paging System components in accordance with the manufacturer's instructions.
1. Terminate all field wiring on telephone punch blocks mounted in an enclosure as specified.
2. Label cables and wiring logically, legibly, and permanently for ease of identification, using adhesive strip type labels.
3. All communications wire and cables, which are to be routed in the ceiling spaces

shall be identified and tagged at the end and beginning of every home run. The identification shall include the room number on markers like T&B sleeve marker.

4. Provide integration of local sound reinforcement system override.

B. Speaker Installation:
   1. Install new speaker types as indicated on the drawings.
   2. Speakers in high ambient noise areas (cafetorium, gymnasiums, etc.) Shall be tapped as required to overcome the ambient noise generated by the public.
   3. Provide silicone sealant to all openings and conduit penetrations at all exterior back box locations.

C. Conduit and Cables
   1. Install conduit, fittings and boxes as specified in Division 26.
   2. Single system cables shall be grouped together in a common conduit of adequate capacity to facilitate the ease of installation and prevent conductor or insulation damage.
      a. In no case shall the conduit fill exceed 50% capacity.
      b. Do not group conductors or cables of different systems in a common conduit.
   3. Cable:
      a. Install cables as recommended by the system manufacturer. Conductor quantities specified are minimum required. Conductors to be installed shall be coordinated with the system equipment supplier.
      b. Cables installed on exposed surfaces, in inaccessible locations, or underground shall be installed in conduit.
      c. Cables installed above accessible, ceiling spaces may be installed without conduit. All cables not installed in conduit shall be plenum rated.
   4. Cables not installed in conduit shall be grouped and bundled. Cable shall be bundled on a maximum of 2'-6" on center. Support cables from D-rings or J-hooks. D-rings and J-hooks shall be secured to the structure at a maximum of 5' on center. Bundling and support shall be with plenum rated cable ties.
   5. Cables installed in hollow wall spaces shall be installed in conduit to an accessible location.

6. Tag each circuit at each end and at each terminal with a separate tag indicating the area served.

3.4 ADDITIONAL REQUIREMENTS

A. Provide four hours' instruction to the operating/maintenance personnel, which shall include initial programming of eight schedules.

3.5 INSTRUCTIONS

A. Provide eight hours instruction to the operating/maintenance personnel, which shall include initial programming of eight schedules.

3.6 TESTING AND ACCEPTANCE

A. General
   1. After completion of installation and start-up procedures, commence a verification and testing sequence leading to final acceptance.
   2. Submit for approval, a sample of the form on which the test will be reported.
      a. Identify project.
      b. Provide a list of all system devices, arrange in numerical order of point

addresses.
1) Show descriptor and location of each.
c. Signatures of participants and observers.
d. Results.
e. Description of adjustment or corrections of defective components.
f. Date.

3. Provide schedule of tests. Estimate dates of significant events.

a. All testing shall be performed in the presences of the Owner / Engineer.

4. Test, calibrate and adjust each device in the system.
5. Verify operation of all specified functions.
6. Provide documentation of all tests and verifications as specified.

3.7 GRAPHIC FLOOR PLANS

A. Provide two (2) color coded floor plan detailed with actual room names, actual graphic room numbers as directed by the Owner, and adequate information to indicate group / zone / circuit information with non-fading floor plan media. Do not use architectural plan room names and numbers.

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.

C. The floor plan shall be solvent welded in acrylic plastic.
1. Mount in an extruded aluminum frame.

D. Install graphic floor plans as directed by Architect / Owner prior to substantial completion. Each area or room designation shall be verified with the communication device during testing.

3.8 GROUNDING OF EQUIPMENT

A. Racks and cabinets shall be grounded to the metallic structure of the building or to the building system power ground in accordance with NEC section 250. Securely bond equipment to the ground system through a minimum 14-gauge green insulated conductor.

B. Electronic systems shall be grounded to the building system ground, with a maximum resistance of 0.1 ohm. Systems ground shall be a driven ground rod, building steel, or other approved ground of the building power systems ground.

3.9 ANTENNA

A. Furnish and install the Antenna as specified.

3.10 SERVICE AND MAINTENANCE

A. The contractor shall provide a 1-year warranty of the installed system against defects in material and workmanship. All labor and materials shall be provided at no expense to the Owner during normal working hours. The warranty period shall begin on the date of acceptance by the Owner/Engineer.

B. The contractor shall, at the Owner's request, make available a service contract offering continuing factory authorized service of this system after the initial warranty period.

END OF SECTION

SECTION 28 01 00 - 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 sing-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
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.
   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.
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

SECTION 28 05 00 - 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*
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.

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.

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.

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.

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.

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 *(Now referred to as TR)*
TR	Telecommunications Room *(A.K.A. TC - Telecommunication Closet)*
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.

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.

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.

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.

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.

1.28 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.

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.

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.

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 if 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.

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 megohmeter (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 not rime 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.

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.

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.

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.

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 ad 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 28 umbrellas, as identified in the Division 2 of the Construction Specifications Institute (CSI) current

Master Format7 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.

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 cam 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.

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

SECTION 28 05 05 - ELECTRONIC SAFETY AND SECURITY 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 exists the possibility that there are existing conditions and devices which 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 Contractors responsibility to visit the site and determine all of the existing conditions and to take these existing conditions into consideration when making and presenting a proposal to as 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.

C. Verify field measurements and circuiting arrangements.

D. Verify that abandoned wiring and equipment serve only abandoned facilities.

E. Demolition Drawings are based on casual field observation and existing record documents. Report discrepancies to Architect before disturbing existing installation.

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. 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.

C. 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.

D. Material or equipment salvaged for Owner's use shall be carefully handled and stored where directed by the Owner.

E. Materials and equipment not indicated to be removed or abandoned shall be reconnected to the new system.

F. Clean and repair existing materials and equipment that remain or are to be reused.

3.3 SEQUENCING AND SCHEDULING

A. Coordinate utility service outages with 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.

C. Remove and replace existing conduit, wiring, outlets, devices, and appurtenances as occasioned by new or remodeled construction. Re-establish service to devices that may be interrupted by remodeled construction.

D. Disconnect communication 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.

E. Remove equipment, systems, conductors, wiring, raceways, etc. abandoned or not required for existing or new systems. Coordinate with Architect/Owner for salvage by Owner.

F. 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 24 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

G. Existing Security System: Maintain existing system in service. Disable system only to make switchovers and connections. Notify the Owner at least 24 hours before partially or completely disabling system. Minimize outage duration.

H. Existing Video Surveillance System: Maintain existing system in service. Disable system only to make switchovers and connections. Notify the Owner at least 24 hours before partially or completely disabling system. Minimize outage duration.

3.4 DEMOLITION AND EXTENSION OF EXISTING SAFETY AND SECURITY 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 and 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 hereinbefore specified.

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.

F. Disconnect and remove communication devices and equipment serving utilization equipment that has been removed.

G. Repair adjacent construction and finishes damaged during demolition and extension work.

H. Maintain access to existing communication installations that remain active. Modify installation or provide access panel as appropriate.

I. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

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.

D. Repairs, equipment replacements, and corrections to special systems due to damage caused by contractor:
1. For each special 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.
2. Corrective measures to the special systems to correct components of the special systems found damaged by the contractor shall be completed to the satisfaction of the Owner and Architect prior to acceptance of substantial completion at no additional cost to the Owner.

3.6 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 preformed 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. Security Access Control System
b. Video Surveillance System
c. Fire Alarm and Detection 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 special systems:
1. Provide complete operational test 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 preformed 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. Security Access Control System
b. Video Surveillance System
c. Fire Alarm and Detection 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.

END OF SECTION

SECTION 28 05 07 - 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

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.

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

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

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

SECTION 28 05 10 - 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.

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

SECTION 28 05 50 - 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

SECTION 28 10 02 - 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.

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. Servers
   11. Clients
   12. Mobile application
   13. Badging Station; including Enrollment Readers, Cameras, Software, and Printers
   14. Lockdown and Lockout Buttons
   15. Audio Intercom Systems
   16. Licensing
   17. Integration
   18. 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
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)

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.

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 expirer 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
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)

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.
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.

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 MANUFACTURERS

A. AMAG Symmetry M2150-8DBC.

B. Power Supply – Life Safety

C. 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.

2.2 SERVERS AND USER INTERFACE

A. Servers and Unser Interfaces are existing to remain. The system installer shall coordinate the installation of all new equipment and/or existing equipment that is affected by the project's scope. All equipment shall be modified and/or added in compliance with the existing systems parameters. The system installed shall provide and additional equipment to furnish a complete expansion of the system as shown on the project drawings, access control schedule, details, and legends.

2.3 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.
   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 (sever-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
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.

J. Provide and install all software and/or hardwire 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 and any other VMS required by Crosby ISD. Integration to be completed by the system installer:
1. ExacQvision
2. Milestone
3. OnSSi
4. Salient Systems
5. Video Insight

2.4 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.

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 resisters 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.

2.5 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.

C. Card Readers: Provide card readers as shown on the floor plans, access control schedule, and access control details.
1. Card readers shall be HID 20NKS-00-000000 for all mullion installations.
2. Card readers shall be HID 40NKS-00-000000 for all single gang wall switch mounted installations.

D. Credentials: Coordinate Facility Code, External Start Number, and Internal Start number with the Owner prior to procuring credentials.
1. Contractor shall provide a minimum of 100, HID iClass Access Cards.

E. 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

2.6 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
      e. Local Door Siren Strobe: 2-conductor, 18 AWG, 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
      e. Local Door Siren Strobe: 2-conductor, 18 AWG, 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.

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.
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.

SECTION 28 20 00 - 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 Video Management System shall be owner provided and to 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 levering 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.
   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. Rackmount.
a. Servers will be provided by owner, installed, and programmed by the system installer.

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).

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.

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.
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.

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.

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 owner provided 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 the owner with 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. Servers and Cameras are owner provided, manufactured by Hanwha.
2. Coordinate license and VMS requirements with owner.

2.2 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.

2.3 HEALTH MONITOR

A. Front end, or by sending out an e-mail to one or more users.

2.4 VIDEO WALL

A. The VSS shall support video wall applications by connecting and controlling multiple workstations and monitors simultaneously.

2.5 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.

2.6 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.

2.7 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.

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.
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)

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.

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 as NVR's, Power Supplies and any other equipment furnished by contractor.

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

SECTION 28 31 02 - 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 furnish and install a complete 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 of 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

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.

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.
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

A. Honeywell (Ademco) Security Panel product no. VISTA128BP.

B. Field Devices:
1. Sentrol Devices
2. Intellisense Devices
3. Tri Tech Devices

B. Contractor shall field verify and match manufacturers of existing headend equipment and field devices. Requests for substitutions will be considered in accordance with provisions of Division 1.

2.2 CONTROL COMMUNICATOR (PANEL)

A. The unit shall be UL listed for commercial fire alarm and burglar alarm application, and shall be FM approved.
1. Integral modem for remote accessibility for the purposes of programming, diagnostics, and remote control of functions.
2. Equipped with a minimum of eight (8) protective zones and shall have a 1.4-amp power output capability for alarm signals.
3. Minimum of 1-amp power for auxiliary devices, real-time clock and test timer, battery charging circuit, on-board diagnostic LED's, automatic resetting circuit breakers, transformer cover, and RFI protection.
4. Main control panel shall be capable of annunciation alarm, trouble, and supervisory signals at the local key pad(s) and to a remote security-monitoring center.
5. Main control panel shall incorporate a minimum of four (4) hours standby power.
6. Main control panel shall be located in the Head End Room of the campus or as directed.
7. Card Reader interface card.
8. Network Interface Module.
9. Remote reset interface module.

B. Programmable features shall include:
1. Independently control zones through an independent zone control keypad.
2. Two telephone number dial up for primary and secondary remote receivers.
3. Automatic test reports.
4. Selective zone shunting.
5. Custom text on the associated command centers.

C. Zone Expansion - Expanded to 128 individually annunciated points of protection through the addition of a two-wire multiplex zone expansion system. Points of protection are annunciated with custom text at the keypad Command Center and they can be reported to a Receiver.

D. User Pass Codes – One-Hundred Fifty (150) user pass codes shall be available to identify the user when arming/disarming the system.

E. Protective Circuits shall consist of zones designed for fire and/or panic (holdup, duress, or emergency) and/or burglary and/or supervisory. Each master zone represents a protective circuit and shall accommodate normally opened and closed devices. Each of the eight master zones are programmable as to whether they are controlled versus 24

hours; interior versus perimeter; instant versus delayed; silent versus audible (and if audible, pulsed or steady); and local or reporting.

1. Additional programmable parameters for each master zone include the ability to suppress trouble or restorable reports, designate it as a priority zone (system cannot be armed if this zone is off-normal), report two separate telephone numbers and provide for automatic shunting of master zone from the system in the event that the detection device malfunctions and creates numerous false alarms.

F. Entry/exit delays shall be independently programmable from 10 to 150 seconds. A pre-warn audible shall be coincident with the entry delay.

G. Programming of all system functions shall be achievable at system site or remotely via the use of the dial-up telephone network. Minimum programmable functions shall include:
1. User pass codes, entry/exit delay times, master zone personality, day/date/time, telephone numbers, point of protection text labels, and bell time.
2. A programmable system pass code shall be used to prevent unauthorized remote programming attempts.
3. Remote programming capability shall be automatic or require user enabling at the discretion of the user.

H. Remote control via the use of the dial-up telephone network shall include:
1. System arming.
2. Reset of audible signals.
3. Activation/deactivation of eight relay contacts.
4. Interrogation of battery.
5. Zone and armed status.
6. Enable/disable of reporting functions and removing reporting devices for servicing while the remainder of the system is operative.

I. Recognitions shall include: UL for central station fire and/or burglary, local burglary and / or fire; FM for fire, California Fire Marshal for fire; and NYBSA for fire.

J. Miscellaneous built-in features shall include:
1. Real-time clock.
2. Interrogator.
3. Auto-answer modem.
4. Phone line monitor.
5. Loop start/ground start telephone interface.
6. Auto bell test.
7. Lug-in terminal strips, and user controlled zone bypass.

K. Command centers shall be microprocessor-based, UL listed, with built in:
1. 16 character illuminated alpha-numeric display.
2. Burglary and fire sounders.
3. Back lighted 15-key touch pad.
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), (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. Honeywell Product no. 6160.

L. Modules and Accessories
1. Zone Expansion
2. Independent zone control
3. Battery charger module
4. Universal enclosure
5. Attack resistant enclosure
6. Relay module - provides eight form "C" dry contact relay outputs for a variety of programmable responses to alarm, trouble and other system conditions. They shall be automatically operated through skeds.
7. CRT interface module - provides either RS232 or current loop output for printer and/or CRT for on-premises recording of events recorded in logger.
8. Provide Printer that connects directly to the Control Panel to provide printed copy of events recorded in logger.
9. Auxiliary power supplies as required for powering of motion detectors.
10. Keyboard programmer with memory card, case and accessories.

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.
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
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. Recessed Door Contact shall be Sentrol 1078-M.
3. Hatch Contacts Shall be Sentrol 2505AL door contact.

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 CA2000.

2.4 WIRING

A. All wiring shall be by the manufacture’s 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 their 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 #P182C-07
Tappan Wire & Cable, Inc. #P40020.122
2. 18/4 unshielded:
Belden #P184CS-07
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.

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.

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.
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

SECTION 28 46 00 - 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. Provide proper spacing and coverage of all devices.

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.	NFPA1	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
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.

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.

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.
   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.
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".

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 emote 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.

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. Notifier – Notifier Engineered Systems Distributor for Notifier
2. Edwards - Local Strategic Partner for Edwards

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.

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.

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.

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.

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.
    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.
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.

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: Cellular is Primary 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
5. Provide Starlink cellular 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.

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.

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.

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.
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.
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. Minimum 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.

2.5 NOT USED

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:
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.

2.10 NOT USED

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. Provide and install t-grid box hanger and box for all ceiling mounted devices.

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.

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 fire alarm control panel.

R. Smoke detectors shall be mounted to a 4-inch octagon box with hanger bar or with box secured to building structure.

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 all locations currently covered by existing smoke detectors, with exception of locations that are harmful to detectors or the normal status of the system, unless required by current code and local AHJ. Provide additional smoke detectors in all areas required by current code.

U. Provide heat/thermal detectors in all locations currently covered by existing heat/thermal detectors. Provide additional heat/thermal detectors in all areas required by current code.

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 beam type detectors at the following locations when appropriate. Provide quantity or install configured to provide adequate coverage without nuisance or false alarms:
1. Atriums to avoid exposed conduits.
2. High ceiling areas 25 feet and higher where maintenance of spot type detectors will be difficult.
3. Skylights to avoid exposed conduits.

Z. Provide manual pull stations at each exterior exit and at each exit from all floors if existing or required by local AHJ or if the building is not fully sprinklered. Provide one manual pull station at the central reception area adjacent to the remote annunciator, and main FACP, location 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.

DD. Provide finished surface extension rings for any wall mounted devices at existing locations, as necessary. Surface mount electrical boxes and conduit is unacceptable.

EE. Cellular dialer is to be the primary dialer. Crosby ISD to perform final programming to monitoring station. Provide and install fiber interface to FACP for future use.

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.

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.

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.
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.

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 2% 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.

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.

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. 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.

F. 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.

G. 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.

J. The existing fire alarm system shall remain fully operational until the new system is fully operational. Do not remove existing field devices until transition to fully operational new system as required by the Fire Marshall. The existing system shall be fully tested by the contractor prior to construction and a written report given to Owner indicating any operational deficiencies in the existing system. Owner will, or provide direction to correct any operational deficiencies, and afterwards, the contractor will take responsibility of maintain the existing system full functionality until the new fire alarm system is fully operational and accepted by the AHJ.

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.
   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.

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.

3.15 DEMOLITION OF EXISTING SYSTEM

A. Remove pre-existing fire alarm system after new fire alarm system has been accepted by AHJ and Crosby ISD.

B. Remove pre-existing fire alarm control panel, booster panels, annunciator, detection devices, monitoring modules, control modules, notification devices, and all other associated devices from system that has been replaced.

C. Remove all wire from pre-existing devices, j-boxes, raceway, ceilings, and walls, back to source. Do not abandon any unused fire alarm wire in ceilings or walls.

D. Remove unused conduit raceways back to nearest j-box. Cover all unused boxes with stainless steel covers.

E. Remove unused power circuits, raceway, and boxes back to source. Do not abandon unused power circuits.

F. Patch and paint all blemishes left from device removals and replacements.

END OF SECTION

SECTION 28 48 00 - EMERGENCY RADIO COMMUNICATION ENHANCEMENT SYSTEM (BDA SYSTEM)

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 DESCRIPTION

A. General:
   1. Provide a Public Safety Radio Distributed Antenna System (DAS), designed to provide in-building, 2-way radio coverage for all radio frequencies used by local first responder agencies, giving users the ability to receive and transmit radio signals from their portable radio units within the building.
      The DAS components specified in this document include:
      a. Bi-Directional Amplifiers (BDA)
      b. Donor Antennas
      c. Coverage Antennas
      d. Coax Cable
      e. Coax Connectors
      f. Splitters
      g. Combiners
      h. Couplers
      These devices shall be used as part of a system, to be designed by a DAS integrator, experienced with design-build projects for in-building, public safety, amplification systems. Quantities and locations of antennas shall be as determined by the equipment selected and the DAS integrator's design.
   2. The system shall comply with the minimum requirements of UL60950 In-building 2-Way Emergency Radio Communication Enhancement Systems, NFPA 72 2019 Edition, NFPA 1221 2019 Edition, NFPA 1225 2022 Edition and IFC 2015, as referenced.
   3. The entire system shall meet the requirements of the Fire Department, the Building Department and all other agencies and authorities having jurisdiction (AHJ).
   4. The work in this section shall include the responsibility for all permit requirements with the AHJ. Where filings require engineer's signature, documents shall be submitted for his review and signature. This responsibility shall include furnishing of required quantities of floor plans, descriptive notes and/or specifications, wiring diagrams, shop drawings and amendment forms.
   5. Early completion of the in-building emergency radio communication enhancement system will be required as to permit a Certificate of Occupancy to be obtained in a timely manner
   6. Any permits necessary for the installation of the work shall be obtained prior to the commencement of the work. All permit costs and inspection fees shall be included.
   7. The in-building emergency radio communication enhancement system shall use a UL60950, NFPA 72, NFPA 1221, NFPA 1225 and IFC 2018 compliant signal booster and equipment.

8. 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.

B. Design requirements:
1. In-building emergency radio communication enhancement systems for emergency responders are an integral component of the life safety equipment of a building or structure. The primary function is to provide reliable emergency responder communications at the required signal strength within the specified areas.
2. Critical Areas such as emergency command center, fire pump room, stairwells, corridors, elevator lobbies, standpipe cabinets, sprinkler sectional valve locations and similar critical areas shall be provided with 100% floor area radio coverage.
3. General building areas shall be provided with 95% radio coverage, or as specified by AHJ.
4. The In-building emergency radio communication enhancement systems must provide the following signal strengths:
   a. Downlink - Minimum signal strength of -95 dBm throughout the coverage area.
   b. Uplink - Minimum signal strength of -95 dBm received at the AHJ Radio System.
   c. OR As otherwise required by the AHJ
5. The system shall be complete with all components and wiring required for compliance with all applicable codes and regulations, and for its operations described hereinafter.
6. An approved manufacturer or a qualified and approved vendor shall perform an RF Survey to determine locations of components which are required for proper operation as well as to supply, install, test and certify the performance of the complete system. Vendor qualifications must be acceptable to the AHJ.
7. Design shall include iBwave software-simulated radio propagation modeling with heat maps showing predicted signal coverage levels within the building. The iBWave design shall be done by iBWave certified personnel.
8. All tests shall be conducted, documented, and signed by a person in possession of an FCC General Radio Telephone Operators License. All testing personnel shall be certified and authorized by the signal booster manufacturer in the installation and operation of their equipment. Personnel qualifications must be acceptable to the AHJ.
9. The system design shall be based on the line of Public Safety Signal Boosters UL60950, NFPA 72, NFPA 1221, NFPA 1225, IFC and FCC certified to establish standards of quality for materials and performance. The naming of a specific manufacturer or a catalog number does not waiver any requirement or performance of individual components described in the specifications.
10. Assembly and installation of all components of the Emergency Responder Radio Communication Enhancement System shall comply with all applicable sections of the National Electrical Code.
11. Survivability from attack by fire shall meet requirements of NFPA 72, NFPA 1221, NFPA 1225, IFC or as required by the local jurisdiction.
12. The system must comply with all applicable sections of the FCC rules. Signal booster shall have FCC certification prior to installation.
13. Antenna isolation shall be maintained between the donor antenna and all inside antennas (DAS) to a minimum of 20dB under all operating conditions

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 minimum product and performance warranty of one (1) year
3. Only products listed in Part 2 of this specification, or approved in compliance with the project manual's approval requirements, will be accepted

B. Installer Qualifications:
1. The 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 communications industry and shall provide a reference list of ten (10) large-scale projects and contact names confirming successful Structure Cabling System installations.
2. The System 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 individual with a valid FCC issued general radio operator's license. License shall be provided in the product submittals.
4. All individuals installing the DAS 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 DAS contractor will be allowed for any portion of the DAS 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 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.

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.

1.4 SUBMITTALS AND CLOSE-OUT DOCUMENTS

A. Contractor shall provide product data submittals, shop drawing submittals, and close-out documents as designated in Division 1 and Division 27 submittal requirements.

B. Submittals:
1. At a minimum, the submittals shall consist of the following: The installing contractor and/or equipment supplier shall provide complete and detailed shop drawings and include:
   a. Wiring and interconnection schematics.
   b. Complete point-to-point wiring diagrams.
   c. Riser diagrams.
   d. Complete floor plan drawings locating all system devices.
   e. Factory data sheets on each piece of equipment proposed.
   f. Detailed system operational description. Any specification differences and deviations shall be clearly noted and marked.
   g. Complete system bill of material, quantities not required.
   h. Line by line specification review stating compliance or deviation.
2. Product Data Submittals and shop drawings shall be submitted separate from one another and independent of any other system submittals. Submittals combines with other system submittals will be rejected without review.

C. Close-Out Documents: Reference Division 27 Electronic Communications O&M Manuals specification for close-out document instructions.

2 PRODUCTS

2.1 GENERAL

A. Acceptable Manufacturers
1. Advanced RF Technologies Inc
2. RSI
3. RF Technologies
4. Comba
5. Honeywell
6. Approved Equal

B. 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. TECHNICAL SPECIFICATIONS AND PERFORMANCE REQUIREMENTS

A. The system specified shall be based upon line of Public Safety UL60950, NFPA72, NFPA 1221, NFPA 1225, IFC compliant signal boosters

B. The signal booster shall be a Class A Public Safety type as designated by the FCC or as required by the AHJ.

C. The secondary power supplies, battery chargers and system monitoring shall be fully compliant with NFPA 72, NFPA 1221, NFPA 1225, and IFC. The signal booster shall have both the primary and the secondary power supplies within a waterproof, type-4 approved enclosure.

D. All signal boosters and other active system components must have FCC certification prior to installation. The equipment FCC ID must be shown on the product datasheets and technical submittals. The ID must also be displayed on the product as required by the FCC.

E. The signal booster shall be pre-set by the equipment manufacturer for the frequencies specified by the AHJ. Field tuning of RF filters and duplexers is not allowed.

F. Signal Boosters shall have oscillation suppression circuitry to protect the public safety radio system in case of system malfunction or other causes. The oscillation suppression circuit shall not disable the system operation. Systems that automatically disable the signal booster upon oscillation detection shall not be allowed.

G. Signal Boosters shall have uplink noise suppression function to eliminate uplink noise while in standby (i.e. no radio transmission from within a building). Systems that produce any measurable level of uplink noise while in standby shall not be allowed.

H. Signal Booster gain shall be rated at minimum of 80dB and the gain shall be adjustable in a minimum of 30dB range. System gain shall be set and documented at the time of the final system test.

I. Maximum Propagation delay of the signal booster system shall be 14µs (microseconds) or as specified by AHJ.

J. The signal booster system shall include built-in automatic supervision of malfunctions of the signal booster and battery system as per NFPA 1221 NFPA 72 and IFC. Non-OEM

equipment add-ons and modifications to comply with this specification shall not be allowed.

K. As required by code and the local AHJ, the system shall be monitored and shall included automatic supervision signals for malfunctions of the in-building emergency responder communications enhancement system that are annunciated by the fire alarm system in accordance with NFPA 72.
System supervisory signals shall include the following:
1. Signal source malfunction
2. Active RF-emitting device failure
3. Low-battery
4. Active system component failure
5. Power supply supervisory signals, consisting of the following
   a. Loss of normal AC power
   b. Failure of battery charger
6 Integrity of communications link between the fire alarm system and the in-building emergency responder communications system

L. A dedicated supervised monitoring annunciation panel shall be provided within the emergency command center next to the fire alarm panel / annunciator or other location as designated by AHJ to annunciate the status of all signal booster locations. The monitoring panel shall provide visual and labeled indication of the following for each signal booster:
1 Normal AC power
2. Loss of normal AC power
3. Battery charger failure
4. Low-battery capacity
5. Signal source malfunction
6. Active RF-emitting device malfunction
7. Active system components malfunction

M. External filters, duplexers, power supplies or other non-OEM additions or modifications of the original equipment shall not be allowed. All duplexers shall be built-in and FCC certified with the signal booster as a complete and fully integrated FCC-certified and UL-Listed unit.

N. All signal booster components shall be contained in a type-4 approved waterproof enclosure. All enclosures shall be painted red with external labeling as required by the AHJ.

2.3 MATERIAL AND EQUIPMENT LIST

A. All materials and equipment necessary for a complete, functional, and code compliant, turnkey system shall be provided, installed, and warrantied by the installing contractor.

B. Broadband high isolation Donor Antenna – antenna shall feature a multi-band design accommodating all applicable Public Safety frequencies in a single pole-mounted antenna. Antenna azimuth pattern shall be as proposed by the manufacturer to meet the performance specifications of the system as installed. Antenna shall be rated for outdoor use.

C. Coverage Antenna – Omnidirectional – antennas shall feature a multi-band design, accommodating multiple frequency bands in a single ceiling-mounted antenna. Beam width: horizontal 110 degrees directional, vertical 90 degrees nominal. Antenna shall be rated for indoor use.

D. Bi-Directional Amplifiers (BDA) – BDA shall be of a modular design and use digital filtering to mitigate interference. Unit shall be standard 19” rack or wall mountable. Each RF amplifier shall be capable of adjusting and controlling power levels. Units shall be IP-addressable and be monitored/controllable via a web-based application.

E. Cables – shall be as recommended by the equipment manufacturer and shall be compatible with the installed equipment. Cables shall be listed as required by the pathway and compatible with the environments in which they are installed.

F. Miscellaneous Equipment – Splitters, Combiners, Couplers, Jumpers, and Connectors to be utilized with the system shall be by a manufacturer recognized by the manufacturer of the major system components.

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.

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, and cable sheath removed too far.
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.

3.2 STATION WIRING INSTALLATION

A. General: All cable must be handled with care during installation so as not to change performance specifications. There shall not be any exposed/unsheathed cable at any termination location.

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 approved 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.
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.

3.3 INSTALLATION REQUIREMENTS

A. Installation of all components of the

B. Communication Enhancement System shall comply with all applicable sections of the National Electrical Code NFPA-70, NFPA-72, NFPA 1221, NFPA 1225, IFC or as required by the local AHJ.

C. The primary power source shall be supplied from a dedicated twenty (20) ampere branch circuit and shall be connected to the buildings emergency power and comply with NFPA-70 National Electrical Code, NFPA 72, NFPA 1221, and NFPA 1225.

D. The signal booster shall be equipped with a secondary source of power. The secondary source of power shall be a battery system with a dedicated battery charger powered by a separate, dedicated twenty (20) ampere branch circuit. The secondary power supply shall power on automatically when the primary power source is lost. The secondary source of power shall be capable of operating the emergency responder radio coverage enhancement system for a period of at least 24 hours. The battery system shall automatically charge in the presence of external power input. Battery charger and all other electronic components must be fully enclosed in a waterproof Type-4 approved enclosure. Batteries shall be enclosed in a separate, vented Type-3R approved enclosure. External UPS (Uninterruptable Power Supplies) are not acceptable.

E. RF Coaxial Cable shall be a listed, CMP plenum. Non-plenum cable can be used when installed in a metallic raceway. The cable classification shall be clearly marked on the outer surface of the cable regular intervals.

F. Provide at each Donor Antenna an exterior dielectric enclosure in which a ground busbar and surge arrestor are mounted. Bond busbar to ground distribution system. Make all donor antenna mounts/masts and associated components, accessories, and hardware electrically continuous and bond to ground. Bond surge protection to ground distribution system.

G. Grounding conductors shall be provided from all racks, cabinets, and control panels. It shall be the responsibility of the integrator to follow good engineering practice to provide minimum cross-talk and maximum signal-to-noise ratios and reduce interference in the radio systems.

3.4 ACCEPTANCE AND TEST PROCEDURES

A. Acceptance testing for an in-building radio system is required upon completion of installation.

B. The coverage testing shall be done in accordance with NFPA 72, NFPA 1221, NFPA1225, IFC and as required by the local AHJ

C. All tests shall be conducted, documented, and signed by a person in possession of a current FCC General Radio Operator License.

D. All test records along with system diagrams, iBWave design, equipment specifications, user manuals, RF link budget calculations, battery backup calculation and other design data shall be submitted upon completion of the project, and as required by the AHJ.

END OF SECTION

SECTION 28 55 00 - RF SURVEY FOR IN-BUILDING EMERGENCY RESPONDER RADIO COVERAGE (ERRC) AND TESTING OF EXISTING ERRC ENHANCEMENT SYSTEMS (EERCES)

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The purpose of this specification is to establish the requirements and standards for surveys for public safety radio signal strength in buildings as required by the NFPA, IBC, IFC and local AHJ. This specification is only for a RF survey. If an existing ERRCES is on premise and is operational, provide verification and documentation of the existing ERRCES as specified.
   1. This survey is required as part of the contract documents and shall be implemented as specified in this specification unless indicated or specified otherwise.
   2. This survey is required for in all buildings with basements, all buildings four stories and taller, and all buildings with an aggregate total building area of 50,000 square feet or more; this survey may still be required for other buildings that do not meet these structural requirements.
   3. This survey may not be required if the local AHJ has pre-determined that an Emergency Responder Radio Coverage Enhancement System (ERRCES) is not required for the subject building(s). If a survey is not required by the AHJ, notify the Architect, Engineer, Owner prior to scheduling the survey.
   4. The survey requirements specified in this section are intended to be slightly more stringent than minimum IBC and IFC requirements. This is to help mitigate radio coverage deficiencies that could be caused by future minor variations in building use configurations and changing atmospheric conditions.

B. Where the subject building(s) do not have an existing ERRCES, this survey shall be for ERRC measurements and compliance evaluation only, it is not intended as a requirement for designing nor a requirement for providing an ERRCES.

C. Where the subject building(s) have an existing and operational ERRCES, this survey shall include a full yearly functionality test of the existing ERRCES hardware, antennae, wave guides, cabling, wiring, and connectivity as required by the local AHJ, IBC, IFC, and NFPA. This survey shall then be able to be used for the required yearly inspection and testing report of the existing ERRCES. If deficiencies of an existing ERRCES are observed or detected during field signal measurement, the contractor shall document those deficiencies and report them to the Owner in writing within two Owner’s business days of completion of the testing so that the Owner can take immediate remedial action. Corrections and modifications to existing ERRCES are not part of this specification section requirements.

D. Technical information for this survey shall be obtained from the local AHJs pertaining the specific technical information and requirements for the emergency responder communications coverage system. This information shall include but not be limited to the various frequencies required, the location of radio antennae sites, the effective radiated power of the AHJ radio antennae sites, the maximum propagation delay in microseconds, the applications being used, and other supporting technical information that would be necessary for an ERRCES design and to fully test an existing ERRCES.

E. Surveys for new construction shall be performed after the building is fully dried in, with interior wall construction and all exterior wall glazing completed, and prior to start of installation of electrical wiring. It is the intent that this survey be completed as soon as practical, results reported to the Owner and analyzed, and if required or specified as part of the contract documents or if it is to be provided by others, a radio antenna/repeater

system can be designed, installed, fully operational, and commissioned without delaying the scheduled contract date for certificate of occupancy (CO) or the AHJs final inspection and approval for full Owner and public occupation of the building.

F. Conduct surveys using a RF Spectrum Analyzer, a calibrated system-compatible radio or another suitable instrument with traceable certificate of calibration to analyze the RF signal strength of Emergency Responder Radio Signal into the building and determine if amplification of the signal is required or that if existing, the existing ERRCES is functioning properly and providing the proper radio coverage. All test equipment shall have been calibrated within the previous 12-months of the date(s) of testing. Both inbound and outbound signal strength shall be determined, measured, calculated, and documented as required by code. General weather conditions and time of day during the test shall be documented as part of the survey report.

1.2 SURVEY CRITERIA

A. The required Public Safety Radio Signal Level inside the Owner's facility shall be as required by code, ordinance, AHJ, and as specified.

B. Survey shall be performed by an FCC licensed technician holding a current General Radiotelephone Operator License (GROL). Where required by the local AHJ, the licensed operator shall be registered with the AHJ as an ERRC Special Inspector (or equivalent designation given by the AHJ) with in-building emergency radio system certification issued by a nationally recognized organization, school, or the emergency radio system manufacturer of the equipment being tested where an existing ERRCES is being tested, or certification by the ERRCES if a new ERRCES is specified elsewhere to be installed as part of the contract documents.

1.3 REGULATIONS

A. Codes, regulations, and standards shall be the latest published standards. The latest national published standards listed below shall supersede any local standard unless doing so would violate the intent of the local code requirements.
1. NFPA 1 – Fire Code
2. NFPA 70 – National Electrical Code
3. IFC 510- Emergency Responder Radio Coverage
4. NFPA 101, Life Safety Code, and all local amendments and requirements.
5. NFPA 72 National Fire Alarm and Signaling Code
6. FCC 47 CFR Telecommunications
7. FCC 47 CFR 90.219 Use of Signal Boosters
8. IFC - International Fire Code
9. Local or State Fire Codes
10. ADA "Americans with Disabilities Act" and any local or state or local accessibility standards and amendments.
11. FCC's OET 65 Standards "Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields"
12. FCC Rules Part 22 Public Mobile Services, Part 90 and Part 101
13. NFPA 1221- Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems
14. IBC - International Building Code
15. UL 2524 - Standard for In-building 2-Way Emergency Radio Communication Enhancement Systems
16. NFPA 3000 (PS) - Standard for an Active Shooter/Hostile Event Response (ASHER) Program and if present, Owner’s specific ASHER Program. Note: Although currently considered by the NFPA as a Provisional Standard (PS), the issued NFPA 3000 shall be considered part of this specifications as if it were a

fully accredited document to NFPA standards. If the building Owner has established an ASHER Program, it too shall be considered part of this specification section requirements.

1.4 DEFINITIONS

A. Definitions:

1. Area: A enclosed space in a building consisting floor to ceiling walls with doors.
2. ASHER Program: Active Shooter Hostile Event Response Program. Program elements developed by the building's Owner to determine the necessary functions and actions related to preparedness, response, and recovery from an active shooter/hostile event response.
3. BDA: Bi-Directional Amplifier. A device used to amplify band-selective or multi-band RF signals in the uplink, to the base station and in the downlink from the base station to subscriber devices for enhanced signals and improved coverage.
4. BER: Bit Error Rate is the number of bit errors per unit time
5. DAS: Distributed Antenna System
6. ERRCES / ERRCS: Emergency Responder Radio Coverage Enhancement System / Emergency Responder Radio Coverage System. A two-way radio communication system installed to assure the effective operation of radio communications systems for fire, emergency medical services, or law enforcement agencies within a building or structure. A system used by firefighters, police, and other emergency services personnel.
7. FCC: Federal Communications Commission
8. Grid or test grid: The individual specified and/or code required imaginary spaces inside the building used for radio coverage testing. Typically a grid space consist of a square space with equal or almost equal side dimensions where the radio signal levels are measured at the center of each grid space to verify radio coverage. Grid spaces can consist of individual areas or rooms meeting the maximum size requirements.
9. GROL- FCC General Radiotelephone Operators License
10. OET 65 Standards: FCC's Bulletin 65 provides Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields.
11. Public Safety/First Responder: Public Safety or First Responder agencies that are charged with the responsibility of responding to emergency situations. These include, but are not limited to law enforcement departments, fire departments, and emergency medical companies. Typically, there may be multiple agencies for each type of responder, including those administered by the building Owner.
12. RSSI: Received signal strength indicator RSSI is a relative measurement of the power present in a received radio signal.
13. Zone: The individual partitioned grid specified and/or code required imaginary space(s) inside large buildings. Typically, each zone shall be no more than 50,000 square feet and shall be contiguous on the same building floor. Zones are further sub-divided into smaller grid spaces so that radio signal levels can be measured at the center of each grid space to verify radio coverage. A zone can be an individual wing of a building or separate floors of a building that do not exceed 50,000 square feet each. Zones can be created for separate test report areas to ensure individual grid test spaces are not excessive in physical area size and detrimental to the accuracy and resolution of the test data measurement point locations. Each zone must pass the radio coverage test for the entire building to pass the test. Zones can exceed 50,000 square feet as long as the maximum allowable grid space size is not exceeded.

PART 3 – EXECUTION

3.1 EXECUTION

A. Testing Procedures and Parameters
   1. The test shall be conducted using a calibrated portable radio authorized by the local AHJ, and of the latest brand and model used by the agency talking through the agency's radio communication system.
   2. Testing shall include all critical areas required by the NFPA 1221 and others included in the list below. Critical areas shall be provided with a minimum 99-percent floor area radio coverage in each specific area. Critical areas include but are not limited to the following areas:
      a. Fire command centers
      b. Fire pump rooms
      c. Exit stairs
      d. Exit passageways
      e. Elevator lobbies
      f. Areas of rescue or refuge
      g. Areas with or spaces adjacent to standpipe cabinets
      h. Areas with or spaces adjacent to sprinkler sectional valve locations
      i. Areas with or spaces adjacent to bleeding control kits.
      j. Areas with or spaces adjacent to Automatic External Defibrillators (AEDs) for public use.
      k. Areas designated for persons with special needs or areas for specifically designated for persons who are not ambulatory including those in wheelchairs but require physical assistance by others to evacuate the building.
      l. Specific bullet resistant areas or spaces designated by the Owner or designated in the Owner's ASHER Program as a bullet resistant panic and safe room/areas or spaces.
      m. Front lobby areas and/or building administrative areas with direct wired microphone or wired telephone handset access to the building's mass notification or building wide communication system when such system is existing or to be installed as part of this project.
      n. Areas and/or building administrative areas with public safety radio base stations used for direct communications with Owner's police or security personnel.
      o. Other areas deemed critical by the AHJ.
   3. Testing grid spaces, areas, and zones shall be as required by the local AHJ and/or as specified in this specification. The more stringent requirements of the local code, AHJ, or those specified or indicated elsewhere in the contract documents shall apply. Specific requirement for the test grids, areas, and zones shall be follows:
      a. Testing shall be based on a minimum of 20 approximately equal size grid spaces per floor or zone with a maximum of 2,500 square foot per test space. Failure of more than one test space shall be considered a test failure.
      b. In the event that only two test spaces fail the 20-space grid test above, the same floor/zone shall be divided into 40 approximately equal size grid spaces or a maximum of 1,250 square feet per space and re-tested. Failure of only one or only two nonadjacent test spaces on that floor or zone shall result in a non-failure for that floor or zone. Failure of three or more spaces shall result in a test failure for that floor or zone. Failure of two adjacent test spaces shall result in a test failure of that floor or zone.
   4. If there is an existing ERRCES and there are grid space test failures resulting in a failed test, notify the Owner in writing immediately about the failed spaces after the completed test and identify the specific areas of the building that are not compliant. The final test result formal submittal data may be submitted at a later date as specified. Contractor may provide recommendations for alterations or

modifications to the existing system to the Owner/Architect/Engineer so that the deficiencies can be addressed by the Owner as soon as possible and corrective measures taken by the Owner. Make corrective measures or modifications to the existing system only if specifically instructed by the Owner in writing.

5. Two-way radio communications shall be verified by testing the two-way communication to and from the outside of the building from a single point approximately at the center of each test grid space or room area. Retesting from a different point inside the same grid space or room area is prohibited if the first point selected fails the test. The initial failure shall be recorded as a failed test grid space or area.
6. Signal strength for a non-failure shall be sufficient to meet the requirements of the applications being utilized by public safety for emergency operations through the coverage area as required by the AHJ.
7. The minimum inbound signal strength shall be sufficient to provide usable voice communications throughout the coverage area as required by the AHJ. The inbound signal level shall be sufficient to provide not less than -95 dBm for analog systems or a Delivered Audio Quality (DAQ) of 3.0 for digital systems or an equivalent Signal-to-Interference-Plus-Noise-Ratio (SINR) applicable to the technology of either analog or digital signals.
8.. The minimum outbound signal strength shall be sufficient to provide usable voice communications throughout the coverage area as required by the AHJ. The outbound signal level shall be sufficient to provide not less than -95 dBm for analog systems or a Delivered Audio Quality (DAQ) of 3.0 for digital systems or an equivalent Signal-to-Interference-Plus-Noise-Ratio (SINR) applicable to the technology of either analog or digital signals.
9. Buildings with existing ERRCES: Verify the following, include the requested information report deficiencies to the Owner as part of the ERRC report.
    a. Verify the existing ERRCES is fully monitored by the building fire alarm system as required by NFPA 1221 and NFPA 72.
    b. If there is an existing remote ERRCES annunciator, verify all annunciators and indicators required by NFPA 1221 are operational and functioning properly.
    c. The gain values of all existing ERRCES amplifiers shall be measured and documented for comparison for future annual testing of the ERRCES.
    d. A spectrum analyzer or other suitable test equipment shall be used to verify spurious oscillations are not being generated by existing signal booster(s).
    e. Verify that the isolation between the donor antenna and all inside antennas is maintained to a minimum of 20dB above system gain.

3.2 SURVEY REPORT SUBMITTALS

A. Submit summary findings and detailed test report data within 14-days of notice to proceed.

B. Buildings not in compliance with the ERRC testing: Indicate areas of the building deficient in ERRC. Provide general recommendations of the necessary equipment and means required to bring the building into full ERRC compliance for Owner review in the summary findings. This specification section is only intended for survey, report, and recommendation information only and is not intended for detailed design, modification, or corrective measures. The report data submittal shall be complete in such that it would be useful to assist in a detailed design of a ERRCES. Submit additional report data as indicated below.

C. Building in compliance with required ERRC: Include a copy of the inspection report to be issued to the AHJ(s) in the format required by the AHJ(s) and submit the report to the AHJ(s) as part of the building permitting process.

D. Report data submittals shall include but are not be limited the following:
   1. Include a copy of survey contractor's AHJ and FCC required licenses to perform the survey.
   2. Where there is an existing ERRCES, include an updated ERRCES technical document and yearly report which the Owner shall keep on file as required by NFPA 1221. Technical documents shall in include but may not be limited to the following information typically provided by the AHJ(s):
      a. Frequencies required by the AHJ(s) for the existing in-building enhancement system (EERCES).
      b. Location and effective radiated power (ERP) of radio sites used by the public safety radio enhancement system (ERRCES).
      c. Maximum propagation delay in microseconds.
      d. List of specifically approved ERRCES components.
      e. Other supporting technical information necessary for the existing system maintenance, or future modifications.
   3. Confirmation that the ERRC for the building that is subject of the report has been determined to meet the minimum coverage requirement as defined by the IBC/IFC, this survey specification section's requirements, and the local AHJ requirements.
   4. Include a scaled drawing of the building with RF measurements of each floor or zone of the building which indicates relative RF field strength for each frequency band of interest. Minimum drawing size 11x17-inch, maximum 30x42-inch.
   5. The drawings shall indicate clearly the areas that have passed or failed based on the more restrictive of the above parameters or those specifically required by the AHJ.
   6. When required by the AHJ, inspection reports by AHJ approved third-party inspector in the format required by the AHJ.

END OF SECTION

SECTION 31 11 00 – CLEARING AND GRUBBING

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. THIS SECTION PERTAINS TO THE SPECIFICATIONS FOR CLEARING AND GRUBBING, TOPSOIL REMOVAL AND STOCKPILING, DISCONNECTING, CAPPING OR SEALING, AND ABANDONING SITE UTILITIES IN PLACE, AND DISPOSAL OF ALL VEGETATION, RUBBISH AND EXCESS MATERIAL, AS REQUIRED FOR SITE GRADING AND RELATED STAGING AREAS AS NOTED ON THE DRAWINGS AND IN ACCORDANCE WITH THESE SPECIFICATIONS.

1.02 DEFINITIONS

A. TOPSOIL: SOIL WITH ORGANIC CONTENT SUITABLE FOR SUSTAINING THE GROWTH OF A SOIL STABILIZING GROUNDCOVER SUCH AS TURF. TOPSOIL IS SPREAD OVER PREPARED SUBGRADE.
   1. STOCKPILED NATIVE TOPSOIL: TOPSOIL STRIPPED FROM THE SITE PRIOR TO ROUGH GRADING WORK TO BE SPREAD AND AMENDED AS REQUIRED. NO ONSITE SOIL MAY BE USED AS TOPSOIL UNLESS APPROVED BY LANDSCAPE ARCHITECT. SOIL CUT FROM NON-ORGANIC LAYERS WILL NOT BE CONSIDERED FOR USE AS TOPSOIL.
   2. IMPORTED LANDSCAPE TOPSOIL: OFF-SITE TOPSOIL IMPORTED AND STOCKPILED TO BE SPREAD AND AMENDED AS SPECIFIED.

B. TREE PROTECTION ZONE: AREA SURROUNDING INDIVIDUAL TREES OR GROUPS OF TREES TO BE PROTECTED DURING CONSTRUCTION, AND DEFINED BY THE DRIP LINE OF INDIVIDUAL TREES OR THE PERIMETER DRIP LINE OF GROUPS OF TREES, UNLESS OTHERWISE INDICATED.

C. SUBGRADE: THE UPPERMOST SURFACE OF AN EXCAVATION, INCLUDING EXCAVATION FOR TRENCHES, OR THE TOP SURFACE OF A FILL OR BACKFILL IMMEDIATELY BELOW BASE COURSE, PAVEMENT, OR TOPSOIL MATERIALS.

D. UNAUTHORIZED EXCAVATION CONSISTS OF REMOVING MATERIALS BEYOND INDICATED SUBGRADE ELEVATIONS OR DIMENSIONS WITHOUT DIRECTION BY THE OWNER’S REPRESENTATIVE. UNAUTHORIZED EXCAVATION, AS WELL AS REMEDIAL WORK DIRECTED BY THE OWNER’S REP SHALL BE AT THE CONTRACTOR'S EXPENSE.

1.03 REGULATORY REQUIREMENTS

A. CONFORM TO APPLICABLE CODES FOR DISPOSAL OF DEBRIS.

B. COORDINATE CLEARING WORK WITH UTILITY COMPANIES.

C. PRIOR TO COMMENCEMENT OF WORK, THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING, AT THE CONTRACTORS OWN EXPENSE, ALL CONSTRUCTION PERMITS NECESSARY TO COMPLETE THE PROJECT ACCORDING TO THE PLANS AND SPECIFICATIONS.

1.04 MATERIAL OWNERSHIP

A. EXCEPT FOR STRIPPED TOPSOIL OR OTHER MATERIALS INDICATED TO REMAIN OWNER'S PROPERTY, CLEARED MATERIALS SHALL BECOME CONTRACTOR'S PROPERTY AND SHALL BE REMOVED FROM PROJECT SITE.

1.05 PROJECT CONDITIONS

A. SUBSURFACE DATA IS AVAILABLE FROM THE OWNER. CONTRACTOR IS URGED TO CAREFULLY ANALYZE THE SITE CONDITIONS.

B. TRAFFIC: MINIMIZE INTERFERENCE WITH ADJOINING ROADS, STREETS, WALKS, AND OTHER ADJACENT OCCUPIED OR USED FACILITIES DURING SITE-PREPARATION OPERATIONS.

1. DO NOT CLOSE OR OBSTRUCT STREETS, WALKS, OR OTHER ADJACENT OCCUPIED OR USED FACILITIES WITHOUT PERMISSION FROM OWNER AND AUTHORITIES HAVING JURISDICTION.
2. PROVIDE ALTERNATE ROUTES AROUND CLOSED OR OBSTRUCTED TRAFFIC WAYS IF REQUIRED BY AUTHORITIES HAVING JURISDICTION.

C. SALVABLE IMPROVEMENTS: CAREFULLY REMOVE ITEMS INDICATED ON DRAWINGS TO BE SALVAGED AND STORE ON OWNER'S PREMISES WHERE INDICATED. CONTRACTOR TO CONTACT OWNER’S REPRESENTATIVE FOR COORDINATION.

D. DO NOT COMMENCE SITE CLEARING OPERATIONS UNTIL TEMPORARY EROSION AND SEDIMENTATION CONTROL MEASURES ARE IN PLACE

E. PROTECTION OF EXISTING UTILITIES:
1. EXISTENCE AND LOCATION OF UNDERGROUND ITEMS ARE NOT GUARANTEED. INVESTIGATE AND FIELD VERIFY BEFORE STARTING WORK. EXCAVATION AND BACKFILL IN THE VICINITY OF EXISTING ITEMS OF WORK SHALL BE CARRIED OUT WITH EXTREME CAUTION.
2. UTILITY LOCATOR SERVICE: NOTIFY TEXAS 811 BEFORE SITE CLEARING.
3. CONTRACTOR SHALL BE HELD RESPONSIBLE FOR ANY DAMAGE AND FOR MAINTENANCE AND PROTECTION OF EXISTING UTILITIES.
4. INDICATE ON RECORD DRAWINGS WHERE THERE IS CONFLICT BETWEEN FIELD CONDITIONS AND DRAWINGS.

F. STAGING AREAS - APPROVAL MUST BE OBTAINED FROM THE OWNER TO USE ANY AREA FOR STAGING THAT IS NOT SPECIFICALLY IDENTIFIED AS SUCH ON THE PLANS. THE CONTRACTOR SHALL RESTORE ALL AREAS USED FOR STAGING, THE EXTENT OF SAID RESTORATION TO BE DEFINED BY THE OWNER UPON GRANTING APPROVAL FOR THE USE OF SAID AREA FOR STAGING.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 PREPERATION

A. PROTECT AND MAINTAIN BENCHMARKS AND SURVEY CONTROL POINTS FROM DISTURBANCE DURING CONSTRUCTION.

B. PROTECT EXISTING SITE IMPROVEMENTS TO REMAIN FROM DAMAGE DURING CONSTRUCTION. RESTORE DAMAGED IMPROVEMENTS TO THEIR ORIGINAL CONDITION, AS ACCEPTABLE TO OWNER.

C. LOCATE AND CLEARLY FLAG TREES AND VEGETATION TO REMAIN OR TO BE RELOCATED

D. CONTROL DUST AND NOISE, PERFORM WORK IN ACCORDANCE WITH REQUIREMENT OF AUTHORITIES HAVING JURISDICTION. NO EXPLOSIVES ARE PERMITTED. NO ON-SITE BURNING IS PERMITTED.

3.02 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. PROVIDE TEMPORARY EROSION AND SEDIMENTATION CONTROL MEASURES PER SECTION 01 57 13 – EROSION AND SEDIMENTATION CONTROLS.

B. PROVIDE MEASURES ACCORDING TO A SEDIMENT AND EROSION CONTROL PLAN, SPECIFIC TO THE SITE, WHICH COMPLIES WITH EPA 832/R-92-005 OR REQUIREMENTS OF AUTHORITIES HAVING JURISDICTION, WHICHEVER IS MORE STRINGENT.

C. INSPECT, REPAIR, AND MAINTAIN EROSION AND SEDIMENTATION CONTROL MEASURES DURING CONSTRUCTION UNTIL PERMANENT VEGETATION HAS BEEN ESTABLISHED.

D. REMOVE EROSION AND SEDIMENTATION CONTROLS AND RESTORE AND STABILIZE AREAS DISTURBED DURING REMOVAL.

3.03 TREE PROTECTION

A. ERECT AND MAINTAIN TEMPORARY FENCING AROUND TREE PROTECTION ZONES (TPZ) BEFORE STARTING SITE CLEARING. TPZ IS 1.50 FEET AWAY IN RADIAL DISTANCE FROM THE TRUNK FOR EVERY INCH IN STEM DIAMETER. REMOVE FENCE WHEN CONSTRUCTION IS COMPLETE.

B. DO NOT EXCAVATE WITHIN TREE PROTECTION ZONES, UNLESS OTHERWISE INDICATED.

C. REPAIR OR REPLACE TREES AND VEGETATION INDICATED TO REMAIN THAT ARE DAMAGED BY CONSTRUCTION OPERATIONS, IN A MANNER APPROVED BY ARCHITECT.

3.04 UTILITIES

A. LOCATE, IDENTIFY, DISCONNECT, AND SEAL OR CAP OFF UTILITIES INDICATED TO BE REMOVED.
   1. ARRANGE WITH UTILITY COMPANIES TO SHUT OFF INDICATED UTILITIES. CONTRACTOR IS RESPONSIBLE FOR ANY SERVICE CHARGE REQUIRED FOR SHUT-OFF ACTION. IF OTHER OUTSTANDING FEES OR BILLINGS ARE ENCOUNTERED, THE CONTRACTOR SHALL NOTIFY THE OWNER'S REPRESENTATIVE FOR DIRECTION.

B. KNOWN UTILITIES ARE SHOWN ON DRAWINGS. IF UTILITIES ARE DISCOVERED THAT ARE NOT SHOWN ON THE DRAWINGS, CONTACT OWNER'S REPRESENTATIVE FOR DIRECTION. DO NOT INTERRUPT UNKNOWN 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'S REPRESENTATIVE NOT LESS THAN TWO WEEKS IN ADVANCE OF PROPOSED UTILITY INTERRUPTIONS.
2. DO NOT PROCEED WITH UTILITY INTERRUPTIONS WITHOUT THE AUTHORIZATION OF THE AUTHORITY HAVING JURISDICTION.

3.05 CLEARING

A. THAT PORTION OF THE SITE REQUIRED FOR CONSTRUCTING THE WORK UNDER THESE SPECIFICATIONS SHALL BE CLEARED OF ALL VEGETATION, SUCH AS TREES, BRUSH, GRASS AND WEEDS AND ALL OTHER OBJECTIONABLE MATTER TO THE LIMITS AS DEPICTED IN THE PLANS.
   1. STUMPS AND ROOTS SHALL BE REMOVED TO A DEPTH OF 24 INCHES BELOW FINISHED SUBGRADE ELEVATION IN AREA BOUNDED BY LINES TWO FEET BEHIND BACK OF CURBS OR TO A DEPTH OF 24 INCHES BELOW FINISHED SURFACE OF REQUIRED CROSS SECTION FOR OTHER AREAS.

B. FILL DEPRESSIONS CAUSED BY CLEARING AND GRUBBING OPERATIONS WITH SATISFACTORY SOIL MATERIAL UNLESS FURTHER EXCAVATION OR EARTHWORK IS INDICATED.
   1. PLACE FILL MATERIAL IN HORIZONTAL LAYERS NOT EXCEEDING A LOOSE DEPTH OF 8 INCHES AND COMPACT EACH LAYER TO A DENSITY EQUAL TO ADJACENT ORIGINAL GROUND.

3.06 STRIPPING

A. TOPSOIL STRIPPING:
   1. REMOVE SOD AND GRASS BEFORE STRIPPING TOPSOIL.
   2. STRIP TOPSOIL TO WHATEVER DEPTHS ARE ENCOUNTERED IN A MANNER TO PREVENT INTERMINGLING WITH UNDERLYING SUBSOIL OR OTHER WASTE MATERIALS. A MINIMUM OF 6 INCHES OF SOIL SHALL BE STRIPPED. THIS MUST BE VERIFIED WITH THE GEOTECHNICAL REPORT PROVIDED BY THE OWNER FOR THIS PROJECT. IF DISCREPANCY, REVIEW WITH OWNER PRIOR TO START OF WORK.
      a. REMOVE SUBSOIL AND NONSOIL MATERIALS FROM TOPSOIL, INCLUDING TRASH, DEBRIS, WEEDS, ROOTS, AND OTHER WASTE MATERIALS.
   3. STRIP MAN-MADE FILLS UNDER STRUCTURES AND PAVEMENTS TO MINIMUM 12" BELOW THE GROUND SURFACE AND DISPOSE OF ALL WASTE MATERIALS.

B. AT ALL TIMES DURING CLEARING AND STRIPPING OPERATIONS THE AREA SHALL BE KEPT IN A MANNER TO PREVENT PONDING. REFER TO SECTION 01 57 13 – EROSION AND SEDIMENTATION CONTROL.

3.07 SITE IMPROVEMENTS

A. REMOVE EXISTING ABOVE AND BELOW-GRADE IMPROVEMENTS AS INDICATED AND AS NECESSARY TO FACILITATE NEW CONSTRUCTION.

B. REMOVE SLABS, PAVING, CURBS, GUTTERS, AND AGGREGATE BASE AS INDICATED.
   1. UNLESS EXISTING FULL-DEPTH JOINTS COINCIDE WITH LINE OF DEMOLITION, NEATLY SAW-CUT LENGTH OF EXISTING PAVEMENT TO REMAIN BEFORE REMOVING EXISTING PAVEMENT. SAW-CUT FACES VERTICALLY.

2. PAINT CUT ENDS OF STEEL REINFORCEMENT IN CONCRETE TO REMAIN TO PREVENT CORROSION

3.08 STOCKPILING

A. ALL TOPSOIL FROM THE STRIPPING OPERATIONS SHALL BE STOCKPILED IN THE AREAS DESIGNATED BY THE OWNER'S REPRESENTATIVE OR SHOWN ON THE DRAWINGS. MATERIALS SHALL BE DEPOSITED AND SPREAD IN SUCH A MANNER TO ENSURE PROPER DRAINAGE AND PREVENT SEVERE EROSION OF THE STOCKPILE.

B. STOCKPILE BORROW MATERIALS AND SATISFACTORY EXCAVATED SOIL MATERIALS. STOCKPILE SOIL MATERIALS WITHOUT INTERMIXING.

C. STOCKPILE MATERIALS AWAY FROM EDGE OF EXCAVATIONS WITHOUT INTERMIXING WITH SUBSOIL. GRADE AND SHAPE STOCKPILES TO DRAIN SURFACE WATER. COVER TO PREVENT WINDBLOWN DUST.
   1. LIMIT HEIGHT OF TOPSOIL STOCKPILES TO 72 INCHES.
   2. DO NOT STOCKPILE MATERIAL WITHIN TREE PROTECTION ZONES.
   3. STOCKPILE SURPLUS TOPSOIL TO ALLOW FOR RE-SPREADING DEEPER TOPSOIL.

3.09 DISPOSAL

A. SUBJECT TO APPROVAL OF THE OWNER, MATERIAL FROM CLEARING OPERATIONS SHALL BE DISPOSED OF BY REMOVAL FROM THE PROJECT SITE.
   1. DISPOSAL OF MATERIAL BY REMOVAL
      a. MATERIAL DISPOSED OF BY REMOVAL FROM THE CONSTRUCTION AREA SHALL BE REMOVED FROM THE AREAS PRIOR TO THE COMPLETION OF THE WORK UNDER THESE SPECIFICATIONS. ALL MATERIALS REMOVED SHALL BECOME THE PROPERTY OF THE CONTRACTOR.
      b. MATERIALS TO BE DISPOSED OF BY DUMPING SHALL BE HAULED TO AN APPROVED DUMP. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO MAKE ANY NECESSARY ARRANGEMENTS WITH PRIVATE PARTIES AND WITH LOCAL OFFICIALS PERTINENT TO LOCATIONS AND REGULATIONS OF SUCH DUMPING. ANY FEES OR CHARGES REQUIRED TO BE PAID FOR DUMPING OF MATERIALS SHALL BE PAID BY THE CONTRACTOR.
      c. IN HAULING ANY MATERIAL FROM THE SITE, IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO PREVENT DEBRIS FROM DROPPING FROM VEHICLES AND LITTERING THE SITE OR AREA STREETS AND ROADS. THE CONTRACTOR SHALL PROMPTLY REMOVE ANY DEBRIS WHICH FALLS FROM VEHICLES.
      d. SEPARATE RECYCLABLE MATERIALS PRODUCED DURING SITE CLEARING FROM OTHER NONRECYCLABLE MATERIALS. STORE OR STOCKPILE WITHOUT INTERMIXING WITH OTHER MATERIALS AND TRANSPORT THEM TO RECYCLING FACILITIES.

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SECTION 31 22 13 – SITE GRADING

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. THIS SECTION PERTAINS TO THE EARTHWORK GENERALLY CONSISTING OF EXCAVATION, FILLING, BACKFILLING AND SUBGRADE PREPARATION AS REQUIRED FOR CONSTRUCTION OF SITE RETAINING WALLS/STRUCTURES, SLAB ON GRADE WALKS, PAVEMENT SURFACES, LANDSCAPED AREAS AND THE GENERAL SHAPING OF THE SITE AS SHOWN, DESCRIBED OR REASONABLY INFERRED ON THE DRAWINGS.

B. THIS SECTION EXCLUDES WORK NECESSARY FOR BUILDING PAD PREPARATIONS.

1.02 DEFINITIONS

A. EXCAVATION CONSISTS OF THE REMOVAL OF MATERIAL ENCOUNTERED TO SUBGRADE ELEVATIONS AND THE REUSE OR DISPOSAL OF MATERIALS REMOVED.

B. SUBGRADE: THE UPPERMOST SURFACE OF AN EXCAVATION, INCLUDING EXCAVATION FOR TRENCHES, OR THE TOP SURFACE OF A FILL OR BACKFILL IMMEDIATELY BELOW BASE COURSE, PAVEMENT, OR TOPSOIL MATERIALS.

C. BORROW: SOIL MATERIAL OBTAINED OFF-SITE WHEN SUFFICIENT APPROVED SOIL MATERIAL IS NOT AVAILABLE FROM EXCAVATIONS.

D. BASE COURSE: THE LAYER PLACED BETWEEN THE SUBGRADE AND SURFACE PAVEMENT IN A PAVING SYSTEM.

E. UNAUTHORIZED EXCAVATION CONSISTS OF REMOVING MATERIALS BEYOND INDICATED SUBGRADE ELEVATIONS OR DIMENSIONS WITHOUT DIRECTION BY THE OWNER’S REP. UNAUTHORIZED EXCAVATION, AS WELL AS REMEDIAL WORK DIRECTED BY THE OWNER’S REP SHALL BE AT THE CONTRACTOR'S EXPENSE.

F. STRUCTURES: BUILDINGS, FOOTINGS, FOUNDATIONS, RETAINING WALLS, SLABS, TANKS, CURBS, MECHANICAL AND ELECTRICAL APPURTENANCES, OR OTHER MAN-MADE STATIONARY FEATURES CONSTRUCTED ABOVE OR BELOW GROUND SURFACE.

G. UNFORESEEN EXCAVATION: EXCAVATION OF MATERIAL, REGARDLESS OF ITS CHARACTER OR NATURE, BELOW THE SUBGRADE ELEVATION REQUIRED TO CONSTRUCT THE WORK AS INDICATED ON THE DRAWINGS OR SPECIFIED HEREIN.

H. GEOTECHNICAL ENGINEER: PERSON OR COMPANY CONTRACTED BY THE OWNER AND/OR THROUGH THE ARCHITECT TO PROVIDE TESTING AND ONSITE GEOTECHNICAL SERVICES DURING THE CONSTRUCTION SCHEDULE.

1.03 REGULATORY REQUIREMENTS

A. CONTRACTOR SHALL COMPLY WITH ALL CURRENT, APPLICABLE CODES AND REGULATIONS.

B. CONTRACTOR SHALL COMPLY WITH ALL STANDARD SPECIFICATIONS AND DETAILS OF AUTHORITIES HAVING JURISDICTION FOR WORK IN THE RIGHT-OF-WAY OR EASEMENTS.

C. SHORING THAT IS REQUIRED TO COMPLETE THE WORK, IS CONSIDERED A METHOD OR TECHNIQUE AND IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR. IF A REGULATORY AGENCY REQUIRES A LICENSED ENGINEER TO DESIGN, APPROVE OR PROVIDE DRAWINGS FOR SHORING, THEN IT IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR TO ENGAGE THE SERVICES OF A QUALIFIED ENGINEER FOR SHORING DESIGN SERVICES AT NO ADDITIONAL COST TO THE OWNER.

D. PRIOR TO COMMENCEMENT OF WORK, THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING, AT THE CONTRACTORS OWN EXPENSE, ALL CONSTRUCTION PERMITS NECESSARY TO COMPLETE THE PROJECT ACCORDING TO THE PLANS AND SPECIFICATIONS.

1.04 PROJECT CONDITIONS

A. SUBSURFACE DATA IS AVAILABLE FROM THE OWNER. CONTRACTOR IS URGED TO CAREFULLY ANALYZE THE SITE CONDITIONS.

B. TRAFFIC: MINIMIZE INTERFERENCE WITH ADJOINING ROADS, STREETS, WALKS, AND OTHER ADJACENT OCCUPIED OR USED FACILITIES DURING SITE-PREPARATION OPERATIONS.
   1. DO NOT CLOSE OR OBSTRUCT STREETS, WALKS, OR OTHER ADJACENT OCCUPIED OR USED FACILITIES WITHOUT PERMISSION FROM OWNER AND AUTHORITIES HAVING JURISDICTION.
   2. PROVIDE ALTERNATE ROUTES AROUND CLOSED OR OBSTRUCTED TRAFFIC WAYS IF REQUIRED BY AUTHORITIES HAVING JURISDICTION.

C. PRIOR TO EARTHWORK OPERATIONS, EXISTING UTILITIES, FACILITIES AND PERMANENT OBJECTS TO REMAIN SHALL BE LOCATED AND ADEQUATELY PROTECTED.

D. PROTECTION OF EXISTING UTILITIES:
   1. EXISTENCE AND LOCATION OF UNDERGROUND ITEMS ARE NOT GUARANTEED. INVESTIGATE AND FIELD VERIFY BEFORE STARTING WORK. EXCAVATION AND BACKFILL IN THE VICINITY OF EXISTING ITEMS OF WORK SHALL BE CARRIED OUT WITH EXTREME CAUTION.
   2. NOTIFY TEXAS 811 OR THE UTILITY COMPANY INVOLVED TO LOCATE ALL PUBLIC AND PRIVATE UTILITY COMPANY LINES BEFORE BEGINNING WORK.
   3. CONTRACTOR SHALL BE HELD RESPONSIBLE FOR ANY DAMAGE AND FOR MAINTENANCE AND PROTECTION OF EXISTING UTILITIES.
   4. IF UNKNOWN AND UNCHARTED UTILITIES ARE ENCOUNTERED DURING EXCAVATION, PROMPTLY NOTIFY OWNER'S REPRESENTATIVE AND THE GOVERNING UTILITY COMPANY WHEN DETERMINABLE AND WAIT FOR INSTRUCTIONS.
   5. FOR PRIVATE UTILITIES FOUND, IF IT IS ASCERTAINED BY OWNER'S REPRESENTATIVE THAT SUCH UTILITY LINE HAS BEEN ABANDONED, PROPERLY CAP LINE AT A DEPTH APPROVED BY OWNER'S REPRESENTATIVE OR REMOVE LINE AS DIRECTED. ALL WORK TO CAP AND REMOVE ABANDONED PUBLIC UTILITIES FOUND, MUST BE COORDINATED THROUGH THE GOVERNING UTILITY COMPANY.

6. IF SUCH UNKNOWN UTILITIES ARE ENCOUNTERED AND WORK IS CONTINUED WITHOUT CONTACTING THE OWNER FOR INSTRUCTIONS, AND DAMAGE IS CAUSED TO SAID UTILITIES, CONTRACTOR SHALL REPAIR, AT HIS OWN EXPENSE, SUCH DAMAGE TO THE SATISFACTION OF THE OWNER AND THE UTILITY COMPANY.
7. INDICATE ON RECORD DRAWINGS WHERE THERE IS CONFLICT BETWEEN FIELD CONDITIONS AND DRAWINGS.

1.05 SUBMITTALS

A. PROJECT RECORD DOCUMENTS: ACCURATELY RECORD ACTUAL LOCATIONS OF UTILITIES REMAINING BY HORIZONTAL DIMENSIONS, ELEVATIONS OR INVERTS, AND SLOPE GRADIENTS.

B. SAMPLES: SUBMIT SAMPLES OF ALL MATERIALS USED FOR ARCHITECT'S APPROVAL WHEREVER SPECIFIED OR AS DIRECTED BY THE ARCHITECT.

C. SHORING AND SLOPE PROTECTION DESIGN:
1. PRIOR TO BEGINNING ANY EXCAVATION, SUBMIT CERTIFICATION TO THE ARCHITECT THAT THE PROPOSED SHORING AND SLOPE PROTECTION SYSTEM HAS BEEN ACCEPTED AND APPROVED BY ALL GOVERNING JURISDICTIONS. CERTIFICATION SHALL BE SIGNED AND SEALED BY THE ENGINEER OF RECORD FOR THE SHORING DESIGN.
2. PROVIDE SIGNED LETTER FROM THE GEOTECHNICAL ENGINEER STATING THAT THE PROPOSED DESIGN COMPLIES WITH THE RECOMMENDATIONS OF GEOTECHNICAL REPORTS.

1.06 QUALITY ASSURANCE

A. PRE-EXCAVATION CONFERENCE: CONDUCT CONFERENCE AT PROJECT SITE TO COMPLY WITH REQUIREMENTS IN DIVISION 1 SECTION "PROJECT MEETINGS."

B. CODES AND STANDARDS: PERFORM EARTHWORK COMPLYING WITH REQUIREMENTS OF AUTHORITIES HAVING JURISDICTION.

C. TESTING AND INSPECTION SERVICE: OWNER WILL EMPLOY A QUALIFIED INDEPENDENT GEOTECHNICAL ENGINEERING TESTING AGENCY TO CLASSIFY PROPOSED ON-SITE AND BORROW SOIL MATERIALS TO VERIFY THAT SOILS COMPLY WITH SPECIFIED REQUIREMENTS AND TO PERFORM REQUIRED FIELD AND LABORATORY TESTING. CONTRACTOR RESPONSIBLE TO COORDINATE WITH THE TESTING AGENCY PRIOR TO START OF WORK REQUIRING TESTING SO AS TO MINIMIZE UNNECESSARY COST OR DELAYS TO THE PROJECT.

D. TESTING:
1. OWNER WILL RETAIN AND PAY A QUALIFIED GEOTECHNICAL ENGINEER TO TAKE ALL FIELD SAMPLES AND DO ALL LABORATORY TESTING NECESSARY TO VERIFY COMPLIANCE OF THE WORK TO THESE SPECIFICATIONS OR AS REQUIRED BY CITY OR OTHER REGULATORY AGENCIES. THE GEOTECHNICAL ENGINEER SHALL SUBMIT RESULTS OF ALL TESTING DONE DURING THE COURSE OF THE WORK TO THE OWNER, ARCHITECT, AND CONTRACTOR.
2. NOTIFY TESTING LAB A MINIMUM OF 48 HOURS IN ADVANCE OF THE TIME TESTING IS REQUIRED TO SATISFY REQUIREMENTS OF THIS SECTION.
3. SHOULD TESTING SPECIFIED ABOVE SHOW WORK WHICH DOES NOT SATISFY THESE SPECIFICATIONS, THE CONTRACTOR SHALL PAY, THROUGH THE OWNER,

FOR ALL ADDITIONAL TESTS REQUIRED TO DETERMINE THE EXTENT OF WORK THAT IS NOT SATISFACTORY AND FOR ALL ADDITIONAL TESTS NECESSARY TO DEMONSTRATE COMPLIANCE WITH THESE SPECIFICATIONS.

4. ALL TESTS SHALL BE PERFORMED BY THE SOIL ENGINEER IN ACCORDANCE WITH ASTM D 1557, D1556, D2922, D3017, OR OTHER TEST METHOD SELECTED BY GEOTECHNICAL ENGINEER.

PART 2 – PRODUCTS

2.01 SOIL MATERIALS

A. FILL MATERIALS AND SOURCES MUST BE APPROVED BY THE OWNER'S REPRESENTATIVE. THE CONTRACTOR IS RESPONSIBLE FOR PROVIDING ADEQUATE SAMPLES AND TESTING RESULTS TO THE OWNER FOR TESTING AND APPROVAL.

B. SELECT FILL PER 2.2 SHALL BE USED BENEATH ALL SITE RETAINING WALLS AND SITE STRUCTURES WHERE FILL MATERIAL IS REQUIRED TO ACHIEVE THE GRADES AND ELEVATIONS ON THE PLANS.

C. GENERAL FILL PER 2.3 SHALL BE USED FOR FILL IN LANDSCAPING AREAS NOT SUPPORTING STRUCTURES. TOPSOIL PER 2.4 SHALL BE SPREAD OVER LANDSCAPE AREAS AS NEEDED.

D. FILL MATERIAL BENEATH PAVING SHALL BE PER 2.2 OR 2.3. REGARDLESS OF THE FILL MATERIAL USED, SUBGRADE SHALL BE CHEMICALLY STABILIZED FOR THE THICKNESS SPECIFIED AND DETAILED IN THE DRAWINGS.

E. MATERIAL EXCAVATED ONSITE MAY BE USED AS FILLS, WITH PRIOR GEOTECHNICAL ENGINEER APPROVAL.
   1. ONSITE FILL MATERIALS SHALL BE FREE OF ORGANIC OR DELETERIOUS PRODUCTS.
   2. MOISTURE CONTENT OF EXISTING SOILS MAY REQUIRE ADJUSTMENT FOR COMPACTION APPROVAL.

2.02 SELECT FILL

A. THE SELECT FILL SHALL CONSIST OF SANDY CLAY, LIME STABILIZED CLAYS OR CLEAN SAND, UNIFORMLY GRADED AND FREE OF OBJECTIONABLE MATERIAL.
   1. SANDY CLAY FILL: SANDY CLAY FILL SHALL HAVE A PLASTICITY INDEX BETWEEN 10 AND 20. THE FILL MATERIALS SHALL BE PLACED IN LOOSE LIFTS NOT EXCEEDING 8 INCHES IN HEIGHT AND COMPACTED TO 95 PERCENT OF STANDARD MAXIMUM DENSITY AT THE PROPER MOISTURE CONTENT FOR THAT SOIL TYPE AS DEFINED BY ASTM D 698.
   2. LIME STABILIZED CLAY FILL: CLAYS MAY BE STABILIZED IN PLACE OR MIXED WITH LIME AT ANOTHER LOCATION ON THE SITE AND PLACED AND COMPACTED. LIME STABILIZATION SHALL BE PERFORMED IN ACCORDANCE WITH SECTION 31 32 13.29 – LIME STABILIZATION OR 31 32 13.26 – LIME-FLY ASH OR FLY ASH STABILIZATION. THE PERCENT OF LIME TO BE USED SHALL BE DETERMINED BY THE TESTING LABORATORY AT THE SOURCE PRIOR TO ACCEPTANCE OF THE MATERIAL FOR FILL. THE MATERIAL SHALL BE PLACED IN LOOSE LIFTS NOT EXCEEDING 8 INCHES IN THICKNESS AND COMPACTED TO 95 PERCENT OF STANDARD MAXIMUM DENSITY AT THE PROPER MOISTURE CONTENT FOR THAT SOIL TYPE AS DETERMINED BY ASTM D 698.

2.03 GENERAL FILL

A. GENERAL FILL MATERIAL SHALL BE USED FOR FILL IN LANDSCAPING AREAS NOT SUPPORTING STRUCTURES, AND MAY BE USED BENEATH PAVEMENT. GENERAL FILL MATERIAL MAY BE ANY NATIVE SOIL FREE OF DEBRIS, TRASH, ROCKS OVER ONE (1) INCH IN DIAMETER AND OTHER OBJECTIONABLE MATERIAL WITH A PI LESS THAN 35. GENERAL FILL SHALL BE PLACED AND COMPACTED IN LIFTS NOT EXCEEDING 8 INCHES IN THICKNESS TO 95 PERCENT STANDARD DENSITY AS DEFINED BY ASTM D 698. THE FILL SHALL BE KEPT SUFFICIENTLY LOW TO ACCOMMODATE THE PROPER DEPTH OF TOPSOIL AND RELATED SOD OR OTHER VEGETATION.

2.04 TOPSOIL

A. TOPSOIL MATERIAL SHALL BE NATIVE EARTHEN MATERIAL SUITABLE FOR GROWTH OF VEGETATION SUCH AS SILTY AND SANDY LOAMS. THE SITE STRIPINGS MAY BE USED AS TOPSOIL UNLESS OTHERWISE SHOWN ON THE DRAWINGS. TOPSOIL SHALL BE FREE OF ROOTS AND ROCKS LARGER THAN ½ INCH (12 MM), SUBSOIL, DEBRIS, LARGE WEEDS AND FOREIGN MATTER. TOPSOIL SHALL BE SPREAD OVER LANDSCAPE AREAS TO A DEPTH OF 4 TO 6 INCHES AND COMPACTED TO 92 PERCENT OF STANDARD DENSITY AS DEFINED BY ASTM D 698.

2.05 SPECIAL DRAINAGE MEDIA

A. ALL RETAINING WALL AND FRENCH DRAIN BACKFILL MATERIAL SHALL BE CLEAN OPEN-GRADED GRAVEL, MAXIMUM 3/4" PARTICLE SIZE IN ACCORDANCE WITH THE DETAILS CONTAINED IN THE PLANS

B. DRAINAGE FABRIC: NONWOVEN GEOTEXTILE, SPECIFICALLY MANUFACTURED AS A DRAINAGE GEOTEXTILE; MADE FROM POLYOLEFINS, POLYESTERS, OR POLYAMIDES; AND WITH THE FOLLOWING MINIMUM PROPERTIES DETERMINED ACCORDING TO ASTM D 4759 AND REFERENCED STANDARD TEST METHODS:
   1. GRAB TENSILE STRENGTH: 90 LBF; ASTM D 4632.
   2. TEAR STRENGTH: 40 LBF; ASTM D 4533.
   3. PUNCTURE RESISTANCE: 50 LBF; ASTM D 4833.
   4. WATER FLOW RATE: 150 GPM PER SQ. FT.; ASTM D 4491.
   5. APPARENT OPENING SIZE: NO. 50; ASTM D 4751.

C. APPROVED MATERIALS
   1. MIRAFI 140 FILTER FABRIC.
   2. CONTECH C-35NW
   3. APPROVED ALTERNATE.

PART 3 – EXECUTION

3.01 PREPERATION

A. INSPECTION
   1. PRIOR TO PERFORMING THE WORK OF THIS SECTION, CAREFULLY INSPECT THE INSTALLED WORK OF ALL OTHER TRADES AND VERIFY THAT ALL SUCH WORK IS COMPLETE TO THE POINT WHERE WORK MAY PROPERLY COMMENCE.
   2. VERIFY THAT SURVEY BENCH MARK AND INTENDED ELEVATIONS FOR THE WORK ARE AS INDICATED.

3. VERIFY EXISTING GRADES AND DIMENSIONS BEFORE STARTING ANY GRADING OPERATIONS.
4. VERIFY THAT WORK MAY PROCEED IN COMPLETE ACCORDANCE WITH THE DESIGN.
5. IN THE EVENT OF DISCREPANCY, IMMEDIATELY NOTIFY THE OWNER'S REPRESENTATIVE.

B. GENERAL

1. USE ALL MEANS NECESSARY TO CONTROL DUST ON OR NEAR THE SITE RESULTING FROM THE PERFORMANCE OF THE WORK. THOROUGHLY MOISTEN ALL SURFACES TO PREVENT DUST BEING A NUISANCE TO THE PUBLIC, ADJACENT USES, AND CONCURRENT WORK ON SITE. MOISTURE LEVEL DURING COMPACTION OPERATIONS SHALL NOT EXCEED THAT AMOUNT AS SPECIFIED BY GEOTECHNICAL ENGINEER.
2. CONDUCT WORK SO AS TO AVOID INJURY TO PERSONS AND DAMAGE TO ADJACENT PROPERTY. PROVIDE APPROPRIATE SHORING, BRACING AND BARRIERS, INCLUDING LIGHT WHEN NECESSARY.
3. COORDINATE OPERATIONS WITH, AND PROVIDE ACCESS TO, THE GEOTECHNICAL ENGINEER OR DESIGNATED REPRESENTATIVE DURING DEMOLITION AND CONSTRUCTION FOR PURPOSES OF TESTING, INVESTIGATION AND INSPECTION.

C. PROTECT AND MAINTAIN BENCHMARKS AND SURVEY CONTROL POINTS FROM DISTURBANCE DURING CONSTRUCTION.

D. PROTECT EXISTING SITE IMPROVEMENTS TO REMAIN FROM DAMAGE DURING CONSTRUCTION. RESTORE DAMAGED IMPROVEMENTS TO THEIR ORIGINAL CONDITION, AS ACCEPTABLE TO OWNER.

E. LOCATE AND CLEARLY FLAG TREES AND VEGETATION TO REMAIN OR TO BE RELOCATED

F. 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.

G. PROTECT SUBGRADE FROM EXCESSIVE DRYING OR EXCESSIVE MOISTURE.

3.02 EXCAVATION

A. GENERAL - CONTRACTOR SHALL COMPLETE ALL EXCAVATION REQUIRED REGARDLESS OF THE VARIATIONS IN HARDNESS, TYPE, OR DENSITY OF MATERIALS ENCOUNTERED, TO THE DIMENSIONS AND ELEVATIONS SHOWN ON THE DRAWINGS. WHEN UNSATISFACTORY MATERIAL IS UNCOVERED, THAT MATERIAL SHALL BE REMOVED AND REPLACED WITH SELECT FILL OR TREATED AS DIRECTED BY THE OWNER'S REPRESENTATIVE AT NO ADDITIONAL COST TO THE OWNER.

B. EXCAVATION IS UNCLASSIFIED AND INCLUDES EXCAVATION TO SUBGRADE ELEVATIONS REGARDLESS OF THE CHARACTER OF SURFACE AND SUBSURFACE CONDITIONS ENCOUNTERED, INCLUDING ROCK, SOIL MATERIALS, AND OBSTRUCTIONS.

1. IF EXCAVATED MATERIALS INTENDED FOR FILL AND BACKFILL INCLUDE UNSATISFACTORY SOIL MATERIALS AND ROCK, REPLACE WITH SATISFACTORY SOIL MATERIALS.
2. REMEDIAL WORK DUE TO OVER-EXCAVATION INCLUDING PROVISION OF SUITABLE AND STABLE BACKFILL MEETING THE DEGREE OF COMPACTION REQUIRED SHALL BE AT THE CONTRACTOR'S EXPENSE.

C. IF EXCAVATED MATERIALS OF A SUITABLE NATURE ARE NOT OF SUFFICIENT QUANTITY TO COMPLETE THE WORK, CONTRACTOR MAY PROVIDE BORROW MATERIAL IN SUFFICIENT QUANTITY TO COMPLETE THE WORK WITH THE APPROVAL OF THE OWNER'S REPRESENTATIVE AT NO ADDITIONAL COST TO THE OWNER.

D. DISPOSE OF EXCESS SATISFACTORY SOIL MATERIAL AND ALL UNSATISFACTORY SOIL MATERIAL AND ROCK OBTAINED FROM EXCAVATIONS IN AT NO ADDITIONAL COST TO THE OWNER IN ACCORDANCE WITH ALL LOCAL ORDINANCES AND STATE AND FEDERAL LAWS.

E. EXCAVATION FOR PAVEMENT
1. THE MATERIAL EXPOSED AFTER EXCAVATION SHALL BE SCARIFIED TO A DEPTH OF 6 INCHES AND COMPACTED TO AT LEAST 95 PERCENT OF STANDARD (ASTM D 698) MAXIMUM DENSITY WITHIN PLUS OR MINUS 3 PERCENT OF OPTIMUM MOISTURE CONTENT OF THE SOIL. WHERE NECESSARY TO ACHIEVE THE REQUIRED COMPACTION, STABILIZATION METHODS AS OUTLINED IN PARAGRAPH 2.2. A. 2 OF THIS SPECIFICATION SHALL BE USED AT NO ADDITIONAL COST TO THE OWNER.
2. EXCAVATION REQUIRED BENEATH PAVEMENT SECTIONS SHALL COMPLY WITH ELEVATIONS AND DIMENSIONS SHOWN ON THE PLANS AND DETAILED SECTIONS WITHIN A TOLERANCE OF PLUS OR MINUS 0.10 FOOT. CONTRACTOR SHALL TAKE CARE NOT TO DISTURB AREAS THAT ARE DESIGNATED TO BE PROTECTED OR ARE OUTSIDE THE CONSTRUCTION LIMITS. EXCAVATED AREAS SHALL BE KEPT FREE OF GROUND AND SURFACE WATER.

F. CUT SLOPES AND DITCHES: SLOPES AND GRADES OF DITCHES SHALL CONFORM TO THE PLANS WITHIN A TOLERANCE OF PLUS OR MINUS 0.10 FOOT. NO EXPOSED SLOPES SHALL BE STEEPER THAN THREE FEET HORIZONTAL TO ONE FOOT VERTICAL. WHERE SLOPE PROTECTION IS SPECIFIED OR CALLED OUT ON THE PLANS, SAID PROTECTION SHALL BE PLACED AS SOON AS PRACTICAL, AFTER EXPOSING THE SLOPE. EROSION AND SEDIMENTATION CONTROLS SHALL BE IMPLEMENTED IN ALL CUT AREAS AS SPECIFIED IN SECTION 01 57 13 – EROSION AND SEDIMENTATION CONTROL.

3.03 FILL AND BACKFILL

A. PLACEMENT
1. FILL MATERIAL SHALL BE PLACED IN LOOSE LIFTS NOT EXCEEDING 8 INCHES FOR AREAS BENEATH SITE STRUCTURES AND PAVEMENT, AND 12 INCHES FOR LANDSCAPE AREAS NOT SUPPORTING STRUCTURES. FILL AREAS SHALL BE COMPACTED TO 95 PERCENT OF STANDARD MAXIMUM DENSITY AT THE PROPER MOISTURE OF THAT SOIL AS DEFINED BY ASTM D 698.
2. EACH LIFT SHALL BE THOROUGHLY COMPACTED AND SHALL HAVE OBTAINED SATISFACTORY DENSITY PRIOR TO PROCEEDING WITH THE NEXT LIFT.
3. THE TOP 6 TO 8 INCHES OF MATERIAL BENEATH VEHICULAR PAVEMENT SHALL BE STABILIZED AFTER PLACEMENT.
4. MATERIAL SHALL BE FREE OF TRASH AND ROCKS OVER 1 INCH IN DIAMETER.

5. FILL SHALL BE BROUGHT UP TO THE PROPER ELEVATIONS AS DETERMINED FROM THE LINES, GRADES, SECTIONS AND ELEVATIONS SHOWN ON THE PLANS.

B. SITE RETAINING WALL/STRUCTURE BACKFILL:
   1. PLACE GRANULAR MATERIAL AS ENGINEERED BACKFILL AT ALL BUILDING AND SITE RETAINING WALLS.
   2. FOR PRECAST SITE RETAINING WALLS, INSTALL SPECIFIED GRAVEL AND FILTER FABRIC PRIOR TO BACKFILL INSTALLATION. POSITION ACCORDING TO MANUFACTURER'S RECOMMENDATIONS.
   3. PLACE IN ACCORDANCE WITH APPLICABLE PORTIONS OF THE SPECIFICATIONS.
   4. COMPACT PER APPROVED METHODS, USING HAND OPERATED COMPACTION EQUIPMENT. COMPACT TO AT LEAST 90% PER ASTM D1557.

C. COMPACTION AND FINISHING
   1. SUITABLE COMPACTION EQUIPMENT COMMONLY USED TO MEET THE REQUIREMENTS FOR THIS TYPE OF COMPACTION WORK SHALL BE USED.
   2. THE FINISHED SURFACE SHALL BE REASONABLY SMOOTH, COMPACTED, AND FREE FROM IRREGULAR SURFACE CHANGES. THE SURFACE GRADE SHALL BE CONSISTENT WITH THE DRAINAGE INTENT SHOWN ON THE PLANS SUCH THAT NO UNWANTED PONDING SHALL OCCUR.
   3. SURFACE SHALL NOT BE MORE THAN 0.10 FEET ABOVE OR BELOW THE ESTABLISHED GRADE, AND ALL GROUND SURFACES SHALL VARY UNIFORMLY BETWEEN INDICATED GRADES.
   4. CUT MATERIAL FROM THE SITE MAY BE USED FOR FILL MATERIAL. WHERE CUT MATERIAL IS USED AS FILL, EACH LIFT OF SUCH MATERIAL SHALL BE PROPERLY MIXED TO OBTAIN A UNIFORM MATERIAL WITH CLAY BEING THE PREDOMINANT MATERIAL AND MAINTAINING A PLASTICITY INDEX LESS THAN 35.
      a. LIME STABILIZATION SHALL BE USED FOR CLAY MATERIAL AND SHALL CONFORM TO SECTION 31 32 13.19 – LIME STABILIZATION OR 31 32 13.26 – LIME-FLY ASH OR FLY ASH STABILIZATION.
      b. CEMENT STABILIZATION SHALL BE USED FOR SANDY OR SILTY MATERIALS AND SHALL CONFORM TO SECTION 31 32 13.16 - CEMENT STABILIZATION.

3.04 EROSION CONTROL

A. THERE SHALL BE AT ALL TIMES ADEQUATE PROTECTION TO NEWLY GRADED AREAS TO PREVENT SOIL EROSION AS PROVIDED IN SECTION 01 57 13 – EROSION AND SEDIMENTATION CONTROL.

B. SOIL EROSION THAT OCCURS PRIOR TO ACCEPTANCE OF THE WORK SHALL BE REPAIRED AT NO EXPENSE TO THE OWNER.

C. PROTECTING GRADED AREAS: PROTECT NEWLY GRADED AREAS FROM TRAFFIC, FREEZING, AND EROSION. KEEP FREE OF TRASH AND DEBRIS.

D. REPAIR AND REESTABLISH GRADES TO SPECIFIED TOLERANCES WHERE COMPLETED OR PARTIALLY COMPLETED SURFACES BECOME ERODED, RUTTED, SETTLED, OR WHERE THEY LOSE COMPACTION DUE TO SUBSEQUENT CONSTRUCTION OPERATIONS OR WEATHER CONDITIONS.
   1. SCARIFY OR REMOVE AND REPLACE SOIL MATERIAL TO DEPTH AS DIRECTED BY OWNER'S TESTING AND INSPECTION SERVICE; RESHAPE AND RE-COMPACT.

E. WHERE SETTLING OCCURS BEFORE PROJECT CORRECTION PERIOD ELAPSES, REMOVE FINISHED SURFACING, BACKFILL WITH ADDITIONAL SOIL MATERIAL, COMPACT, AND RECONSTRUCT SURFACING.
   1. RESTORE APPEARANCE, QUALITY, AND CONDITION OF FINISHED SURFACING TO MATCH ADJACENT WORK, AND ELIMINATE EVIDENCE OF RESTORATION TO THE GREATEST EXTENT POSSIBLE.

3.05 GRADING

A. ROUGH GRADING
   1. CUT AND FILL SHALL BE LEFT SUFFICIENTLY HIGH TO REQUIRE CUTTING BY FINE GRADING.
   2. GRADE TO SUBGRADE DEPTHS REQUIRED FOR CONSTRUCTION OF FINISHED SURFACE MATERIALS AND FOR CONTROLLED INTERNAL DRAINAGE OF SITE.

B. FINE GRADING
   1. FINE GRADING SHALL CONFORM TO ELEVATIONS REQUIRED TO ENSURE FINISHED ELEVATIONS AS INDICATED ON THE DRAWINGS.
   2. AT NO ADDITIONAL COST TO THE OWNER THE CONTRACTOR SHALL BE RESPONSIBLE FOR MINOR ADJUSTMENTS TO FINISHED GRADE IF DEEMED REQUIRED BY THE OWNER'S REPRESENTATIVE.
   3. PROVIDE A SMOOTH TRANSITION BETWEEN ADJACENT EXISTING GRADES AND NEW GRADES.
   4. TILL, DISC, HAND RAKE OR OTHERWISE SCARIFY SOIL REMOVING ALL CLODS, STONES, AND UNDESIRABLE MATERIAL ½ INCH OR LARGER. PLACE AND SPREAD ANY ADDITIONAL MATERIAL THAT MAY BE REQUIRED.
   5. PREPARE TO IMMEDIATELY BEGIN PLANTING OPERATIONS OF THE COMPLETED AND ACCEPTED FINISH GRADE TO PREVENT EXCESSIVE WEED GROWTH IN LAWN AREAS.

C. SLOPE GRADES TO DIRECT WATER AWAY FROM BUILDINGS AND TO PREVENT PONDING AT A MINIMUM OF 5% GRADE FOR THE INITIAL 10 FEET, AS SHOWN ON THE DRAWINGS OR AS DIRECTED BY THE OWNER'S REPRESENTATIVE. MAXIMUM CROSS SLOPE FOR ALL WALKWAYS SHALL BE 2% FOR DISABLED ACCESS. FINISH SUBGRADES TO REQUIRED ELEVATIONS WITHIN THE FOLLOWING TOLERANCES:
   1. LAWN OR UNPAVED AREAS: PLUS OR MINUS 0.1 FOOT (1.2 INCHES)
   2. WALKS: PLUS OR MINUS ½ INCH
   3. PAVEMENTS: PLUS OR MINUS ½ INCH

3.06 TESTING AND INSPECTION

A. MATERIALS AND INSTALLED WORK REQUIRE TESTING TO SHOW THAT THE SPECIFICATIONS FOR THE MATERIALS AND WORK HAVE BEEN MET. THE OWNER MAY, AT THE OWNER'S EXPENSE, TAKE RANDOM TESTS ON MATERIALS AND INSTALLED WORK. THE CONTRACTOR SHALL ALLOW FREE ACCESS TO MATERIAL STOCKPILES AND FACILITIES AT ALL TIMES. IN FILL AREAS EACH LIFT MUST BE TESTED AND APPROVED BEFORE PROCEEDING ON THE NEXT LIFT. RETESTING OF REJECTED MATERIALS AND INSTALLED WORK, SHALL BE DONE AT THE CONTRACTOR'S EXPENSE.

B. CONTRACTOR SHALL NOTIFY OWNER'S TESTING LABORATORY 24 HOURS IN ADVANCE OF BEGINNING ANY EARTH WORK OPERATIONS AND COORDINATE TESTING SCHEDULES TO MEET THESE SPECIFICATIONS.

C. MAXIMUM DENSITY TESTS PER ASTM D 698 SHALL BE TAKEN ON ALL FILL MATERIALS AT A RATE OF ONE TEST FOR EACH TYPE OF SOIL TO BE USED AND AT LEAST ONE TEST FOR EVERY 1,000 CUBIC YARDS OF FILL.

D. FIELD DENSITY TESTS PER ASTM D 1556 OR ASTM D 2922 SHALL BE TAKEN ON ALL FILL MATERIAL AT A RATE OF ONE TEST FOR EVERY TEN THOUSAND 10,000 SQUARE FEET AND AT LEAST ONE TEST PER LIFT.

E. ALL IMPORTED FILL MATERIAL SHALL BE APPROVED PRIOR TO IMPORTING.

3.07 DUST ABATEMENT

A. THE CONTRACTOR SHALL COMPLY WITH APPLICABLE FEDERAL, STATE, AND LOCAL LAWS AND REGULATIONS CONCERNING THE PREVENTION AND CONTROL OF DUST POLLUTION.

B. DURING THE PERFORMANCE OF THE WORK REQUIRED BY THESE SPECIFICATIONS OR ANY OPERATIONS APPURTENANT THERETO, WHETHER ON RIGHT-OF-WAY PROVIDED BY THE OWNER OR ELSEWHERE, THE CONTRACTOR SHALL FURNISH ALL THE LABOR, EQUIPMENT, MATERIALS, AND MEANS REQUIRED, AND SHALL CARRY OUT PROPER AND EFFICIENT MEASURES WHEREVER AND AS OFTEN AS NECESSARY TO REDUCE THE DUST NUISANCE, AND TO PREVENT DUST WHICH HAS ORIGINATED FROM THE CONTRACTOR'S OPERATIONS FROM DAMAGING CROPS, ORCHARDS, CULTIVATED FIELDS, AND DWELLINGS, OR CAUSING A NUISANCE TO PERSONS. THE CONTRACTOR WILL BE HELD LIABLE FOR ANY DAMAGE RESULTING FROM DUST ORIGINATING FROM THE CONTRACTOR'S OPERATIONS UNDER THESE SPECIFICATIONS.

C. DUST CONTROL SHALL BE ACCOMPLISHED BY ONE OF THE FOLLOWING METHODS:
   1. SPRINKLING THE GROUND SURFACE WITH WATER UNTIL IT IS MOIST.
   2. WHENEVER ORDERED BY THE OWNER'S REPRESENTATIVE, THE CONTRACTOR SHALL FURNISH AND DISTRIBUTE OVER THE TRAVELED ROAD SURFACES, WHICH HAVE NOT YET BEEN FULLY RESTORED, AN APPLICATION OF CALCIUM CHLORIDE. THE MATERIAL USED SHALL BE REGULAR FLAKE CALCIUM CHLORIDE HAVING A MINIMUM CHEMICAL CONTENT OF CALCIUM CHLORIDE OF 77%. UNLESS OTHERWISE SPECIFIED OR ORDERED BY THE OWNER, RATE OF APPLICATION SHALL BE 3 POUNDS PER SQUARE YARD OF SURFACE COVERED.
   3. ALL METHODS OF REDUCING FORMATION OF DUST SHALL BE AT NO ADDITIONAL COST TO THE OWNER.

3.08 STORAGE OF SOIL MATERIALS

A. STOCKPILE BORROW MATERIALS AND SATISFACTORY EXCAVATED SOIL MATERIALS. STOCKPILE SOIL MATERIALS WITHOUT INTERMIXING. PLACE, GRADE, AND SHAPE STOCKPILES TO DRAIN SURFACE WATER. COVER TO PREVENT WINDBLOWN DUST.

B. STOCKPILE SOIL MATERIALS AWAY FROM EDGE OF EXCAVATIONS. DO NOT STORE WITHIN DRIP LINE OF REMAINING TREES.

C. STOCKPILE TOPSOIL MAY NOT EXCEED 6 FEET IN HEIGHT.

3.09 FIELD QUALITY CONTROL

A. TESTING SHALL BE THE RESPONSIBILITY OF THE OWNER AND COSTS OF INITIAL TESTING SHALL BE PAID BY OWNER. COST OF ALL SUBSEQUENT TESTING NECESSARY DUE TO NON-COMPLIANCE WITH SPECIFICATIONS SHALL BE PAID BY CONTRACTOR.

B. DENSITY TEST:
   1. DENSITY TESTS SHALL BE PERFORMED BY AN APPROVED COMMERCIAL TESTING LABORATORY APPROVED PER ASTM D 1557.
   2. TESTS SHALL BE PERFORMED IN ACCORDANCE WITH THE REFERENCED STANDARDS.
   3. FIELD AND LABORATORY TESTS FOR MOISTURE DENSITY RELATIONS SHALL BE DETERMINED IN ACCORDANCE WITH ASTM D 1557. THE FREQUENCY AND LOCATION OF FIELD DENSITY TESTS WILL BE DETERMINED BY THE GEOTECHNICAL ENGINEER.
   4. TRENCHES IMPROPERLY COMPACTED SHALL BE REOPENED TO THE DEPTH DIRECTED, THEN REFILLED AND COMPACTED TO THE DENSITY SPECIFIED AT NO ADDITIONAL COST TO THE OWNER.

3.10 DRAINAGE CONTROLS

A. PROVIDE ALL NECESSARY TEMPORARY APPARATUS, PUMPS, CURBS OR DITCHES AS REQUIRED TO DIVERT OR CONVEY WATER FROM ANY SOURCE AWAY FROM THE WORK. DO NOT ALLOW WATER FROM ANY SOURCE TO ACCUMULATE WITHIN OR DAMAGE EARTHWORK.

3.11 CLEANING AND DISPOSAL

A. REMOVE UNUSED STOCKPILED TOPSOIL AND SUBSOIL. GRADE STOCKPILE AREA TO PREVENT STANDING WATER.

B. REMOVE SURPLUS SOIL MATERIAL, UNSUITABLE TOPSOIL, OBSTRUCTIONS, DEMOLISHED MATERIALS, AND WASTE MATERIALS INCLUDING TRASH AND DEBRIS, AND LEGALLY DISPOSE OF THEM OFF OWNER'S PROPERTY AT NO ADDITIONAL COST TO THE OWNER.

C. LEAVE SITE CLEAN AND RAKED, READY TO RECEIVE LANDSCAPING.

END OF SECTION 31 22 13

SECTION 31 23 15 – BUILDING EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Excavation, preparing of subgrade, and select fill installation for building foundations and exterior equipment slabs.
2. Excavating and backfilling of trenches within building lines and 5 ft. out.
3. Excavating and backfilling for underground mechanical and electrical utilities and buried mechanical and electrical appurtenances.
4. Disposal of removed materials not utilized in the Work.

B. Related Requirements:

1. Section 00 31 32 - Geotechnical Data.

1.2 SUBMITTALS

A. Test Reports: The independent testing laboratory shall submit the following reports directly to Architect/Engineer with copy to others as designated in accordance with the provisions of section 01 40 00 "Quality Control Services." State in each report whether or not the test specimens comply with the specified requirements, and indicate any deviations.

1. Test reports on soil material properties.
2. Verification of suitability of each footing subgrade material, in accordance with specified requirements.
3. Field reports; in-place soil density tests.
4. One optimum moisture-maximum density curve for each type of soil encountered.

B. Testing Laboratory Qualifications: To qualify for acceptance, the geotechnical testing laboratory must demonstrate to Architect/Engineer's satisfaction, based on evaluation of laboratory-submitted criteria conforming to ASTM E 699, that it has the experience and capability to conduct required field and laboratory geo-technical testing without delaying the progress of the Work.

1.3 DEFINITIONS

A. Borrow consists of off-site material.

B. Excavation consists of removal of all materials encountered to over-excavate for replacement with select fill, and to obtain the required subgrade elevations indicated.

C. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Architect/Engineer. Unauthorized excavation, as well as remedial work directed by Architect/Engineer, shall be at Contractor's expense.

1. Under footings, foundation bases, or retaining walls, fill unauthorized excavation by extending indicated bottom elevation of footing or base to excavation bottom, without

altering required top elevation. Lean concrete fill may be used to bring elevations to proper position, when acceptable to Architect/Engineer.

2. In locations other than those above, backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by Architect/Engineer.

D. Additional Excavation: When excavation has reached required subgrade elevations, notify Architect/Engineer, who will make an inspection of conditions. If Architect/Engineer determines that bearing materials at required subgrade elevations are unsuitable, continue excavation until suitable bearing materials are encountered and replace excavated material as directed by Architect/Engineer. The Contract Sum may be adjusted by an appropriate Contract Modification.

1. Removal of unsuitable material and its replacement, as directed, will be paid on basis of Conditions of the Contract relative to changes in Work.

E. Subgrade: The undisturbed earth or the compacted soil layer immediately below topsoil materials and down to the excavated level.

F. Structure: Buildings, foundations, slabs, tanks, curbs, or other man-made stationary features occurring above or below ground surface.

1.4 QUALITY ASSURANCE

A. Codes and Standards: Perform excavation Work in compliance with applicable requirements of authorities having jurisdiction.

B. Soil properties: Test in accordance with the requirements of Part 2 - Products, article "Soil Materials."

1.5 PROJECT CONDITIONS

A. Site Information: Data in subsurface investigation reports was used for the basis of the design and are available to the Contractor for information only. Conditions are not intended as representations or warranties of accuracy or continuity between soil borings. The Owner will not be responsible for interpretations or conclusions drawn from this data by Contractor.

B. Additional test borings and other exploratory operations may be performed by Contractor, at the Contractor's option; however, no change in the Contract Sum will be authorized for such additional exploration.

C. Existing Utilities: Locate existing underground utilities in areas of excavation Work. If utilities are indicated to remain in place, provide adequate means of support and protection during earthwork operations.

1. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility Owner.
2. Do not interrupt existing utilities serving facilities occupied by Owner or others, during occupied hours, except when permitted in writing by Architect/Engineer and then only after acceptable temporary utility services have been provided.

3. Provide minimum of 48-hour notice to Architect/Engineer and receive written notice to proceed before interrupting any utility.
4. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies for shutoff of services if lines are active.

D. Use of Explosives: Use of explosives is not permitted.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. Satisfactory soil materials are defined as those complying with ASTM D2487 soil classification groups GW, GP, GM, SM, SW, and SP, and meeting the requirements of the General Notes on the structural drawings.

B. Unsatisfactory soil materials are defined as those complying with ASTM D2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT.

C. Backfill and Select Fill Materials: Satisfactory soil materials free of clay, rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation and other deleterious matter. Refer to the general notes on the drawings and project's geotechnical report for acceptable soil properties as determined by ASTM D4318.

D. Other Materials: All other materials not specifically described but required for the proper completion of the Work of this Section, shall be as selected by the Contractor subject to the approval of the Architect/Engineer.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Excavation is unclassified and includes excavation to subgrade elevations indicated, regardless of character of materials and obstructions encountered.

B. 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 earth and other materials encountered that are not classified as rock or unauthorized excavation. Trenches in excess of 10 feet in width and pits in excess of 30 feet in either length or width are classified as open excavation.

1. Rock excavation in open excavations includes removal and disposal of materials and obstructions encountered that cannot be dislodged and excavated with modern, track-mounted, heavy-duty excavating equipment without drilling, blasting, or ripping.
2. Typical of materials classified as rock are boulders 1/2 cu. yd. or more in volume, solid rock, rock in ledges, and rock-hard cementitious aggregate deposits.
3. Intermittent drilling, blasting, or ripping performed to increase production and not necessary to permit excavation of material encountered will be classified as earth excavation.

D. Do not perform rock excavation Work until material to be excavated has been cross-sectioned and classified by Architect/Engineer. Such excavation will be paid on basis of Contract Conditions relative to changes in Work.

3.2 STABILITY OF EXCAVATIONS

A. General: Comply with local codes, ordinances, and requirements of agencies having jurisdiction.

B. Slope sides of excavations to comply with local codes, ordinances, and requirements of agencies having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated. Maintain sides and slopes of excavations in safe condition until completion of backfilling.

C. Shoring and Bracing: Provide materials for shoring and bracing, such as sheet piling, uprights, stringers, and cross braces, in good serviceable condition. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Extend shoring and bracing as excavation progresses.Provide permanent steel sheet piling or pressure-creosoted timber sheet piling wherever subsequent removal of sheet piling might permit lateral movement of soil under adjacent structures. Cut off tops a minimum of 2'-6" below final grade and leave permanently in place.

3.3 DEWATERING

A. Prevent surface water and subsurface or groundwater from flowing into excavations and from flooding project site and surrounding area.

1. Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrades and foundations. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.
2. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water removed from excavations to collecting or runoff areas. Do not use trench excavations as temporary drainage ditches. Do not allow water to stand near the foundation of any structure at any time.

3.4 STORAGE OF EXCAVATED MATERIALS

A. Stockpile excavated materials acceptable for site utility backfill, for chemically treated fill under paving, and for final lawn area grading where directed. Excavated materials shall not be utilized under building structures unless specifically approved by the Owner’s geotechnical laboratory. Place, grade, and shape stockpiles for proper drainage.

1. Locate and retain soil materials away from edge of excavations. Do not store within drip line of trees indicated to remain.
2. Dispose of excess excavated soil material and materials not acceptable for use as backfill or fill as directed in PART 3 section: “DISPOSAL OF EXCESS AND WASTE MATERIALS”.

3.5 EXCAVATION FOR STRUCTURES

A. Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 foot, and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, and other construction and for inspection.

1. Excavations for footings and foundations: Do not disturb bottom of excavation. Trim bottoms to required lines and grades to leave solid base to receive other work.
2. When excavation exceeds five (5) foot in depth, the soil on all sides of the excavation shall be laid back at a slope not to exceed two (2) horizontal to one (1) vertical.
3. In cohesive materials, footing sides do not require formwork as long as the sides can be maintained in a neat and vertical manner, "mushrooming" will not be allowed. Provide forms if sides cannot be maintained or if the excavation is larger than footing design dimensions.

B. Removal of Unsatisfactory Soil Materials:

1. Strip the exposed soils within the proposed building and paving footprints and 5-ft. beyond to a depth of 6-inches. Vegetation, topsoil, debris, and other deleterious materials shall be removed during the initial stripping operations. Stockpile useable topsoil in an area on the site as approved by the Architect.

C. After removal and stockpiling of the upper 6 inches of topsoil, provide additional excavation as may be needed to achieve a depth of compacted select fill as noted below for each project. In this excavation, remove all soil, roots, organic material, fill material, and miscellaneous debris.

1. Remove and replace at least 12-inches supporting the slab-on-grade and extending a minimum of 3-feet beyond the building footprint.
2. Slope building fill from building perimeter as indicated on the drawings.

D. Where unsatisfactory materials are encountered that extend below the specified excavation depths, excavate to the required additional depths as directed by the Owner’s geotechnical engineer.

1. Such additional excavation, provided it is not due to the fault or neglect of the Contractor, will be measured as directed by the Architect/Engineer and paid for by the Owner as a change in the Work.
2. Where the removal of unsatisfactory soil materials, is due to the fault or negligence of the Contractor in his performance of earthwork and site grading operations, excavate the resulting unsatisfactory soil material and replace with compacted satisfactory soil material as required.
3. Proceed with additional soil removal requiring additional payment only with approval from the Architect and Owner.

E. Under direct observation by representatives of the Owner's testing laboratory, proof roll the exposed subgrade with a 20-ton pneumatic roller or equivalent equipment, such as a fully loaded tandem axle dump truck, to detect any wet, soft, unstable, loose, or weak zones in the upper 18-inches of subgrade after excavation.

1. When proof rolling areas containing fill soils, exercise special care in an attempt to observe soft and weak zones. Weak areas detected during proof rolling, as well as zones of fill containing organic matter and/or debris, shall be removed and replaced with compacted select fill.

2. Scarify and moisture condition the upper 6” of exposed subgrade and re-compact to 95% standard proctor density per ASTM D698 at a moisture content between optimum and plus 4%.

3.6 TRENCH EXCAVATION FOR PIPES AND CONDUIT

A. Excavate trenches to uniform width, sufficiently wide to provide ample working room and a minimum of 6 to 9 inches of clearance on both sides of pipe or conduit. When excavation exceeds five (5) foot in depth, the soil on all sides of the excavation shall be laid back at a slope not to exceed two (2) horizontal to one (1) vertical.

B. Excavate trenches and conduit to depth indicated or required to establish indicated slope and invert elevations and to support bottom of pipe or conduit on undisturbed soil. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

1. Where rock is encountered, carry excavation 6 inches below required elevation and backfill with a 6 inch layer of crushed stone or gravel prior to installation of pipe.
2. For pipes or conduit less than 6 inches in nominal size, and for flat-bottomed, multiple-duct conduit units, do not excavate beyond indicated depths. Hand-excavate bottom cut to accurate elevations and support pipe or conduit on undisturbed soil.
3. For pipes and equipment 6 inches or larger in nominal size, shape bottom of trench to fit bottom of pipe for 90 degrees (bottom 1/4 of the circumference). Fill depressions with tamped sand backfill. At each pipe joint, dig bell holes to relieve pipe bell of loads. Ensure continuous bearing of pipe barrel on bearing surface.
4. To restrict water intrusion at utility trenches, provide a clay fill or Bentonite trench “plug” at piping as it crosses the building line. Place fully compacted clay plug to completely surround the utility line and fill the excavated trench for a distance of 5 ft. outside the building line and 5 ft. inside the building line.

3.7 COLD WEATHER PROTECTION

A. Protect excavation bottoms against freezing when atmospheric temperature is less than 35° F.

3.8 BACKFILL AND FILL

A. General: Place fill material in layers to required subgrade elevations, for each area classification listed below, using materials specified in Part 2 of this Section.

1. Under building slabs, use select fill material.
2. Under steps, use subbase material.
3. Under piping and conduit and equipment, use subbase materials where required over rock bearing surface and for correction of unauthorized excavation. Shape excavation bottom to fit bottom 90 degrees of cylinder.
4. Backfill trenches with concrete where trench excavations pass within 18 inches of column or wall footings and that are carried below bottom of such footings or that pass under wall footings. Place concrete to level of bottom of adjacent footing.
5. Concrete is specified in Division 3.
6. Do not backfill trenches until tests and inspections have been made and backfilling has been authorized by Architect/Engineer. Use care in backfilling to avoid damage or displacement of pipe systems.

B. Backfill excavations as promptly as work permits, but not until completion of the following:

1. Acceptance of construction below finish grade including, where applicable, damp proofing, waterproofing, and perimeter insulation.
2. Inspection, testing, approval, and recording locations of underground utilities have been performed and recorded.
3. Removal of concrete formwork.
4. Removal of shoring and bracing, and backfilling of voids with satisfactory materials. Cut off temporary sheet piling driven below bottom of structures and remove in manner to prevent settlement of the structure or utilities, or leave in place if required.
5. Removal of trash and debris from excavation.
6. Permanent or temporary horizontal bracing is in place on horizontally supported walls.

3.9 PLACEMENT AND COMPACTION

A. Place backfill and select fill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers. Compacted thickness of each layer not to exceed 6-inches.

B. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

C. Place backfill and fill materials evenly adjacent to structures, piping, or conduit to required elevations. Prevent wedging action of backfill against structures or displacement of piping or conduit by carrying material uniformly around structure, piping, or conduit to approximately same elevation in each lift.

D. Control soil and fill compaction, providing minimum percentage of density specified for each area classification indicated.

E. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density, in accordance with ASTM D 1557/698:

1. Under building structures, building slabs, steps, and outdoor mechanical equipment slabs, compact each layer of fill material at a minimum of 95-percent maximum density, and a maximum of 100 percent maximum density.
2. Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade or layer of soil material. Apply water in minimum quantity as necessary to prevent free water from appearing on surface during or subsequent to compaction operations. Acceptable moisture content shall be plus or minus 2% from optimum as determined by ASTM D 1557/698.
3. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.
4. Stockpile or spread soil material that has been removed because it is too wet to permit compaction. Assist drying by disking, harrowing, or pulverizing until moisture content is reduced to a satisfactory value.

3.10 GRADING

A. General: Uniformly grade areas within limits of grading under this section, including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are indicated, or between such points and existing grades. Fill low areas resulting from removal of unsatisfactory soil materials, obstructions, and other deleterious materials, using satisfactory soil material. Shape to line, grade, and cross section as shown on the drawings.

B. Grading Outside Building Lines: Grade areas adjacent to building lines to drain away from structures and to prevent ponding. Finish surfaces free from irregular surface changes and as follows:

1. Grading Surface of Fill Under Building Slabs: Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of 1/2 inch when tested with a 10 foot straightedge.
2. Compaction: After grading, compact subgrade surfaces to the depth and indicated percentage of maximum or relative density for each area classification.

3.11 FIELD QUALITY CONTROL

A. Quality Control Testing During Construction: Independent testing laboratory shall inspect and approve each subgrade and fill layer before further backfill or construction work is performed. The testing laboratory will be responsible for verbally informing the Contractor of the test results immediately upon completion, so unnecessary delay is eliminated and unsatisfactory Work is not covered up. Continued progress of the Work shall not relieve the Contractor of the responsibility of complying with specification requirements.

1. Perform field density tests in accordance with ASTM D 1556 (sand cone method) or ASTM D 2167 (rubber balloon method), as applicable.
2. Field density tests may also be performed by the nuclear method in accordance with ASTM D 2922, providing that calibration curves are periodically checked and adjusted to correlate to tests performed using ASTM D 1556. In conjunction with each density calibration check, check the calibration curves furnished with the moisture gages in accordance with ASTM D 3017.

B. If field tests are performed using nuclear methods, make calibration checks of both density and moisture gages at beginning of work, on each different type of material encountered, and at intervals as directed by the Architect/Engineer.

1. Footing Subgrade: For each strata of soil on which footings will be placed, perform at least one test to verify required design bearing capacities. Subsequent verification and approval of each footing subgrade may be based on a visual comparison of each subgrade with related tested strata when acceptable to Architect/Engineer.

C. Building Slab Subgrade: Perform at least one field density test of subgrade per the frequency listed below, but in no case fewer than three tests. In each compacted fill layer, perform one field density test per the frequency listed below, but in no case fewer than three tests.

1. Structures and building slabs: 3,000 sq. ft.

D. Foundation Wall Backfill: Perform at least two field density tests at locations and elevations as directed.

E. If in opinion of Architect/Engineer, based on testing service reports and inspection, subgrade or fills that have been placed are below specified density, perform additional compaction and testing until specified density is obtained.

3.12 EROSION CONTROL

A. Provide erosion control methods in accordance with requirements of authorities having jurisdiction.

B. Use all means necessary to control dust on and near the Work and on and near all off-site borrow areas if such dust is caused by the Contractor's operations during performance of the Work or if resulting from the condition in which the Contractor leaves the site.

C. Thoroughly moisten all surfaces as required to prevent dust being a nuisance to the public, neighbors, and concurrent performance of other work on the site.

3.13 MAINTENANCE

A. Protection of Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris.

B. Repair and reestablish grades in settled, eroded, and rutted areas to specified tolerances.

C. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, and compact to required density prior to further construction.

D. Settling: Where settling is measurable or observable at excavated areas during general project warranty period, remove surface, add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.14 DISPOSAL OF EXCESS AND WASTE MATERIALS

A. Removal to Designated Areas on Owner's Property: Transport acceptable excess excavated material to designated soil storage areas on Owner's property. Stockpile soil or spread as directed by Architect/Engineer.

1. Transport waste material, including unacceptable excavated material, trash, and debris to designated spoil areas on Owner's property and dispose of as directed.

B. Removal from Owner's Property: Remove waste materials, including unacceptable excavated material, trash, and debris, and dispose of it off Owner's property.

END OF SECTION 31 23 15

SECTION 31 23 33 – TRENCHING BACKFILLING AND COMPACTION

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. THIS SECTION SPECIFIES THE REQUIREMENTS FOR EXCAVATING AND BACKFILLING FOR STORM SEWER, SANITARY SEWER, WATER DISTRIBUTION LINES, AND ALL RELATED APPURTENANCES. EXCAVATION AND BACKFILL SHALL BE IN CONFORMANCE WITH THE LOCATIONS, LINES, ELEVATIONS AND GRADES SHOWN ON THE PLANS. THIS SECTION ALSO SPECIFIES THE REQUIREMENTS FOR CLAY PLUGS THAT MUST BE INSTALLED NEAR BUILDING FACE ON ALL UTILITY TRENCHES INCLUDING WATER, STORM SEWER, SANITARY SEWER, MECHANICAL, ELECTRICAL, TELECOM, DATA, PLUMBING AND OTHER UTILITY TRENCHES FOR SLAB ON GRADE AND STRUCTURAL FIRST FLOOR BUILDING PROJECTS.

1.02 DEFINITIONS

A. EXCAVATION CONSISTS OF THE REMOVAL OF MATERIAL ENCOUNTERED TO SUBGRADE ELEVATIONS AND THE REUSE OR DISPOSAL OF MATERIALS REMOVED.

B. SUBGRADE: THE UPPERMOST SURFACE OF AN EXCAVATION, INCLUDING EXCAVATION FOR TRENCHES, OR THE TOP SURFACE OF A FILL OR BACKFILL IMMEDIATELY BELOW BASE COURSE, PAVEMENT, OR TOPSOIL MATERIALS.

C. BORROW: SOIL MATERIAL OBTAINED OFF-SITE WHEN SUFFICIENT APPROVED SOIL MATERIAL IS NOT AVAILABLE FROM EXCAVATIONS.

D. BASE COURSE: THE LAYER PLACED BETWEEN THE SUBGRADE AND SURFACE PAVEMENT IN A PAVING SYSTEM.

E. UNAUTHORIZED EXCAVATION CONSISTS OF REMOVING MATERIALS BEYOND INDICATED SUBGRADE ELEVATIONS OR DIMENSIONS WITHOUT DIRECTION BY THE OWNER’S REP. UNAUTHORIZED EXCAVATION, AS WELL AS REMEDIAL WORK DIRECTED BY THE OWNER’S REP SHALL BE AT THE CONTRACTOR'S EXPENSE.

F. STRUCTURES: BUILDINGS, FOOTINGS, FOUNDATIONS, RETAINING WALLS, SLABS, TANKS, CURBS, MECHANICAL AND ELECTRICAL APPURTENANCES, OR OTHER MAN-MADE STATIONARY FEATURES CONSTRUCTED ABOVE OR BELOW GROUND SURFACE.

G. UTILITIES INCLUDE UNDERGROUND PIPES, CONDUITS, DUCTS, AND CABLES, AS WELL AS UNDERGROUND SERVICES WITHIN BUILDING LINES.

H. UNFORESEEN EXCAVATION: EXCAVATION OF MATERIAL, REGARDLESS OF ITS CHARACTER OR NATURE, BELOW THE SUBGRADE ELEVATION REQUIRED TO CONSTRUCT THE WORK AS INDICATED ON THE DRAWINGS OR SPECIFIED HEREIN.

I. BEDDING MATERIAL: GRANULAR MATERIAL UTILIZED TO BED PIPED UTILITIES PLACED IN TRENCH EXCAVATIONS.

1.03 REGULATORY REQUIREMENTS

A. CONTRACTOR SHALL COMPLY WITH ALL CURRENT, APPLICABLE CODES AND REGULATIONS.

B. CONTRACTOR SHALL COMPLY WITH ALL STANDARD SPECIFICATIONS AND DETAILS OF AUTHORITIES HAVING JURISDICTION FOR WORK IN THE RIGHT-OF-WAY OR EASEMENTS.

C. SHORING THAT IS REQUIRED TO COMPLETE THE WORK, IS CONSIDERED A METHOD OR TECHNIQUE AND IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR. IF A REGULATORY AGENCY REQUIRES A LICENSED ENGINEER TO DESIGN, APPROVE OR PROVIDE DRAWINGS FOR SHORING, THEN IT IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR TO ENGAGE THE SERVICES OF A QUALIFIED ENGINEER FOR SHORING DESIGN SERVICES AT NO ADDITIONAL COST TO THE OWNER.

D. PRIOR TO COMMENCEMENT OF WORK, THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING, AT THE CONTRACTOR'S OWN EXPENSE, ALL CONSTRUCTION PERMITS NECESSARY TO COMPLETE THE PROJECT ACCORDING TO THE PLANS AND SPECIFICATIONS.

1.04 PROJECT CONDITIONS

A. SUBSURFACE DATA IS AVAILABLE FROM THE OWNER. CONTRACTOR IS URGED TO CAREFULLY ANALYZE THE SITE CONDITIONS.

B. TRAFFIC: MINIMIZE INTERFERENCE WITH ADJOINING ROADS, STREETS, WALKS, AND OTHER ADJACENT OCCUPIED OR USED FACILITIES DURING SITE-PREPARATION OPERATIONS.
   1. DO NOT CLOSE OR OBSTRUCT STREETS, WALKS, OR OTHER ADJACENT OCCUPIED OR USED FACILITIES WITHOUT PERMISSION FROM OWNER AND AUTHORITIES HAVING JURISDICTION.
   2. PROVIDE ALTERNATE ROUTES AROUND CLOSED OR OBSTRUCTED TRAFFIC WAYS IF REQUIRED BY AUTHORITIES HAVING JURISDICTION.

C. PRIOR TO EARTHWORK OPERATIONS, EXISTING UTILITIES, FACILITIES AND PERMANENT OBJECTS TO REMAIN SHALL BE LOCATED AND ADEQUATELY PROTECTED.

D. DO NOT INTERRUPT UTILITIES SERVING FACILITIES OCCUPIED BY OWNER OR OTHERS UNLESS PERMITTED IN WRITING BY THE AUTHORITY HAVING JURISDICTION (AHJ) AND THEN ONLY AFTER ARRANGING TO PROVIDE TEMPORARY UTILITY SERVICES AS REQUIRED BY THE AHJ.

E. PROTECTION OF EXISTING UTILITIES:
   1. UTILITIES HAVE BEEN LOCATED FROM SURVEYS AND AVAILABLE EXISTING RECORDS; NOT ALL UTILITIES MAY BE SHOWN ON THE DRAWINGS. LOCATE ALL UTILITIES PRIOR TO BEGINNING ANY CONSTRUCTION ACTIVITIES.
   2. NOTIFY TEXAS 811 OR THE UTILITY COMPANY INVOLVED TO LOCATE ALL PUBLIC AND PRIVATE UTILITY COMPANY LINES BEFORE BEGINNING WORK.
   3. EXCAVATION AND BACKFILL IN THE VICINITY OF EXISTING ITEMS OF WORK SHALL BE CARRIED OUT WITH EXTREME CAUTION. CONTRACTOR SHALL BE HELD RESPONSIBLE FOR ANY DAMAGE AND FOR MAINTENANCE AND PROTECTION OF EXISTING UTILITIES.
   4. IF UNKNOWN AND UNCHARTED UTILITIES ARE ENCOUNTERED DURING EXCAVATION, PROMPTLY NOTIFY OWNER'S REPRESENTATIVE AND THE

GOVERNING UTILITY COMPANY WHEN DETERMINABLE AND WAIT FOR INSTRUCTIONS.

5. FOR PRIVATE UTILITIES FOUND, IF IT IS ASCERTAINED BY OWNER'S REPRESENTATIVE THAT SUCH UTILITY LINE HAS BEEN ABANDONED, PROPERLY CAP LINE AT A DEPTH APPROVED BY OWNER'S REPRESENTATIVE OR REMOVE LINE AS DIRECTED. ALL WORK TO CAP AND REMOVE ABANDONED PUBLIC UTILITIES FOUND, MUST BE COORDINATED THROUGH THE GOVERNING UTILITY COMPANY.
6. IF SUCH UNKNOWN UTILITIES ARE ENCOUNTERED AND WORK IS CONTINUED WITHOUT CONTACTING THE OWNER FOR INSTRUCTIONS, AND DAMAGE IS CAUSED TO SAID UTILITIES, CONTRACTOR SHALL REPAIR, AT HIS OWN EXPENSE, SUCH DAMAGE TO THE SATISFACTION OF THE OWNER AND THE UTILITY COMPANY.
7. INDICATE ON RECORD DRAWINGS WHERE THERE IS CONFLICT BETWEEN FIELD CONDITIONS AND DRAWINGS.

F. WHERE UTILITIES REQUIRE ADJUSTMENT OR RELOCATION TO CONSTRUCT THE WORK, AND THOSE UTILITIES ARE SHOWN ON THE DRAWINGS, RELOCATION OR ADJUSTMENT IS A PART OF THE WORK AND SHALL BE COMPLETED AT NO ADDITIONAL COST TO THE OWNER.

G. DEMOLISH AND COMPLETELY REMOVE FROM SITE EXISTING UNDERGROUND UTILITIES INDICATED TO BE REMOVED. COORDINATE WITH UTILITY COMPANIES TO SHUT OFF SERVICES IF LINES ARE ACTIVE.

1.05 SUBMITTALS

A. PROJECT RECORD DOCUMENTS: ACCURATELY RECORD ACTUAL LOCATIONS OF UTILITIES REMAINING BY HORIZONTAL DIMENSIONS, ELEVATIONS OR INVERTS, AND SLOPE GRADIENTS.

B. MATERIAL TEST REPORTS: FROM A QUALIFIED TESTING AGENCY INDICATING AND INTERPRETING TEST RESULTS FOR COMPLIANCE OF THE FOLLOWING WITH CLASSIFICATION ACCORDING TO ASTM D 2487 OF EACH SOIL MATERIAL PROPOSED FOR BACKFILL.

C. SAMPLES: SUBMIT SAMPLES OF ALL MATERIALS USED FOR OWNER'S REPRESENTATIVE'S APPROVAL WHEREVER SPECIFIED OR AS DIRECTED.

D. SUBMIT PROPOSED TARGET CEMENT CONTENT AND PRODUCTION DATA FOR SAND-CEMENT MIXTURE IN ACCORDANCE WITH REQUIREMENTS OF PARAGRAPH 2.3, MATERIALS QUALIFICATIONS.

1.06 QUALITY ASSURANCE

A. PRE-EXCAVATION CONFERENCE: CONDUCT CONFERENCE AT PROJECT SITE TO COMPLY WITH REQUIREMENTS IN DIVISION 1 SECTION "PROJECT MEETINGS."

B. CODES AND STANDARDS: PERFORM EARTHWORK COMPLYING WITH REQUIREMENTS OF AUTHORITIES HAVING JURISDICTION.

C. TESTING AND INSPECTION SERVICE: OWNER WILL EMPLOY A QUALIFIED INDEPENDENT GEOTECHNICAL ENGINEERING TESTING AGENCY TO CLASSIFY PROPOSED ON-SITE AND BORROW SOIL MATERIALS TO VERIFY THAT SOILS COMPLY

WITH SPECIFIED REQUIREMENTS AND TO PERFORM REQUIRED FIELD AND LABORATORY TESTING. CONTRACTOR RESPONSIBLE TO COORDINATE WITH THE TESTING AGENCY PRIOR TO START OF WORK REQUIRING TESTING SO AS TO MINIMIZE UNNECESSARY COST OR DELAYS TO THE PROJECT.

D. TESTING:
   1. OWNER WILL RETAIN AND PAY A QUALIFIED GEOTECHNICAL ENGINEER TO TAKE ALL FIELD SAMPLES AND DO ALL LABORATORY TESTING NECESSARY TO VERIFY COMPLIANCE OF THE WORK TO THESE SPECIFICATIONS OR AS REQUIRED BY CITY OR OTHER REGULATORY AGENCIES. THE GEOTECHNICAL ENGINEER SHALL SUBMIT RESULTS OF ALL TESTING DONE DURING THE COURSE OF THE WORK TO THE OWNER, ARCHITECT, AND CONTRACTOR.
   2. NOTIFY TESTING LAB A MINIMUM OF 48 HOURS IN ADVANCE OF THE TIME TESTING IS REQUIRED TO SATISFY REQUIREMENTS OF THIS SECTION.
   3. SHOULD TESTING SPECIFIED ABOVE SHOW WORK WHICH DOES NOT SATISFY THESE SPECIFICATIONS, THE CONTRACTOR SHALL PAY, THROUGH THE OWNER, FOR ALL ADDITIONAL TESTS REQUIRED TO DETERMINE THE EXTENT OF WORK THAT IS NOT SATISFACTORY AND FOR ALL ADDITIONAL TESTS NECESSARY TO DEMONSTRATE COMPLIANCE WITH THESE SPECIFICATIONS.
   4. ALL TESTS SHALL BE PERFORMED BY THE SOIL ENGINEER IN ACCORDANCE WITH ASTM D 1557, D1556, D2922, D3017, OR OTHER TEST METHOD SELECTED BY GEOTECHNICAL ENGINEER.

PART 2 – PRODUCTS

2.01 EARTH BACKFILL

A. EARTH BACKFILL SHALL BE NATIVE SOILS FREE OF DEBRIS, TRASH, ROCKS OVER 1-INCH IN DIAMETER AND OTHER OBJECTIONABLE MATERIAL.

2.02 CEMENT STABILIZED SAND BACKFILL

A. USE SAND-CEMENT MIXTURE PRODUCING MINIMUM UNCONFINED COMPRESSIVE STRENGTH OF 100 POUNDS PER SQUARE INCH (PSI) IN 48 HOURS.
   1. DESIGN WILL BE BASED ON STRENGTH SPECIMENS MOLDED IN ACCORDANCE WITH ASTM D 558 AT MOISTURE CONTENT WITHIN 3 PERCENT OF OPTIMUM AND WITHIN 4 HOURS OF BATCHING.
   2. DETERMINE MINIMUM CEMENT CONTENT FROM PRODUCTION DATA AND STATISTICAL HISTORY. PROVIDE NO LESS THAN 1.1 SACKS OF CEMENT PER TON OF DRY SAND.

B. CEMENT: TYPE I PORTLAND CEMENT CONFORMING TO ASTM C 150.

C. SAND: CLEAN, DURABLE SAND MEETING GRADING REQUIREMENTS FOR FINE AGGREGATES OF ASTM C 33, OR REQUIREMENTS FOR BANK SAND BELOW, AND THE FOLLOWING REQUIREMENTS:
   1. CLASSIFIED AS SW, SP, SW-SM, SP-SM, OR SM BY UNIFIED SOIL CLASSIFICATION SYSTEM OF ASTM D 2487.
   2. DELETERIOUS MATERIALS:
      a. CLAY LUMPS, ASTM C 142 - LESS THAN 0.5 PERCENT.
      b. LIGHTWEIGHT PIECES, ASTM C 123; LESS THAN 5.0 PERCENT.

c. ORGANIC IMPURITIES, ASTM C 40, COLOR NO DARKER THAN STANDARD COLOR.

3. PLASTICITY INDEX OF 4 OR LESS WHEN TESTED IN ACCORDANCE WITH ASTM D 4318.

D. ADD REQUIRED AMOUNT OF WATER AND MIX THOROUGHLY IN PUGMILL-TYPE MIXER. THIS MATERIAL CANNOT BE USED AFTER IT LOSES ITS MOISTURE CONTENT.

2.03 BANK SAND BACKFILL

A. DURABLE BANK RUN SAND CLASSIFIED AS SP, SW, OR SM BY UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487) MEETING FOLLOWING REQUIREMENTS:
1. LESS THAN 15 PERCENT PASSING NUMBER 200 SIEVE WHEN TESTED IN ACCORDANCE WITH ASTM D 1140. AMOUNT OF CLAY LUMPS OR BALLS MAY NOT EXCEED 2 PERCENT.
2. MATERIAL PASSING NUMBER 40 SIEVE SHALL MEET THE FOLLOWING REQUIREMENTS WHEN TESTED IN ACCORDANCE WITH ASTM D 4318: PI NOT EXCEEDING 7.

2.04 WATER

A. WATER USED FOR MIXING OR CURING SHALL BE REASONABLY CLEAN AND FREE OF OIL, SALT, ACID, ALKALI, SUGAR, VEGETABLE MATTER OR OTHER SUBSTANCES INJURIOUS TO THE FINISHED PRODUCT.

B. WATER SOURCES OTHER THAN THE LOCAL MUNICIPAL DOMESTIC WATER SUPPLY MUST BE APPROVED BY THE OWNER'S REPRESENTATIVE.

C. IF ONSITE RECLAIMED WATER SOURCES ARE USED, TANKS AND APPURTENANCES MUST BE CLEARLY MARKED WITH THE WORDS "NON-POTABLE" WATER.

PART 3 – EXECUTION

3.01 PREPERATION

A. INSPECTION
1. PRIOR TO PERFORMING THE WORK OF THIS SECTION, CAREFULLY INSPECT THE INSTALLED WORK OF ALL OTHER TRADES AND VERIFY THAT ALL SUCH WORK IS COMPLETE TO THE POINT WHERE WORK MAY PROPERLY COMMENCE.
2. VERIFY THAT SURVEY BENCH MARK AND INTENDED ELEVATIONS FOR THE WORK ARE AS INDICATED.
3. VERIFY EXISTING GRADES AND DIMENSIONS BEFORE STARTING ANY GRADING OPERATIONS.
4. VERIFY THAT WORK MAY PROCEED IN COMPLETE ACCORDANCE WITH THE DESIGN.
5. IN THE EVENT OF DISCREPANCY, IMMEDIATELY NOTIFY THE OWNER'S REPRESENTATIVE.

B. GENERAL
1. USE ALL MEANS NECESSARY TO CONTROL DUST ON OR NEAR THE SITE RESULTING FROM THE PERFORMANCE OF THE WORK. THOROUGHLY MOISTEN ALL SURFACES TO PREVENT DUST BEING A NUISANCE TO THE PUBLIC, ADJACENT

USES, AND CONCURRENT WORK ON SITE. MOISTURE LEVEL DURING COMPACTION OPERATIONS SHALL NOT EXCEED THAT AMOUNT AS SPECIFIED BY GEOTECHNICAL ENGINEER.

2. CONDUCT WORK SO AS TO AVOID INJURY TO PERSONS AND DAMAGE TO ADJACENT PROPERTY. PROVIDE APPROPRIATE SHORING, BRACING AND BARRIERS, INCLUDING LIGHT WHEN NECESSARY.
3. COORDINATE OPERATIONS WITH, AND PROVIDE ACCESS TO, THE GEOTECHNICAL ENGINEER OR DESIGNATED REPRESENTATIVE DURING DEMOLITION AND CONSTRUCTION FOR PURPOSES OF TESTING, INVESTIGATION AND INSPECTION.

C. PROTECT AND MAINTAIN BENCHMARKS AND SURVEY CONTROL POINTS FROM DISTURBANCE DURING CONSTRUCTION.

D. PROTECT EXISTING SITE IMPROVEMENTS TO REMAIN FROM DAMAGE DURING CONSTRUCTION. RESTORE DAMAGED IMPROVEMENTS TO THEIR ORIGINAL CONDITION, AS ACCEPTABLE TO OWNER.

E. LOCATE AND CLEARLY FLAG TREES AND VEGETATION TO REMAIN OR TO BE RELOCATED

F. 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.

3.02 EXCAVATION

A. GENERAL
1. ALL UTILITY TRENCHES SHALL BE CONSTRUCTED IN CONFORMANCE WITH OSHA TRENCH SAFETY STANDARDS.
2. SHEETING AND SHORING SHALL BE ACCOMPLISHED TO THE EXTENT NECESSARY TO MAINTAIN THE SIDES OF THE TRENCH IN A VERTICAL POSITION THROUGHOUT THE CONSTRUCTION PERIOD FOR TRENCHES FIVE (5) FEET IN DEPTH OR DEEPER. WHERE APPROVED, TRENCH SIDES MAY BE LAID BACK IN LIEU OF SHORING TO MEET OSHA SAFETY STANDARDS.
3. UTILITIES SHALL NOT BE CONSTRUCTED OR LAID IN A TRENCH IN THE PRESENCE OF WATER. ALL WATER SHALL BE REMOVED FROM THE TRENCH SUFFICIENTLY PRIOR TO THE LINE PLACING OPERATION TO INSURE A DRY, FIRM BED ON WHICH TO PLACE THE UTILITY LINE.
4. EXCAVATION IS UNCLASSIFIED AND INCLUDES EXCAVATION TO SUBGRADE ELEVATIONS REGARDLESS OF THE CHARACTER OF SURFACE AND SUBSURFACE CONDITIONS ENCOUNTERED, INCLUDING ROCK, SOIL MATERIALS, AND OBSTRUCTIONS.
    a. IF EXCAVATED MATERIALS INTENDED FOR FILL AND BACKFILL INCLUDE UNSATISFACTORY SOIL MATERIALS AND ROCK, REPLACE WITH SATISFACTORY SOIL MATERIALS.
    b. REMEDIAL WORK DUE TO OVER-EXCAVATION INCLUDING PROVISION OF SUITABLE AND STABLE BACKFILL MEETING THE DEGREE OF COMPACTION REQUIRED SHALL BE AT THE CONTRACTOR'S EXPENSE.
5. IF EXCAVATED MATERIALS OF A SUITABLE NATURE ARE NOT OF SUFFICIENT QUANTITY TO COMPLETE THE WORK, PROVIDE BORROW MATERIAL IN SUFFICIENT QUANTITY TO COMPLETE THE WORK AT NO ADDITIONAL COST TO THE OWNER.

6. DISPOSE OF EXCESS SATISFACTORY SOIL MATERIAL AND ALL UNSATISFACTORY SOIL MATERIAL AND ROCK OBTAINED FROM EXCAVATIONS IN ACCORDANCE WITH THE PROVISIONS OF THIS SECTION.
7. WHERE UTILITIES ARE IN FILL, COMPACT FILL MATERIAL TO 95% STANDARD PROCTOR MAXIMUM DRY DENSITY AT LEAST 12 INCHES ABOVE THE TOP OF THE PROPOSED UTILITY PRIOR TO EXCAVATION OF TRENCH.
8. WHERE INDICATED WIDTHS OF UTILITY TRENCHES ARE EXCEEDED, PROVIDE STRONGER PIPE, OR SPECIAL INSTALLATION PROCEDURES, AS REQUIRED BY THE OWNER'S REPRESENTATIVE. UNAUTHORIZED EXCAVATION, AS WELL AS REMEDIAL WORK, SHALL BE AT THE CONTRACTOR'S EXPENSE.

B. SEWER TRENCHES
1. FOR PIPE SIZES LESS THAN 30-INCHES IN DIAMETER, THE MINIMUM TRENCH WIDTH SHALL BE OUTSIDE DIAMETER OF PIPE PLUS 24-INCHES.
2. FOR PIPE SIZES 30-INCHES IN DIAMETER AND LARGER THE MINIMUM TRENCH WIDTH SHALL BE OUTSIDE DIAMETER OF PIPE PLUS-36 INCHES.
3. TRENCHES SHALL BE EXCAVATED TO A DEPTH AT LEAST 12-INCHES BELOW THE BARREL OF PIPE, AND THEN THE PIPE BEDDING AND BACKFILL SHALL BE PLACED AS SHOWN ON THE APPROPRIATE DETAILS CONTAINED WITHIN THE PLANS AND AS DESCRIBED IN PARAGRAPH 3.3 A. OF THIS SECTION.

C. EXCAVATION FOR MANHOLES, INLETS, TIE-IN TO EXISTING FACILITIES AND SIMILAR STRUCTURES SHALL BE SUFFICIENT TO LEAVE AT LEAST 12-INCHES CLEAR BETWEEN THE OUTER SURFACES AND THE EMBANKMENT OR SHEETING THAT MAY BE USED TO HOLD AND PROTECT THE BANKS. ANY OVER DEPTH EXCAVATION BELOW SUCH APPURTENANCES SHALL BE REFILLED WITH CEMENT STABILIZED SAND, AS DIRECTED, AT NO ADDITIONAL COST TO THE OWNER.

D. WATER LINE TRENCHES:
1. WATER LINES MUST BE A MINIMUM OF 4-FEET IN DEPTH FROM THE TOP OF PROPOSED GRADE TO THE TOP OF PIPE, UNLESS OTHERWISE SHOWN ON THE PLANS.
2. TRENCH WIDTH FOR WATER LINES SHALL BE A MINIMUM OF THE OUTSIDE PIPE DIAMETER PLUS 24-INCHES.
3. TRENCHES SHALL BE EXCAVATED TO A DEPTH OF AT LEAST 12-INCHES BELOW THE BARREL OF PIPE, AND THEN THE PIPE BEDDING AND BACKFILL SHALL BE PLACED AS SHOWN ON THE APPROPRIATE DETAILS CONTAINED WITHIN THE PLANS AND AS DESCRIBED IN PARAGRAPH 3.3 B. OF THIS SECTION.

3.03 PIPE BEDDING AND BACKFILL

A. STORM AND SANITARY SEWER TRENCHES:
1. PIPE SHALL BE BEDDED AND BACKFILLED IN TRENCH IN ACCORDANCE WITH THE DETAILS SHOWN ON THE PLANS.
2. CEMENT STABILIZED SAND BEDDING SHALL EXTEND FROM A POINT 12 INCHES BELOW THE BOTTOM OF THE PIPE TO THE LEVEL OF THE SPRING LINE. THE CEMENT STABILIZED SAND SHALL BE THOROUGHLY RODDED AFTER BEING PLACED IN TRENCH.
3. BEDDING, SEWER PIPE AND INITIAL BACKFILL OVER THE TOP OF PIPE MUST BE PLACED IN A SINGLE DAY'S OPERATION FOR ANY GIVEN PORTION OF PIPE. INITIAL BACKFILL SHALL BE PLACED TO 12-INCHES OVER THE TOP OF PIPE FOR CEMENT STABILIZED SAND BACKFILL.

4. BACKFILL SHALL BE PLACED IN UNIFORM LAYERS NOT TO EXCEED 8-INCH LOOSE DEPTH, AND COMPACTED TO A MINIMUM OF 95 PERCENT OF STANDARD MAXIMUM DENSITY (ASTM D 698) AT THE PROPER MOISTURE CONTENT SPECIFIED IN THE GEOTECHNICAL REPORT FOR THIS PROJECT.
5. BACKFILL, UNDER PAVEMENT AND TO 2-FOOT FROM OUTER EDGE, SHALL BE CEMENT STABILIZED SAND UP TO 1-FOOT BELOW SUBGRADE ELEVATION.

B. WATER LINE TRENCHES
1. PIPE SHALL BE BEDDED AND BACKFILLED IN TRENCH IN ACCORDANCE WITH THE DETAILS SHOWN ON THE PLANS.
2. BANK SAND BEDDING SHALL EXTEND FROM A POINT 12-INCHES BELOW THE BOTTOM OF THE PIPE TO THE LEVEL OF THE SPRING LINE. THE BANK SAND SHALL BE THOROUGHLY RODDED AFTER BEING PLACED IN TRENCH.
3. BEDDING, SEWER PIPE AND INITIAL BACKFILL OVER THE TOP OF PIPE MUST BE PLACED IN A SINGLE DAY'S OPERATION FOR ANY GIVEN PORTION OF PIPE. INITIAL BACKFILL SHALL BE PLACED TO 12-INCHES OVER THE TOP OF PIPE FOR BANK SAND BACKFILL.
4. BACKFILL SHALL BE PLACED IN UNIFORM LAYERS NOT TO EXCEED 8-INCH LOOSE DEPTH, AND COMPACTED TO A MINIMUM OF 95 PERCENT OF STANDARD MAXIMUM DENSITY (ASTM D 698) AT THE PROPER MOISTURE CONTENT SPECIFIED IN THE GEOTECHNICAL REPORT FOR THIS PROJECT.
5. BACKFILL, UNDER PAVEMENT AND TO 2-FOOT FROM OUTER EDGE, SHALL BE CEMENT STABILIZED SAND UP TO 1-FOOT BELOW SUBGRADE ELEVATION.

C. BENTONITE CLAY PLUG FOR ALL UTILITY TRENCHES (WATER, STORM, SANITARY, MECHANICAL, ELECTRICAL, TELECOM, PLUMPING, ETC.)
1. ALL TRENCHES MUST HAVE A BENTONITE GRANULAR CLAY PLUG INSTALLED TO REDUCE THE TRANSMISSION OF GROUND WATER UNDER SLAB ON GRADE BUILDINGS AND STRUCTURAL FIRST FLOOR BUILDINGS.
    a. THE PLUG MUST BE INSTALLED AT A DISTANCE OF 1-FOOT BEYOND THE FACE OF THE BUILDING FOUNDATION AND BE A MINIMUM OF 1-FOOT WIDE.
    b. THE PLUG MUST EXTEND 6-INCHES BENEATH UTILITY TRENCH INTO UNDISTURBED SOIL. THIS PORTION OF THE CLAY PLUG MUST BE INSTALLED PRIOR TO THE INSTALLATION OF THE UTILITY PIPE.
    c. THE PLUG MUST EXTEND ACROSS THE ENTIRE TRENCH WIDTH AND EXTEND 6-INCHES INTO UNDISTURBED SOIL BEYOND THE TRENCH WIDTH. INSTALL BENTONITE CLAY PLUG AND THE UTILITY PIPE AT THE SAME TIME.
    d. THE PLUG MUST EXTEND TO WITHIN 12-INCHES OF FINISHED GRADE. A CLAY PLUG CAP CONSISTING OF MATERIAL WITH A PI GREATER THAN 15 AND A LL IN EXCESS OF 30 SHALL BE PLACED ON TOP OF THE BENTONITE GRANULAR CLAY PLUG. THIS CLAY PLUG CAP SHALL FILL THE REMAINING 12-INCHES UP TO FINISHED GRADE AND BE PLACED UP TO THE EDGE OF THE BUILDING.

3.04 STORAGE OF SOIL MATERIALS

A. STOCKPILE BORROW MATERIALS AND SATISFACTORY EXCAVATED SOIL MATERIALS. STOCKPILE SOIL MATERIALS WITHOUT INTERMIXING. PLACE, GRADE, AND SHAPE STOCKPILES TO DRAIN SURFACE WATER. COVER TO PREVENT WINDBLOWN DUST.

B. STOCKPILE SOIL MATERIALS AWAY FROM EDGE OF EXCAVATIONS. DO NOT STORE WITHIN DRIP LINE OF REMAINING TREES.

C. STOCKPILE TOPSOIL MAY NOT EXCEED 6 FEET IN HEIGHT.

3.05 FIELD QUALITY CONTROL

A. TESTING SHALL BE THE RESPONSIBILITY OF THE OWNER AND COSTS OF INITIAL TESTING SHALL BE PAID BY OWNER. COST OF ALL SUBSEQUENT TESTING NECESSARY DUE TO NON-COMPLIANCE WITH SPECIFICATIONS SHALL BE PAID BY CONTRACTOR.

B. DENSITY TEST:
   1. FREQUENCY AND SCOPE OF TESTING SHALL BE ESTABLISHED BY GEOTECHNICAL ENGINEER, AND AS REQUIRED BY LOCAL JURISDICTIONAL AUTHORITY. IF GEOTECHNICAL ENGINEER HAS NOT ESTABLISHED A FREQUENCY OF TESTING IN THE GEOTECHNICAL REPORT, TESTING SHALL BE AT EVERY 100 LINEAR FOOT OF TRENCH AT A MINIMUM OF ONE PER LIFT AND A MINIMUM OF ONE PER DAY.
   2. TESTS SHALL BE PERFORMED IN ACCORDANCE WITH THE REFERENCED STANDARDS.
   3. LABORATORY TESTS FOR MOISTURE DENSITY RELATIONS SHALL BE DETERMINED IN ACCORDANCE WITH ASTM D 1557. A MINIMUM OF ONE TEST SHALL BE PERFORMED FOR EACH MAJOR SOILS TYPE. IN ADDITION, SUFFICIENT NUMBER OF RETESTS OR CHECK POINTS SHALL BE PERFORMED TO EVALUATE ACCURACY OF MAXIMUM DENSITY VALUES BEING USED.
   4. FIELD IN-PLACE DENSITY SHALL BE DETERMINED IN ACCORDANCE WITH ASTM TEST METHODS D 1556 OR D 2922, AND THE MOISTURE-DENSITY RELATIONS SHALL BE DETERMINED IN ACCORDANCE WITH ASTM TEST METHOD D 1557.
   5. REOPEN IMPROPERLY COMPACTED TRENCHES TO DEPTH DIRECTED, THEN REFILL AND COMPACT TO THE SPECIFIED DENSITY AT NO ADDITIONAL COST TO OWNER

3.06 DRAINAGE CONTROLS

A. PROVIDE ALL NECESSARY TEMPORARY APPARATUS, PUMPS, CURBS OR DITCHES AS REQUIRED TO DIVERT OR CONVEY WATER FROM ANY SOURCE AWAY FROM THE WORK. DO NOT ALLOW WATER FROM ANY SOURCE TO ACCUMULATE WITHIN OR DAMAGE TRENCHES.

END OF SECTION 31 22 13

SECTION 31 31 16

TERMITE CONTROL

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
1. Soil treatment - partial treatment of soil below slab.

1.02 DEFINITIONS

1. EPA: Environmental Protection Agency.
2. IPM: Integrated Pest Management. It is the policy of the Owner to use Integrated Pest Management (IPM) as the strategy for control of termites in and around Owner's facilities.
3. PCO: Pest control operator.
4. SPCS: Structural Pest Control Service.

1.03 ACTION SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: For each type of product.
1. Include material descriptions, Material Safety Data Sheets (MSDS), and profiles for termite control products.
2. Include the EPA-Registered Label for termiticide products.
3. Classification of Termiticide: Indicate as green listed product as recognized by the Texas Department of Agriculture "Structural Pest Control Service".

1.04 INFORMATIONAL 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. Product Data:
1. Treatments and application instructions, including EPA-Registered Label.
2. Material Safety Data Sheets (MSDS).
3. Classification of Termiticide: Indicate as green listed, yellow listed, or red listed product as recognized by the TDA SPCS.
4. Concurrent with submission of product data to Architect, provide one copy of the submittal to Owner.
5. Proposed termiticides must be approved by the Owner prior to the start of any preparation or application.

C. Product Certificates: For each type of termite control product. Signed by manufacturers of termite control products certifying that treatments furnished comply with requirements.

D. Soil Treatment Application Report: After application of termiticide is completed, submit report for Owner's records and include the following:
   1. Date and time of application.
   2. Moisture content of soil before application.
   3. Termiticide brand name and manufacturer.
   4. Quantity of undiluted termiticide used.
   5. Dilutions, methods, volumes used, and rates of application.
   6. Areas of application.
   7. Water source for application.

E. Sample Warranties: For special warranties.

1.05 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.

C. Conform with all applicable codes and ordinances including the Federal Insecticide, Fungicide, and Rodenticide Act (7 United Sates Code 136 et seq.); Owner policies and procedures; Environmental Protection Agency regulations in 40 Code of Federal Regulations; Occupational Safety and Health Administration regulations; and state and local regulations.

D. Conform with approved termiticide list criteria established by the TDA SPCS

E. The State of Texas Structural Pest Control Service (SPCS) Coordinator suggest that you visit the following web page for up to date information, forms and resources for education and information on the topic, at the following web pages. “Approval for Yellow and Red List Products” Form is available at the first link.
   1. http://www.texasagriculture.gov/RegulatoryPrograms/Pesticides/StructuralPestControlService/SchoolIntegratedPestManagement/SchoolIPMForms.aspx
   2. www.TexasAgriculture.gov/spcs

1.06 FIELD CONDITIONS

A. Soil Treatment:
   1. 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 requirements of the EPA-Registered Label and requirements of authorities having jurisdiction.
   2. Related Work: Coordinate soil treatment application with excavating, filling, grading, and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs before construction.
   3. Conform with all applicable codes and ordinances including the Federal Insecticide, Fungicide, and Rodenticide Act (7 United Sates Code 136 et seq.); Owner policies and procedures; Environmental Protection Agency regulations in 40 Code of Federal Regulations; Occupational Safety and Health Administration regulations; and state and local regulations.

4. Conform with approved termiticide list criteria established by the Texas Structural Pest Control Service.

1.07 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.

1.08 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. 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, including Formosan termites (Coptotermes formosanus). If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.

C. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Source Limitations: Obtain termite control products from single source.

2.02 GENERAL

A. Criteria established in the most recent TDA SPCS definitions of these products.
   1. Green List. All products must be from the following: inorganic termiticides (i.e., boric acid, disodium octoborate tetrahydrate, silica gels, diatomaceous earth); insect growth regulators; insect baits in tamper-resistant containers or for crack and crevice placement only; microbe-based insecticides; botanical insecticides (not including synthetic pyrethroids) containing not more than 5% synergists; biological (living) control agents.
   2. Yellow List. All EPA Category III and IV termiticides (i.e., products carrying a CAUTION signal word) not included in the Green List, with the exception of restricted-use or state limited-use termiticides as defined under the Federal Insecticide, Fungicide, and Rodenticide Act and/or the Texas Agricultural Code.
   3. Red List. All Category I and II termiticides (i.e., products carrying a WARNING or DANGER signal word), not included in the Green List, or restricted-use termiticides, or state limited-use termiticides as defined under the Federal Insecticide, Fungicide, and Rodenticide Act and/or the Texas Agricultural Code.

2.03 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.

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the Work include the following:
   a. BASF Corporation 800-777-8570 http://pestcontrol.basf.us/
   b. Bayer Corp., Garden & Professional Care 800-842-8020 https://www.bayer.com/en/
   c. Dow AgroScience LLC 317-337-3000 https://www.dow.com/en-us.html
   d. FMC Corp.; Pest Control Specialties 312-861-6000 https://www.fmcprosolutions.com/en
   e. Syngenta Global www2.syngenta.com
   f. Substitutions: Section 01 60 00 - Product Requirements.
2. Service Life of Treatment: Soil treatment termiticide that is effective for not less than five years against infestation of subterranean termites.
3. Highest priority shall be given to use of products on the Green Lists, according to the criteria established in the most recent Texas Structural Pest Control Service definitions of these products. Pesticide Use in School Districts is described in detail at the web site (same web site as above last website in paragraph [1.5-C]): http://texreg.sos.state.tx.us/public/readtac$ext.TacPage?sl=R&app=9&p_dir=&p_rloc=&p_tloc=&p_ploc=&pg=1&p_tac=&ti=4&pt=1&ch=7&rl=204
   a. Green List. 1) All active ingredients belonging to EPA toxicity categories III and IV, 2) Products carry a CAUTION signal word if required by EPA, 3) All products must be from the following: inorganic termiticides (i.e., boric acid, disodium octoborate tetrahydrate, silica gels, diatomaceous earth); insect growth regulators; insect baits in tamper-resistant containers or for crack and crevice placement only; microbe-based insecticides; botanical insecticides (not including synthetic pyrethroids) containing not more than 5% synergists; biological (living) control agents.
   b. Yellow List. All EPA Category III and IV termiticides (i.e., products carrying a CAUTION signal word) not included in the Green List, with the exception of restricted-use or state limited-use termiticides as defined under the Federal Insecticide, Fungicide, and Rodenticide Act and/or the Texas Agricultural Code. Fill out form at end of this section and found on web page:
      1) http://www.texasagriculture.gov/Portals/0/forms/PEST/Structural/approvalforredyellow.pdf
   c. Red List. All Category I and II termiticides (i.e., products carrying a WARNING or DANGER signal word), not included in the Green List, or restricted-use termiticides, or state limited-use termiticides as defined under the Federal Insecticide, Fungicide, and Rodenticide Act and/or the Texas Agricultural Code. Fill out form at end of this section and found on web page:
      1) http://www.texasagriculture.gov/Portals/0/forms/PEST/Structural/approvalforredyellow.pdf

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of soil per termiticide label, interfaces with earthwork, slab and foundation work, landscaping, utility installation, and other conditions affecting performance of termite control.

B. Proceed with application only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. General: Prepare work areas according to the requirements of authorities having jurisdiction and according to manufacturer's written instructions before beginning application and installation of termite control treatment(s). Remove 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 within 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 in writing by termiticide manufacturer.

C. Fit filling hose connected to water source at the site with a backflow preventer, according to requirements of authorities having jurisdiction.

3.03 APPLYING SOIL TREATMENT

A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's EPA-Registered Label for products.

B. Notify the SPCS and the Owner’s IPM Coordinator no less than four (4) hours prior to the start of any termiticide application. Comply with all SPCS notification requirements. Payment will not be made for applications where the aforementioned notification requirements have not been fulfilled.

C. Applications shall be completed no less than seven days prior to initial occupancy of the structure, or as otherwise indicated on the termiticide label, whichever is longer.]

D. Application: All areas of the building(s) foundation(s)shall be treated, unless otherwise indicated. The treatment shall be a “Full Treatment”. Mix soil treatment termiticide solution to a uniform consistency. Distribute treatment uniformly. Apply treatment at the product's EPA-Registered Label volume and rate for maximum specified concentration of termiticide to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction. Apply Green List products only.

1. 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.
2. Foundations: Soil adjacent to and along the entire inside perimeter of foundation walls; along both sides of interior partition walls; around plumbing pipes and electric conduit penetrating the slab; around interior column footers, piers, and chimney bases; and along the entire outside perimeter, from grade to bottom of footing.
3. Penetrations: At expansion joints, control joints, and areas where slabs and below-grade walls will be penetrated.

E. Post warning signs in areas of application.

F. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

G. Return to the site to trench and treat the perimeter of the building(s) foundation(s) after final grading and landscaping are completed.

3.04 PROTECTION

A. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.

B. Protect termiticide solution dispersed in treated soils and fills from being diluted by exposure to water spillage or weather until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.

C. Post warning signs in areas of application as required for Commercial Treatment.

D. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

3.05 MAINTENANCE SERVICE

A. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of termite-control-treatment Installer. Include semiannual maintenance as required for proper performance according to the product's EPA-Registered Label and manufacturer's written instructions. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

B. Continuing Maintenance Proposal: Provide from termite-control-treatment Installer to Owner, in the form of a standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

1. Include annual inspection for termite activity and effectiveness of termite treatment according to manufacturer's written instructions.

END OF SECTION 31 31 16

SECTION 31 32 13.19 – LIME STABILIZATION

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. THIS SECTION SPECIFIES THE REQUIREMENTS FOR TREATING AND STABILIZING EXISTING SUBGRADE MATERIAL OR SELECT FILL MATERIAL UNDER PAVEMENTS OR SITE STRUCTURES AS SHOWN ON THE DRAWINGS, BY PULVERIZING, ADDING LIME, AND FINISHING TO THE LINES AND GRADES SHOWN ON THE DRAWINGS AND CONSTRUCTED AS SPECIFIED HEREIN.

1.02 DEFINITIONS

A. SUBGRADE: THE UPPERMOST SURFACE OF AN EXCAVATION, INCLUDING EXCAVATION FOR TRENCHES, OR THE TOP SURFACE OF A FILL OR BACKFILL IMMEDIATELY BELOW BASE COURSE, PAVEMENT, OR TOPSOIL MATERIALS.

B. BACKFILL: SOIL MATERIAL OR CONTROLLED LOW-STRENGTH MATERIAL USED TO FILL AN EXCAVATION.

C. BASE COURSE: THE LAYER PLACED BETWEEN THE SUBGRADE AND SURFACE PAVEMENT IN A PAVING SYSTEM.

D. GEOTECHNICAL ENGINEER: PERSON OR COMPANY CONTRACTED BY THE OWNER AND/OR THROUGH THE ARCHITECT TO PROVIDE TESTING AND ONSITE GEOTECHNICAL SERVICES DURING THE CONSTRUCTION SCHEDULE.

E. MOIST CURE: CURING SOIL AND LIME TO OBTAIN OPTIMUM HYDRATION.

1.03 REGULATORY REQUIREMENTS

A. CONTRACTOR SHALL COMPLY WITH ALL CURRENT, APPLICABLE CODES AND REGULATIONS.

B. CONTRACTOR SHALL COMPLY WITH ALL STANDARD SPECIFICATIONS AND DETAILS OF AUTHORITIES HAVING JURISDICTION FOR WORK IN THE RIGHT-OF-WAY OR EASEMENTS.

C. PRIOR TO COMMENCEMENT OF WORK, THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING, AT THE CONTRACTOR'S OWN EXPENSE, ALL CONSTRUCTION PERMITS NECESSARY TO COMPLETE THE PROJECT ACCORDING TO THE PLANS AND SPECIFICATIONS.

1.04 SUBMITTALS

A. SUBMIT CERTIFICATION THAT HYDRATED LIME, QUICKLIME, OR COMMERCIAL LIME SLURRY COMPLIES WITH SPECIFICATIONS.

B. SUBMIT WEIGHT TICKETS, CERTIFIED BY SUPPLIER, WITH EACH BULK DELIVERY OF LIME TO WORK SITE.

1.05 QUALITY ASSURANCE

A. OWNER WILL EMPLOY A QUALIFIED INDEPENDENT GEOTECHNICAL ENGINEERING TESTING AGENCY TO CLASSIFY PROPOSED ON-SITE AND BORROW SOIL MATERIALS TO VERIFY THAT SOILS COMPLY WITH SPECIFIED REQUIREMENTS AND TO PERFORM REQUIRED FIELD AND LABORATORY TESTING. CONTRACTOR RESPONSIBLE TO COORDINATE WITH THE TESTING AGENCY PRIOR TO START OF WORK REQUIRING TESTING SO AS TO MINIMIZE UNNECESSARY COST OR DELAYS TO THE PROJECT.

B. TESTING:
   1. OWNER WILL RETAIN AND PAY A QUALIFIED GEOTECHNICAL ENGINEER TO TAKE ALL FIELD SAMPLES AND DO ALL LABORATORY TESTING NECESSARY TO VERIFY COMPLIANCE OF THE WORK TO THESE SPECIFICATIONS OR AS REQUIRED BY CITY OR OTHER REGULATORY AGENCIES. THE GEOTECHNICAL ENGINEER SHALL SUBMIT RESULTS OF ALL TESTING DONE DURING THE COURSE OF THE WORK TO THE OWNER, ARCHITECT, AND CONTRACTOR.
   2. NOTIFY TESTING LAB A MINIMUM OF 48 HOURS IN ADVANCE OF THE TIME TESTING IS REQUIRED TO SATISFY REQUIREMENTS OF THIS SECTION.
   3. SHOULD TESTING SPECIFIED ABOVE SHOW WORK WHICH DOES NOT SATISFY THESE SPECIFICATIONS, THE CONTRACTOR SHALL PAY, THROUGH THE OWNER, FOR ALL ADDITIONAL TESTS REQUIRED TO DETERMINE THE EXTENT OF WORK THAT IS NOT SATISFACTORY AND FOR ALL ADDITIONAL TESTS NECESSARY TO DEMONSTRATE COMPLIANCE WITH THESE SPECIFICATIONS.
   4. ALL TESTS SHALL BE PERFORMED BY THE GEOTECHNICAL ENGINEER IN ACCORDANCE WITH ASTM D 698, D1556, OR OTHER TEST METHOD SELECTED BY GEOTECHNICAL ENGINEER.

PART 2 – PRODUCTS

2.01 LIME SLURRY

A. LIME SLURRY FOR USE IN TREATING THE SUBGRADE SHALL CONFORM TO THE CHEMICAL AND PHYSICAL REQUIREMENTS LISTED IN TABLES 1 AND 2 OF TXDOT DEPARTMENTAL MATERIAL SPECIFICATION (DMS) 6350 FOR COMMERCIAL LIME SLURRY. LIME SLURRY MAY BE PREPARED AT THE JOB SITE OR OTHER OWNER APPROVED LOCATION BY USING HYDRATED LIME OR QUICKLIME AS SPECIFIED BY CHEMICAL AND PHYSICAL REQUIREMENTS IN TABLES 1 AND 2 OF TXDOT DEPARTMENTAL MATERIAL SPECIFICATIONS (DMS) 6350.

2.02 WATER

A. WATER USED FOR MIXING OR CURING SHALL BE REASONABLY CLEAN AND FREE OF OIL, SALT, ACID, ALKALI, SUGAR, VEGETABLE MATTER OR OTHER SUBSTANCES INJURIOUS TO THE FINISHED PRODUCT.

B. WATER SOURCES OTHER THAN THE LOCAL MUNICIPAL DOMESTIC WATER SUPPLY MUST BE APPROVED BY THE OWNER'S REPRESENTATIVE.

C. IF ONSITE RECLAIMED WATER SOURCES ARE USED, TANKS AND APPRENTICES MUST BE CLEARLY MARKED WITH THE WORDS "NON-POTABLE" WATER.

2.03 SOIL

A. SOIL SHOULD BE A CLAYEY TYPE SOIL, FREE OF ORGANIC MATERIAL, LARGE ROCKS AND OTHER UNSUITABLE MATERIALS WITH A PLASTICITY INDEX

GREATER THAN 15 AND A LIQUID LIMIT IN EXCESS OF 30. THE SOIL SHOULD NOT CONTAIN MORE THAN TWENTY PERCENT SANDS OR SILTS.

B. WHERE EXISTING PAVEMENT OR BASE MATERIAL IS ENCOUNTERED, PULVERIZED OR SCARIFY MATERIAL SO THAT 100 PERCENT OF SAMPLED MATERIAL PASSES 2-INCH SIEVE.

PART 3 – EXECUTION

3.01 PREPERATION

A. PROTECT STRUCTURES, UTILITIES, SIDEWALKS, PAVEMENTS, AND OTHER FACILITIES FROM DAMAGE AND DISPLACEMENT.

B. VERIFY COMPACTED SUBGRADE WILL SUPPORT IMPOSED LOADS.

C. VERIFY SUBGRADE LINES AND GRADES.

D. COMPLETE BACKFILL OF UTILITIES PRIOR TO STABILIZATION.

E. CUT MATERIAL TO BOTTOM OF SUBGRADE USING AN APPROVED CUTTING AND PULVERIZING MACHINE MEETING FOLLOWING REQUIREMENTS:
   1. CUTTERS ACCURATELY PROVIDE SMOOTH SURFACE OVER ENTIRE WIDTH OF CUT TO PLANE OF SECONDARY GRADE.
   2. PROVIDE CUT TO DEPTH AS SPECIFIED OR SHOWN IN THE DRAWINGS.

F. ALTERNATIVELY, SCARIFY OR EXCAVATE TO BOTTOM OF STABILIZED SUBGRADE. REMOVE MATERIAL OR WINDROW TO EXPOSE SECONDARY GRADE. OBTAIN UNIFORM STABILITY.

G. CORRECT WET OR UNSTABLE MATERIAL BELOW SECONDARY GRADE BY SCARIFYING, ADDING LIME, AND COMPACTING AS DIRECTED BY THE OWNER'S REPRESENTATIVE, AT NO ADDITIONAL COST TO THE OWNER.

H. PULVERIZE EXISTING MATERIAL SO THAT 100 PERCENT PASSES A 1-3/4-INCH SIEVE.

3.02 APPLICATION

A. THE PERCENT OF LIME TO THE DRY WEIGHT OF THE SOIL SHALL BE AS SHOWN ON THE DRAWINGS.

B. THE LIME SHALL BE MIXED WITH WATER IN TRUCKS WITH APPROVED DISTRIBUTORS AND APPLIED AS A THIN WATER SUSPENSION OR SLURRY.

C. APPLY SLURRY WITH DISTRIBUTOR TRUCK EQUIPPED WITH AN AGITATOR TO KEEP LIME AND WATER IN CONSISTENT MIXTURE. THE DISTRIBUTION OF LIME SHALL BE UNIFORMLY PLACED IN SUCH QUANTITY THAT ALL SOIL TO BE TREATED RECEIVES THE MINIMUM PERCENTAGE OF LIME AND SUCCESSIVE PASSES MADE UNTIL THE PROPER MOISTURE AND LIME CONTENT IS OBTAINED. LIMIT SPREADING TO AN AREA WHERE PRELIMINARY MIXING OPERATIONS CAN BE COMPLETED ON SAME WORKING DAY.

3.03 MIXING

A. DO NOT EXPOSE HYDRATED LIME TO OPEN AIR FOR 6 HOURS OR MORE DURING INTERVAL BETWEEN APPLICATION AND MIXING. AVOID EXCESSIVE HYDRATED LIME LOSS DUE TO WASHING OR BLOWING.

B. THE MATERIAL AND LIME SHALL BE THOROUGHLY MIXED BY APPROVED ROAD MIXERS UNTIL A HOMOGENEOUS, FRIABLE MIXTURE OF MATERIAL AND LIME IS OBTAINED, FREE FROM ALL CLODS OR LUMPS.

C. IMMEDIATELY AFTER THE "FIRST MIXING" OPERATION, THE MIXTURE SHALL BE BROUGHT TO THE PROPER MOISTURE CONTENT AND SEALED WITH A LIGHT PNEUMATIC RUBBER TIRE ROLLER AND LEFT TO CURE FOR 1 TO 4 DAYS, AS DIRECTED BY THE OWNER'S REPRESENTATIVE. IF REWORK IS REQUIRED TO OBTAIN COMPACTION AFTER 72 HOURS OF THE LAST MIXING, ADD 25% OF THE SPECIFIED RATE OF LIME.

D. AFTER CURING TIME ADD WATER TO BRING MOISTURE CONTENT OF SOIL MIXTURE TO OPTIMUM OR ABOVE. MIX AND PULVERIZE UNTIL ALL MATERIAL PASSES 13/4-INCH SIEVE; MINIMUM OF 85 PERCENT, EXCLUDING NON-SLACKING FRACTIONS, PASSES 3/4-INCH SIEVE; AND MINIMUM OF 60 PERCENT EXCLUDING NON-SLACKING FRACTIONS PASSES NO. 4 SIEVE. TEST ACCORDING TO TXDOT TEX-101-E, PART III USING DRY METHOD. ALL CLODS SHALL BE REDUCED IN SIZE BY RAKING, BLADING, DISKING, HARROWING, SCARIFYING OR OTHER APPROVED METHOD.

E. SHAPE MIXED SUBGRADE TO FINAL LINES AND GRADES.

3.04 COMPACTION

A. COMPACTION OF THE MIXTURE SHALL BEGIN IMMEDIATELY AFTER FINAL MIXING AND IN NO CASE LATER THAN 3 CALENDAR DAYS AFTER FINAL MIXING.

B. AERATE OR SPRINKLE TO ATTAIN OPTIMUM MOISTURE CONTENT TO 3 PERCENT ABOVE OPTIMUM, AS DETERMINED BY ASTM D 698 ON MATERIAL SAMPLE AFTER FINAL MIX WITH LIME.

C. SPREAD AND COMPACT IN TWO OR MORE EQUAL LAYERS WHERE TOTAL COMPACTED THICKNESS IS GREATER THAN EQUIPMENT MANUFACTURER'S RECOMMENDED RANGE OF MIXING AND COMPACTION.

D. COMPACT WITH APPROVED HEAVY PNEUMATIC OR VIBRATING ROLLERS, OR COMBINATION OF TAMPING ROLLERS AND LIGHT PNEUMATIC ROLLERS. BEGIN COMPACTION AT BOTTOM AND CONTINUE UNTIL ENTIRE DEPTH IS UNIFORMLY COMPACTED.

E. DO NOT ALLOW STABILIZED SUBGRADE TO MIX WITH UNDERLYING MATERIAL. CORRECT IRREGULARITIES OR WEAK SPOTS IMMEDIATELY BY REPLACING MATERIAL AND RECOMPACTING.

F. COMPACT SUBGRADE TO MINIMUM DENSITY OF 95 PERCENT OF MAXIMUM DRY DENSITY, ACCORDING TO ASTM D 698, AT MOISTURE CONTENT OF OPTIMUM TO 3 PERCENT ABOVE OPTIMUM, UNLESS OTHERWISE INDICATED ON DRAWINGS.

G. SEAL WITH APPROVED LIGHT PNEUMATIC TIRED ROLLERS. PREVENT SURFACE HAIR LINE CRACKING. REWORK AND RECOMPACT AT AREAS WHERE HAIRLINE CRACKING DEVELOPS.

3.05 CURING

A. MOIST CURE FOR MINIMUM OF 3 DAYS BEFORE PLACING BASE OR SURFACE COURSE, OR OPENING TO TRAFFIC. SUBGRADE MAY BE OPENED TO TRAFFIC AFTER 2 DAYS WHEN ADEQUATE STRENGTH HAS BEEN ATTAINED TO PREVENT DAMAGE. RESTRICT TRAFFIC TO LIGHT PNEUMATIC ROLLERS OR VEHICLES WEIGHING LESS THAN 10 TONS.

B. KEEP SUBGRADE SURFACE DAMP BY SPRINKLING. ROLL WITH LIGHT PNEUMATIC ROLLER TO KEEP SURFACE KNIT TOGETHER.

C. PLACE BASE OR SURFACE WITHIN 14 DAYS AFTER FINAL MIXING AND COMPACTION. RESTART COMPACTION AND MOISTURE CONTENT OF BASE MATERIAL WHEN TIME IS EXCEEDED.

3.06 TOLERANCES

A. SURFACE OF THE SUBGRADE SHALL NOT SHOW ANY DEVIATION IN EXCESS OF 1/4 INCH ABOVE OR ONE INCH BELOW ESTABLISHED SUBGRADE ELEVATION. THICKNESS OF THE FINISHED SUBGRADE SHALL BE AT LEAST THE THICKNESS SHOWN ON THE PLANS WITHIN ¼ INCH TOLERANCE AND CAN EXCEED THE THICKNESS SHOWN ON THE PLANS AS NEEDED TO MEET THE NEEDS OF THE PROJECT.

B. THE SURFACE SHALL BE UNIFORM AND SMOOTH WITHOUT LARGE CLUMPS OR VOIDS.

3.07 FIELD QUALITY CONTROL

A. TESTING SHALL BE THE RESPONSIBILITY OF OWNER AND COSTS OF INITIAL TESTING WILL BE PAID BY OWNER. COST OF SUBSEQUENT TESTING NECESSARY DUE TO NON-COMPLIANCE WITH SPECIFICATIONS SHALL BE PAID BY CONTRACTOR.

B. TEST SOILS, LIME, AND MIXTURES AS FOLLOWS:
   1. TESTS AND ANALYSIS OF SOIL MATERIALS WILL BE PERFORMED IN ACCORDANCE WITH ASTM D 4318, USING THE WET PREPARATION METHOD.
   2. SAMPLING AND TESTING OF LIME SLURRY SHALL BE IN ACCORDANCE WITH TXDOT TEX-600-J, EXCEPT USING A LIME SLURRY CUP.
   3. SAMPLE MIXTURES OF HYDRATED LIME OR QUICKLIME IN SLURRY FORM WILL BE TESTED TO ESTABLISH COMPLIANCE WITH SPECIFICATIONS.
   4. MOISTURE-DENSITY RELATIONSHIP WILL BE ESTABLISHED ON MATERIAL SAMPLED FROM ROADWAY, AFTER STABILIZATION WITH LIME AND FINAL MIXING, IN ACCORDANCE WITH ASTM 698, MOIST PREPARATION METHOD.

C. IN-PLACE DEPTH WILL BE EVALUATED FOR EACH 5,000-SQUARE FEET OF SUBGRADE AND DETERMINED IN ACCORDANCE WITH TXDOT TEX-140-E IN HAND EXCAVATED HOLES. FOR EACH 5,000-SQUARE FEET OF SUBGRADE, 3 PHENOLPHTHALEIN TESTS WILL BE PERFORMED. AVERAGE STABILIZATION DEPTH FOR 5,000-SQUARE FEET OF SUBGRADE WILL BE BASED ON AVERAGE DEPTH FOR THREE TESTS.

D. PERFORM COMPACTION TESTING IN ACCORDANCE WITH ASTM D 2922. THREE TESTS WILL BE PERFORMED FOR EACH 5,000-SQUARE FEET OF SUBGRADE.

E. PULVERIZATION ANALYSIS WILL BE PERFORMED AS REQUIRED BY PARAGRAPH 3.03D ON MATERIAL SAMPLED DURING MIXING OF EACH PRODUCTION AREA. THREE TESTS WILL BE PERFORMED PER 5,000-SQUARE FEET OF SUBGRADE OR A MINIMUM OF ONCE DAILY.

3.08 REWORK OF FAILED SECTIONS

A. REWORK SECTIONS THAT DO NOT MEET SPECIFIED THICKNESS.

B. PERFORM THE FOLLOWING STEPS WHEN MORE THAN 72 HOURS HAVE LAPSED SINCE COMPLETION OF COMPACTION.
   1. MOIST CURE FOR MINIMUM OF 3 DAYS AFTER COMPACTION TO REQUIRED DENSITY.
   2. ADD LIME AT RATE OF 25 PERCENT OF SPECIFIED RATE AT NO ADDITIONAL COST TO CITY.
   3. MOISTURE DENSITY TEST OF REWORKED MATERIAL MUST BE COMPLETED BY LABORATORY BEFORE FIELD COMPACTION TESTING CAN BE COMPLETED.

3.09 PROTECTION

A. MAINTAIN STABILIZED SUBGRADE TO LINES AND GRADES AND IN GOOD CONDITION UNTIL PLACEMENT OF BASE OR SURFACE COURSE. PROTECT ASPHALT MEMBRANE FROM BEING PICKED UP BY TRAFFIC.

B. REPAIR DEFECTS IMMEDIATELY BY REPLACING MATERIAL TO FULL DEPTH.

END OF SECTION 31 32 13.19

SECTION 31 32 13.26 – LIME-FLY ASH OR FLY ASH STABILIZATION

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. THIS SECTION SPECIFIES THE REQUIREMENTS FOR TREATING AND STABILIZING EXISTING SUBGRADE MATERIAL OR SELECT FILL MATERIAL UNDER PAVEMENTS OR SITE STRUCTURES AS SHOWN ON THE DRAWINGS, BY PULVERIZING, ADDING LIME AND/OR FLY ASH, AND FINISHING TO THE LINES AND GRADES SHOWN ON THE DRAWINGS AND CONSTRUCTED AS SPECIFIED HEREIN.

1.02 DEFINITIONS

A. SUBGRADE: THE UPPERMOST SURFACE OF AN EXCAVATION, INCLUDING EXCAVATION FOR TRENCHES, OR THE TOP SURFACE OF A FILL OR BACKFILL IMMEDIATELY BELOW BASE COURSE, PAVEMENT, OR TOPSOIL MATERIALS.

B. BACKFILL: SOIL MATERIAL OR CONTROLLED LOW-STRENGTH MATERIAL USED TO FILL AN EXCAVATION.

C. BASE COURSE: THE LAYER PLACED BETWEEN THE SUBGRADE AND SURFACE PAVEMENT IN A PAVING SYSTEM.

D. GEOTECHNICAL ENGINEER: PERSON OR COMPANY CONTRACTED BY THE OWNER AND/OR THROUGH THE ARCHITECT TO PROVIDE TESTING AND ONSITE GEOTECHNICAL SERVICES DURING THE CONSTRUCTION SCHEDULE.

E. MOIST CURE: CURING SOIL AND LIME TO OBTAIN OPTIMUM HYDRATION.

1.03 REGULATORY REQUIREMENTS

A. CONTRACTOR SHALL COMPLY WITH ALL CURRENT, APPLICABLE CODES AND REGULATIONS.

B. CONTRACTOR SHALL COMPLY WITH ALL STANDARD SPECIFICATIONS AND DETAILS OF AUTHORITIES HAVING JURISDICTION FOR WORK IN THE RIGHT-OF-WAY OR EASEMENTS.

C. PRIOR TO COMMENCEMENT OF WORK, THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING, AT THE CONTRACTOR'S OWN EXPENSE, ALL CONSTRUCTION PERMITS NECESSARY TO COMPLETE THE PROJECT ACCORDING TO THE PLANS AND SPECIFICATIONS.

1.04 SUBMITTALS

A. SUBMIT CERTIFICATION THAT FLY ASH, HYDRATED LIME, QUICKLIME, OR COMMERCIAL LIME SLURRY COMPLIES WITH THESE SPECIFICATIONS.

B. SUBMIT WEIGHT TICKETS, CERTIFIED BY SUPPLIER, WITH EACH BULK DELIVERY OF LIME TO WORK SITE.

1.05 QUALITY ASSURANCE

A. OWNER WILL EMPLOY A QUALIFIED INDEPENDENT GEOTECHNICAL ENGINEERING TESTING AGENCY TO CLASSIFY PROPOSED ON-SITE AND BORROW SOIL MATERIALS TO VERIFY THAT SOILS COMPLY WITH SPECIFIED REQUIREMENTS AND TO PERFORM REQUIRED FIELD AND LABORATORY TESTING. CONTRACTOR RESPONSIBLE TO COORDINATE WITH THE TESTING AGENCY PRIOR TO START OF WORK REQUIRING TESTING SO AS TO MINIMIZE UNNECESSARY COST OR DELAYS TO THE PROJECT.

B. TESTING:
   1. OWNER WILL RETAIN AND PAY A QUALIFIED GEOTECHNICAL ENGINEER TO TAKE ALL FIELD SAMPLES AND DO ALL LABORATORY TESTING NECESSARY TO VERIFY COMPLIANCE OF THE WORK TO THESE SPECIFICATIONS OR AS REQUIRED BY CITY OR OTHER REGULATORY AGENCIES. THE GEOTECHNICAL ENGINEER SHALL SUBMIT RESULTS OF ALL TESTING DONE DURING THE COURSE OF THE WORK TO THE OWNER, ARCHITECT, AND CONTRACTOR.
   2. NOTIFY TESTING LAB A MINIMUM OF 48 HOURS IN ADVANCE OF THE TIME TESTING IS REQUIRED TO SATISFY REQUIREMENTS OF THIS SECTION.
   3. SHOULD TESTING SPECIFIED ABOVE SHOW WORK WHICH DOES NOT SATISFY THESE SPECIFICATIONS, THE CONTRACTOR SHALL PAY, THROUGH THE OWNER, FOR ALL ADDITIONAL TESTS REQUIRED TO DETERMINE THE EXTENT OF WORK THAT IS NOT SATISFACTORY AND FOR ALL ADDITIONAL TESTS NECESSARY TO DEMONSTRATE COMPLIANCE WITH THESE SPECIFICATIONS.
   4. ALL TESTS SHALL BE PERFORMED BY THE GEOTECHNICAL ENGINEER IN ACCORDANCE WITH TEST METHOD TEX-114-E OR OTHER APPROVED METHODS SELECTED BY GEOTECHNICAL ENGINEER.

PART 2 – PRODUCTS

2.01 LIME

A. LIME FOR USE IN TREATING THE SUBGRADE SHALL CONFORM TO THE CHEMICAL AND PHYSICAL REQUIREMENTS LISTED IN TABLES 1 AND 2 OF TXDOT DEPARTMENTAL MATERIAL SPECIFICATION (DMS) 6350 FOR HYDRATED LIME OR QUICKLIME. WHEN QUICKLIME IS SELECTED, THE CONTRACTOR IS TO SELECT, PRIOR TO CONSTRUCTION, THE GRADE TO BE USED AND NOTIFY THE OWNER'S REPRESENTATIVE IN WRITING BEFORE CHANGING FROM ONE GRADE TO ANOTHER.

2.02 FLY ASH

A. FLY ASH TO MEET ASTM SPECIFICATION C618-05, CLASS C. FLY ASH, HAVE A MINIMUM CAO CONTENT OF 20 PERCENT AND CONTAIN NO LIGNITE ASH.

2.03 WATER

A. WATER USED FOR MIXING OR CURING SHALL BE REASONABLY CLEAN AND FREE OF OIL, SALT, ACID, ALKALI, SUGAR, VEGETABLE MATTER OR OTHER SUBSTANCES INJURIOUS TO THE FINISHED PRODUCT.

B. WATER SOURCES OTHER THAN THE LOCAL MUNICIPAL DOMESTIC WATER SUPPLY MUST BE APPROVED BY THE OWNER'S REPRESENTATIVE.

C. IF ONSITE RECLAIMED WATER SOURCES ARE USED, TANKS AND APPRENTICES MUST BE CLEARLY MARKED WITH THE WORDS “NON-POTABLE” WATER.

2.04 SOIL

A. SOIL SHOULD BE A CLAYEY TYPE SOIL, FREE OF ORGANIC MATERIAL, LARGE ROCKS AND OTHER UNSUITABLE MATERIALS WITH A PLASTICITY INDEX GREATER THAN 10 AND A LIQUID LIMIT IN EXCESS OF 30. THE SOIL SHOULD NOT CONTAIN MORE THAN TWENTY PERCENT SANDS OR SILTS.

B. WHERE EXISTING PAVEMENT OR BASE MATERIAL IS ENCOUNTERED, PULVERIZED OR SCARIFY MATERIAL SO THAT 100 PERCENT OF SAMPLED MATERIAL PASSES 2-INCH SIEVE.

PART 3 – EXECUTION

3.01 PREPERATION

A. PROTECT STRUCTURES, UTILITIES, SIDEWALKS, PAVEMENTS, AND OTHER FACILITIES FROM DAMAGE AND DISPLACEMENT.

B. VERIFY COMPACTED SUBGRADE WILL SUPPORT IMPOSED LOADS.

C. VERIFY SUBGRADE LINES AND GRADES.

D. COMPLETE BACKFILL OF UTILITIES PRIOR TO STABILIZATION.

E. CUT MATERIAL TO BOTTOM OF SUBGRADE USING AN APPROVED CUTTING AND PULVERIZING MACHINE MEETING FOLLOWING REQUIREMENTS:
   1. CUTTERS ACCURATELY PROVIDE SMOOTH SURFACE OVER ENTIRE WIDTH OF CUT TO PLANE OF SECONDARY GRADE.
   2. PROVIDE CUT TO DEPTH AS SPECIFIED OR SHOWN IN THE DRAWINGS.

F. ALTERNATIVELY, SCARIFY OR EXCAVATE TO BOTTOM OF STABILIZED SUBGRADE. REMOVE MATERIAL OR WINDROW TO EXPOSE SECONDARY GRADE. OBTAIN UNIFORM STABILITY.

G. CORRECT WET OR UNSTABLE MATERIAL BELOW SECONDARY GRADE BY SCARIFYING, ADDING LIME, AND COMPACTING AS DIRECTED BY THE OWNER’S REPRESENTATIVE, AT NO ADDITIONAL COST TO THE OWNER.

H. PULVERIZE EXISTING MATERIAL SO THAT 100 PERCENT PASSES A 1-3/4-INCH SIEVE.

3.02 APPLICATION

A. THE PERCENT OF LIME AND/OR FLY ASH TO THE DRY WEIGHT OF THE SOIL SHALL BE AS SHOWN ON THE DRAWINGS.

B. THE LIME AND/OR FLY ASH SHALL BE MIXED WITH WATER IN TRUCKS WITH APPROVED DISTRIBUTORS AND APPLIED AS A THIN WATER SUSPENSION OR SLURRY.

C. APPLY SLURRY WITH DISTRIBUTOR TRUCK EQUIPPED WITH AN AGITATOR TO KEEP LIME AND WATER IN CONSISTENT MIXTURE. THE DISTRIBUTION OF LIME AND/OR FLY ASH SHALL BE UNIFORMLY PLACED IN SUCH QUANTITY THAT ALL SOIL TO BE TREATED RECEIVES THE MINIMUM PERCENTAGE OF LIME AND SUCCESSIVE PASSES MADE UNTIL THE PROPER MOISTURE AND LIME CONTENT IS OBTAINED. LIMIT SPREADING TO AN AREA WHERE PRELIMINARY MIXING OPERATIONS CAN BE COMPLETED ON SAME WORKING DAY.

D. APPLY LIME/FLY ASH AS SINGLE MIX, SINGLE PASS.

3.03 MIXING

A. DO NOT EXPOSE HYDRATED LIME AND/OR FLY ASH TO OPEN AIR FOR 6 HOURS OR MORE DURING INTERVAL BETWEEN APPLICATION AND MIXING. AVOID EXCESSIVE HYDRATED LIME LOSS DUE TO WASHING OR BLOWING.

B. THE SOIL MATERIAL, LIME AND/OR FLY ASH SHALL BE THOROUGHLY MIXED BY APPROVED ROAD MIXERS UNTIL A HOMOGENEOUS, FRIABLE MIXTURE OF MATERIAL, LIME AND/OR SLY ASH IS OBTAINED, FREE FROM ALL CLODS OR LUMPS.

C. SHAPE MIXED SUBGRADE TO FINAL LINES AND GRADES.

3.04 COMPACTION

A. COMPACTION OF THE MIXTURE SHALL BEGIN IMMEDIATELY AFTER FINAL MIXING AND IN NO CASE LATER THAN 6 HOURS AFTER FINAL MIXING.

B. AERATE OR SPRINKLE TO ATTAIN OPTIMUM MOISTURE CONTENT TO 3 PERCENT ABOVE OPTIMUM, AS DETERMINED BY ASTM D 698 ON MATERIAL SAMPLE AFTER FINAL MIX WITH LIME.

C. SPREAD AND COMPACT IN TWO OR MORE EQUAL LAYERS WHERE TOTAL COMPACTED THICKNESS IS GREATER THAN EQUIPMENT MANUFACTURER'S RECOMMENDED RANGE OF MIXING AND COMPACTION.

D. COMPACT WITH APPROVED HEAVY PNEUMATIC OR VIBRATING ROLLERS, OR COMBINATION OF TAMPING ROLLERS AND LIGHT PNEUMATIC ROLLERS. BEGIN COMPACTION AT BOTTOM AND CONTINUE UNTIL ENTIRE DEPTH IS UNIFORMLY COMPACTED.

E. DO NOT ALLOW STABILIZED SUBGRADE TO MIX WITH UNDERLYING MATERIAL. CORRECT IRREGULARITIES OR WEAK SPOTS IMMEDIATELY BY REPLACING MATERIAL AND RECOMPACTING.

F. COMPACT SUBGRADE TO MINIMUM DENSITY OF 95 PERCENT OF MAXIMUM DRY DENSITY, ACCORDING TO ASTM D 698, AT MOISTURE CONTENT OF OPTIMUM TO 3 PERCENT ABOVE OPTIMUM, UNLESS OTHERWISE INDICATED ON DRAWINGS.

G. SEAL WITH APPROVED LIGHT PNEUMATIC TIRED ROLLERS. PREVENT SURFACE HAIR LINE CRACKING. REWORK AND RECOMPACT AT AREAS WHERE HAIRLINE CRACKING DEVELOPS.

3.05 CURING

A. MOIST CURE FOR MINIMUM OF 3 DAYS BEFORE PLACING BASE OR SURFACE COURSE, OR OPENING TO TRAFFIC. SUBGRADE MAY BE OPENED TO TRAFFIC AFTER 2 DAYS WHEN ADEQUATE STRENGTH HAS BEEN ATTAINED TO PREVENT DAMAGE. RESTRICT TRAFFIC TO LIGHT PNEUMATIC ROLLERS OR VEHICLES WEIGHING LESS THAN 10 TONS.

B. KEEP SUBGRADE SURFACE DAMP BY SPRINKLING. ROLL WITH LIGHT PNEUMATIC ROLLER TO KEEP SURFACE KNIT TOGETHER.

C. PLACE BASE OR SURFACE WITHIN 14 DAYS AFTER FINAL MIXING AND COMPACTION. RESTART COMPACTION AND MOISTURE CONTENT OF BASE MATERIAL WHEN TIME IS EXCEEDED.

3.06 TOLERANCES

A. SURFACE OF THE SUBGRADE SHALL NOT SHOW ANY DEVIATION IN EXCESS OF 1/4 INCH ABOVE OR ONE INCH BELOW ESTABLISHED SUBGRADE ELEVATION. THICKNESS OF THE FINISHED SUBGRADE SHALL BE AT LEAST THE THICKNESS SHOWN ON THE PLANS WITHIN1/4 INCH TOLERANCE AND CAN EXCEED THE THICKNESS SHOWN ON THE PLANS AS NEEDED TO MEET THE NEEDS OF THE PROJECT.

B. THE SURFACE SHALL BE UNIFORM AND SMOOTH WITHOUT LARGE CLUMPS OR VOIDS.

3.07 FIELD QUALITY CONTROL

A. TESTING SHALL BE THE RESPONSIBILITY OF OWNER AND COSTS OF INITIAL TESTING WILL BE PAID BY OWNER. COST OF SUBSEQUENT TESTING NECESSARY DUE TO NON-COMPLIANCE WITH SPECIFICATIONS SHALL BE PAID BY CONTRACTOR.

B. TEST SOILS, LIME, FLY ASH AND MIXTURES AS FOLLOWS:
   1. TESTS AND ANALYSIS OF SOIL MATERIALS WILL BE PERFORMED IN ACCORDANCE WITH ASTM D 4318, USING THE WET PREPARATION METHOD.
   2. SAMPLING AND TESTING OF LIME SLURRY SHALL BE IN ACCORDANCE WITH TXDOT TEX-600-J, EXCEPT USING A LIME SLURRY CUP.
   3. SAMPLE MIXTURES OF HYDRATED LIME OR QUICKLIME IN SLURRY FORM WILL BE TESTED TO ESTABLISH COMPLIANCE WITH SPECIFICATIONS.
   4. MOISTURE-DENSITY RELATIONSHIP WILL BE ESTABLISHED ON MATERIAL SAMPLED FROM ROADWAY, AFTER STABILIZATION WITH LIME AND FINAL MIXING, IN ACCORDANCE WITH ASTM 698, MOIST PREPARATION METHOD.

C. IN-PLACE DEPTH WILL BE EVALUATED FOR EACH 25,000-SQUARE FEET OF SUBGRADE AND DETERMINED IN ACCORDANCE WITH TXDOT TEX-140-E IN HAND EXCAVATED HOLES. FOR EACH 25,000-SQUARE FEET OF SUBGRADE, 3 PHENOLPHTHALEIN TESTS WILL BE PERFORMED. AVERAGE STABILIZATION DEPTH FOR 25,000-SQUARE FEET OF SUBGRADE WILL BE BASED ON AVERAGE DEPTH FOR THREE TESTS.

D. PERFORM COMPACTION TESTING IN ACCORDANCE WITH ASTM D 2922. THREE TESTS WILL BE PERFORMED FOR EACH 25,000-SQUARE FEET OF SUBGRADE.

E. PULVERIZATION ANALYSIS WILL BE PERFORMED AS REQUIRED BY PARAGRAPH 3.03D ON MATERIAL SAMPLED DURING MIXING OF EACH PRODUCTION AREA. THREE TESTS WILL BE PERFORMED PER 25,000-SQUARE FEET OF SUBGRADE OR A MINIMUM OF ONCE DAILY.

3.08 REWORK OF FAILED SECTIONS

A. REWORK SECTIONS THAT DO NOT MEET SPECIFIED THICKNESS.

B. PERFORM THE FOLLOWING STEPS WHEN MORE THAN 72 HOURS HAVE LAPSED SINCE COMPLETION OF COMPACTION.
   1. MOIST CURE FOR MINIMUM OF 3 DAYS AFTER COMPACTION TO REQUIRED DENSITY.
   2. ADD LIME AT RATE OF 25 PERCENT OF SPECIFIED RATE AT NO ADDITIONAL COST TO CITY.
   3. MOISTURE DENSITY TEST OF REWORKED MATERIAL MUST BE COMPLETED BY LABORATORY BEFORE FIELD COMPACTION TESTING CAN BE COMPLETED.

3.09 PROTECTION

A. MAINTAIN STABILIZED SUBGRADE TO LINES AND GRADES AND IN GOOD CONDITION UNTIL PLACEMENT OF BASE OR SURFACE COURSE. PROTECT ASPHALT MEMBRANE FROM BEING PICKED UP BY TRAFFIC.

B. REPAIR DEFECTS IMMEDIATELY BY REPLACING MATERIAL TO FULL DEPTH.

END OF SECTION 31 32 13.26

SECTION 31 41 33 – TRENCH SAFETY

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. THIS SECTION IS INTENDED TO PROVIDE SPECIFICATIONS FOR THE MINIMUM REQUIREMENTS FOR TRENCH SAFETY. THE CONTRACTOR SHALL ENDEAVOR TO INSURE THE SAFETY OF THEIR EMPLOYEES WORKING IN AND AROUND TRENCHES AND OTHER EXCAVATIONS IN ACCORDANCE WITH CURRENT OCCUPATION AND SAFETY HEALTH ADMINISTRATION (OSHA) STANDARDS AND IN PARTICULAR, EXCAVATIONS, TRENCHING AND SHORING, FEDERAL OSHA STANDARDS, 29 C.F.R. PART 1926, SUBPART P, AS AMENDED INCLUDING FINAL RULE, PUBLISHED IN FEDERAL REGISTER VOL. 54, NO. 209 TUESDAY OCTOBER 31, 1989 AND LATEST AMENDMENT THERETO. THESE SPECIFICATIONS OUTLINE MINIMUM STANDARDS OF CONSTRUCTION SAFETY TO BE FOLLOWED, BUT SHOULD NOT BE CONSTRUED AS THE MEANS, METHODS AND OPERATIONS OF CONSTRUCTION. WHERE THE CONTRACTOR DEVIATES FROM THESE OUTLINED MINIMUM STANDARDS, THE CONTRACTOR IS REQUIRED TO SUBMIT FOR APPROVAL BY THE OWNER SEALED ENGINEERING PLANS DESIGNED BY A REGISTERED PROFESSIONAL ENGINEER IN THE STATE OF TEXAS SHOWING THE PROPOSED METHOD OF TRENCH PROTECTION. A COPY OF THE APPROVED DESIGN SHALL BE KEPT AT THE SITE.

1.02 DEFINITIONS

A. TRENCH: A NARROW EXCAVATION (IN RELATION TO ITS DEPTH) MADE BELOW THE SURFACE OF THE GROUND. IN GENERAL, THE DEPTH IS GREATER THAN THE WIDTH, BUT THE WIDTH OF A TRENCH (MEASURED AT THE BOTTOM) IS NOT GREATER THAN 15 FEET. THE TRENCH SAFETY SYSTEM REQUIREMENTS WILL APPLY TO LARGER OPEN EXCAVATIONS IF THE ERECTION OF STRUCTURES OR OTHER INSTALLATIONS LIMITS THE SPACE BETWEEN THE EXCAVATION SLOPE AND THESE INSTALLATIONS TO DIMENSIONS EQUIVALENT OF A TRENCH AS DEFINED.

B. TRENCH SAFETY SYSTEMS: INCLUDE BUT ARE NOT LIMITED TO SLOPING, SHEETING, TRENCH BOXES OR TRENCH SHIELDS, SHEET PILING, CRIBBING, BRACING, SHORING, DEWATERING OR DIVERSION OF WATER TO PROVIDE ADEQUATE DRAINAGE.

C. TRENCH SAFETY PROGRAM: THE SAFETY PROCEDURES GOVERNING THE PRESENCE AND ACTIVITIES OF INDIVIDUALS WORKING IN AND AROUND TRENCH EXCAVATIONS.

D. STABLE ROCK - NATURAL SOLID MINERAL MATTER THAT CAN BE EXCAVATED WITH VERTICAL SIDES AND REMAIN IN TRACT WHILE EXPOSED.

E. TYPE A SOIL – COHESIVE SOILS WITH AN UNCONFINED COMPRESSIVE STRENGTH OF 1.5 TONS PER SQUARE FOOT OR GREATER. EXAMPLES OF COHESIVE SOILS ARE: CLAY, SILTY CLAY, SANDY CLAY, CLAY LOAM AND IN SOME CASES, SILTY CLAY LOAM AND SANDY CLAY LOAM CEMENTED SOILS SUCH AS CALICHE AND HARD PAN ARE ALSO CONSIDERED TYPE A. HOWEVER, NO SOIL IS TYPE A IF:
   1. THE SOIL IS FISSURED.
   2. THE SOIL IS SUBJECT TO VIBRATION FROM HEAVY TRAFFIC, PILING DRIVING, OR SIMILAR EFFECTS
   3. THE SOIL HAS BEEN PREVIOUSLY DISTURBED.

4. THE SOIL IS PART OF A SLOPED, LAYERED SYSTEM WHERE THE LAYERS DIP INTO THE EXCAVATION ON A SLOPE OF FOUR HORIZONTAL TO ONE VERTICAL OR GREATER.
5. THE SOIL IS SUBJECT TO OTHER FACTORS THAT WOULD REQUIRE IT TO BE CLASSIFIED AS A LESS STABLE MATERIAL.

F. TYPE B SOIL – SOIL THAT MEETS ONE OF THE FOLLOWING:
1. COHESIVE SOIL WITH AN UNCONFINED COMPRESSIVE STRENGTH GREATER THAN 0.5 TONS PER SQUARE FOOT, BUT LESS THAN 1.5 TONS PER SQUARE FOOT.
2. GRANULAR COHESIONLESS SOILS INCLUDING: ANGULAR GRAVEL, SILT, SILT LOAM, SANDY LOAM AND IN SOME CASES, SILTY CLAY LOAM AND SANDY CLAY LOAM.
3. PREVIOUSLY DISTURBED SOILS EXCEPT THOSE WHICH WOULD OTHERWISE BE CLASSIFIED AS TYPE C SOIL.
4. SOIL THAT MEETS THE UNCONFINED COMPRESSIVE STRENGTH OR CEMENTATION REQUIREMENTS FOR TYPE A, BUT IS FISSURED OR SUBJECT TO VIBRATION.
5. DRY ROCK THAT IS NOT STABLE.
6. MATERIAL THAT IS PART OF A SLOPED, LAYERED SYSTEM WHERE THE LAYERS DIP INTO THE EXCAVATION ON A SLOPE LESS STEEP THAN FOUR HORIZONTAL TO ONE VERTICAL, BUT ONLY IF THE SOIL WOULD OTHERWISE BE CLASSIFIED AS TYPE B.

G. TYPE C SOIL – SOIL THAT MEETS ONE OF THE FOLLOWING:
1. COHESIVE SOIL WITH AN UNCONFINED COMPRESSIVE STRENGTH OF 0.5 TONS PER SQUARE FOOT OR LESS.
2. GRANULAR SOILS INCLUDING: GRAVEL, SAND AND LOAMY SAND.
3. SATURATED OR SUBMERGED SOIL.
4. SUBMERGED ROCK THAT IS NOT STABLE.
5. SOIL IN A SLOPED, LAYERED SYSTEM WHERE THE LAYERS DIP INTO THE EXCAVATION ON A SLOPE OF FOUR HORIZONTAL TO ONE VERTICAL OR GREATER.

H. UNCONFINED COMPRESSIBLE STRENGTH SHALL MEAN THE LOAD PER UNIT AREA AT WHICH A SOIL WILL FAIL IN COMPRESSION. IT CAN BE DETERMINED BY LABORATORY TESTING, ESTIMATED IN THE FIELD USING A POCKET PENETROMETER, OR OTHER PREVIOUSLY APPROVED METHODS.

I. WET SOIL SHALL MEAN SOIL THAT CONTAINS SIGNIFICANTLY MORE MOISTURE THAN MOIST SOIL, BUT IN SUCH A RANGE OF VALUES THAT COHESIVE MATERIAL WILL SLUMP OR BEGIN TO FLOW WHEN VIBRATED. GRANULAR MATERIAL THAT WOULD EXHIBIT COHESIVE PROPERTIES WHEN MOIST WILL LOSE THOSE COHESIVE PROPERTIES WHEN WET.

1.03 REGULATORY REQUIREMENTS

A. INSTALL AND MAINTAIN TRENCH SAFETY SYSTEMS IN ACCORDANCE WITH CURRENT OCCUPATION AND SAFETY HEALTH ADMINISTRATION (OSHA) STANDARDS AND IN PARTICULAR, EXCAVATIONS, TRENCHING AND SHORING, FEDERAL OSHA STANDARDS, 29 C.F.R. PART 1926, SUBPART P, AS AMENDED INCLUDING FINAL RULE, PUBLISHED IN FEDERAL REGISTER VOL. 54, NO. 209 TUESDAY OCTOBER 31, 1989 AND LATEST AMENDMENT THERETO.

B. THE CONTRACTOR IS RESPONSIBLE FOR OBTAINING A COPY OF OSHA STANDARDS INCLUDED IN "SUBPART P - EXCAVATIONS" FROM THE FEDERAL REGISTER VOL. 54, NO. 209 SECTION OF THE FEDERAL REGISTER.

C. LEGISLATION THAT HAS BEEN ENACTED BY THE TEXAS LEGISLATURE WITH REGARD TO TRENCH SAFETY SYSTEMS, IS HEREBY INCORPORATED, BY REFERENCE, INTO THESE SPECIFICATIONS. REFER TO TEXAS HEALTH AND SAFETY CODE ANN., §756.021 (VERNON 1991).

D. REFERENCE MATERIALS, IF DEVELOPED FOR A SPECIFIC PROJECT, WILL BE ISSUED WITH THE BID/PROPOSAL DOCUMENTS.

1.04 SUBMITTALS

A. SUBMIT A SAFETY PROGRAM SPECIFICALLY FOR THE CONSTRUCTION OF TRENCH EXCAVATION. DESIGN THE TRENCH SAFETY PROGRAM TO BE IN ACCORDANCE WITH OSHA 29CFR STANDARDS GOVERNING THE PRESENCE AND ACTIVITIES OF INDIVIDUALS WORKING IN AND AROUND TRENCH EXCAVATIONS.

B. CONSTRUCTION AND SHOP DRAWINGS CONTAINING DEVIATIONS FROM OSHA STANDARDS OR SPECIAL DESIGNS SHALL BE SEALED BY A LICENSED ENGINEER RETAINED AND PAID BY CONTRACTOR.

C. REVIEW OF THE SAFETY PROGRAM BY THE OWNER'S REPRESENTATIVE WILL ONLY BE IN REGARD TO COMPLIANCE WITH THIS SPECIFICATION AND WILL NOT CONSTITUTE APPROVAL BY THE OWNER'S REPRESENTATIVE NOR RELIEVE CONTRACTOR OF OBLIGATIONS UNDER STATE AND FEDERAL TRENCH SAFETY LAWS.

D. SUBMIT CERTIFICATION THAT TRENCH SAFETY SYSTEM WILL NOT BE SUBJECTED TO LOADS EXCEEDING THOSE WHICH THE SYSTEM WAS DESIGNED TO WITHSTAND ACCORDING TO THE AVAILABLE CONSTRUCTION AND GEOTECHNICAL INFORMATION.

1.05 INDEMNIFICATION

A. CONTRACTOR SHALL INDEMNIFY AND HOLD HARMLESS THE OWNER, ITS EMPLOYEES AND AGENTS, FROM ANY AND ALL DAMAGES, COSTS (INCLUDING, WITHOUT LIMITATION, LEGAL FEES, COURT COSTS, AND THE COST OF INVESTIGATION), JUDGMENTS OR CLAIMS BY ANYONE FOR INJURY OR DEATH OF PERSONS RESULTING FROM THE COLLAPSE OR FAILURE OF TRENCHES CONSTRUCTED UNDER THIS CONTRACT.

B. CONTRACTOR ACKNOWLEDGES AND AGREES THAT THIS INDEMNITY PROVISION PROVIDES INDEMNITY FOR THE OWNER IN CASE THE OWNER IS NEGLIGENT EITHER BY ACT OR OMISSION IN PROVIDING FOR TRENCH SAFETY, INCLUDING, BUT NOT LIMITED TO SAFETY PROGRAM AND DESIGN REVIEWS, INSPECTIONS, FAILURES TO ISSUE STOP WORK ORDERS, AND THE HIRING OF THE CONTRACTOR.

PART 2 – PRODUCTS

2.01 GENERAL

A. MATERIALS USED FOR SHEETING, SHEET PILING, CRIBBING, BRACING, SHORING, UNDERPINNING, AND OTHER STRUCTURAL RETAINING SYSTEMS SHALL BE IN GOOD

SERVICEABLE CONDITION, OF GOOD QUALITY, OF A SUITABLE CONDITION AND GRADE TO PERFORM THE INTENDED USE. WOOD SHALL BE SOUND, FREE FROM LARGE OR LOOSE KNOTS, AND OF THE PROPER DIMENSIONS. THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING THE SYSTEMS IN A MANNER CONSISTENT WITH THE INTENDED DESIGN AND IN A MANNER THAT WILL PREVENT EXPOSURE OF WORKERS TO HAZARDS.

PART 3 – EXECUTION

3.01 GENERAL SAFETY REQUIREMENTS

A. THE WORK AREA SHALL BE KEPT FREE OF HAZARDS TO THE EMPLOYEES. ALL SURFACE ENCUMBRANCES WHICH MAY CREATE A HAZARD SHALL BE REMOVED, SUPPORTED OR OTHERWISE ISOLATED AS NECESSARY TO SAFEGUARD EMPLOYEES.

B. THE CONTRACTOR SHALL TAKE SPECIAL PRECAUTIONS TO LOCATE EXISTING UTILITIES AND TO PROTECT THOSE SYSTEMS AS REQUIRED. THE CONTRACTOR SHALL CALL THE UTILITY COORDINATING COMMITTEE AS REQUIRED 24 HOURS PRIOR TO EXCAVATING AROUND EXISTING UTILITIES.

C. THE CONTRACTOR SHALL PROVIDE SAFE ACCESS AND EGRESS TO EXCAVATIONS. RAMPS OR STAIRWAYS SHALL BE STRUCTURALLY SOUND AND CAPABLE OF PROVIDING A SAFE MEANS OF ESCAPE FROM THE EXCAVATION. TRENCHES IN EXCESS OF FOUR (4) FEET IN DEPTH SHALL HAVE A SAFE MEANS OF EGRESS FROM THE TRENCH SPACED SUCH THAT NO MORE THAN 25 FEET OF LATERAL TRAVEL WOULD BE REQUIRED TO REACH THE EGRESS SYSTEM.

D. THE EMPLOYEES SHALL BE PROTECTED FROM WORK PLACE HAZARDS SUCH AS VEHICULAR TRAFFIC, FALLING LOADS, AND HAZARDOUS ATMOSPHERE. EXCAVATIONS SHALL BE MARKED SO THAT EMPLOYEES AND EQUIPMENT ARE CLEARLY WARNED OF THE LOCATION OF THE EXCAVATIONS. TRENCHES SHALL BE KEPT FREE OF WATER ACCUMULATIONS THAT WOULD PRESENT A HAZARD TO EMPLOYEES. ADJACENT STRUCTURES SHALL BE STABILIZED AS NECESSARY SO AS NOT TO PRESENT A POSSIBLE HAZARD TO THE EMPLOYEES. EQUIPMENT SHALL BE KEPT SUFFICIENTLY CLEAR OF EXCAVATIONS SO AS NOT TO CREATE A POTENTIAL OVERBURDEN STRESS TO TRENCH WALLS CAUSING CAVE-INS. SAFE ACCESS SHALL BE PROVIDED WITH HANDRAILS WHERE ACCESS OVER TRENCHES IS REQUIRED.

E. EMERGENCY RESCUE EQUIPMENT AS REQUIRED BY OSHA SHALL BE READILY AVAILABLE AT THE SITE AND SHALL BE MAINTAINED TO GOOD WORKING CONDITION.

F. DAILY INSPECTIONS OF EXCAVATIONS, THE ADJACENT AREAS, AND THE PROTECTIVE SYSTEMS SHALL BE MADE BY A PERSON OR PERSONS COMPETENT TO MAKE SUCH INSPECTIONS TO KEEP THE CONTRACTOR NOTIFIED OF UNSAFE CONDITIONS SO THAT NECESSARY PRECAUTIONARY ACTIONS CAN BE TAKEN.

3.02 INSTALLATION

A. INSTALL AND MAINTAIN TRENCH SAFETY SYSTEMS IN ACCORDANCE WITH PROVISIONS OF OSHA 29CFR.

B. INSTALL SPECIALLY DESIGNED TRENCH SAFETY SYSTEMS IN ACCORDANCE WITH THE CONTRACTOR'S TRENCH EXCAVATION SAFETY PROGRAM FOR THE LOCATIONS AND CONDITIONS IDENTIFIED IN THE PROGRAM.

C. A COMPETENT PERSON, AS IDENTIFIED IN THE CONTRACTOR'S TRENCH SAFETY PROGRAM, SHALL VERIFY THAT TRENCH BOXES AND OTHER PREMANUFACTURED SYSTEMS ARE CERTIFIED FOR THE ACTUAL INSTALLATION CONDITIONS.

3.03 INSPECTION

A. CONTRACTOR, OR CONTRACTOR'S INDEPENDENTLY RETAINED CONSULTANT, SHALL MAKE DAILY INSPECTIONS OF THE TRENCH SAFETY SYSTEMS TO ENSURE THAT THE INSTALLED SYSTEMS AND OPERATIONS MEET OSHA 29CFR AND OTHER PERSONNEL PROTECTION REGULATIONS REQUIREMENTS.

B. IF EVIDENCE OF POSSIBLE CAVE-INS OR SLIDES IS APPARENT, CONTRACTOR SHALL IMMEDIATELY STOP WORK IN THE TRENCH AND MOVE PERSONNEL TO SAFE LOCATIONS UNTIL THE NECESSARY PRECAUTIONS HAVE BEEN TAKEN BY CONTRACTOR TO SAFEGUARD PERSONNEL ENTERING THE TRENCH.

C. MAINTAIN A PERMANENT RECORD OF DAILY INSPECTIONS.

3.04 FIELD QUALITY CONTROL

A. CONTRACTOR SHALL VERIFY SPECIFIC APPLICABILITY OF THE SELECTED OR SPECIALLY DESIGNED TRENCH SAFETY SYSTEMS TO EACH FIELD CONDITION ENCOUNTERED ON THE PROJECT.

END OF SECTION 31 41 33

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SECTION 31 63 29 - DRILLED CONCRETE PIERS AND SHAFTS

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. Dry-installed drilled piers.

1.3 UNIT PRICES

A. Drilled Piers: Actual net volume of drilled piers in place and approved. Actual length, shaft diameter, and bell diameter if applicable, may vary, to coincide with elevations where satisfactory bearing strata are encountered. These dimensions may also vary with actual bearing value of bearing strata determined by an independent testing and inspecting agency. Adjustments are made on net variation of total quantities, based on design dimensions for shafts and bells.

1. Base bids on indicated number of drilled piers and, for each pier, the design length from top elevation to bottom of shaft, extended through the bell, if applicable, and the diameter of shaft and bell.
2. Unit prices include labor, materials, tools, equipment, and incidentals required for excavation, trimming, shoring, casings, dewatering, reinforcement, concrete fill, testing and inspecting, and other items for complete drilled-pier installation.
3. There will be no additional compensation for excavation, concrete fill, reinforcing, casings, or other costs due to unauthorized over excavating of shafts or bells. No payment will be made for rejected piers.

1.4 ACTION SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections. In addition to Division 1 requirements, provide one half-size hard copy (paper) of any drawings submitted in the electronic files.

B. Product Data: For each type of product.

C. Design Mixtures: in accordance with Division 3 Section, “Cast-in-Place Concrete.”

D. Shop Drawings: in accordance with Division 3 Section, “Cast-in-Place Concrete.”

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and testing agency.

B. Welding certificates.

C. Material Certificates and Test Reports in accordance with Division 3 Section, “Cast-in-Place Concrete.”

D. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Record drawings.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Not less than three successfully completed contracts with similar soil conditions, shaft sizes, depths, and volumes of Work contained in this Project.

B. Testing Agency Qualifications: Qualified according to ASTM C 1077, ASTM D 3740, and ASTM E 329 for testing indicated.

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.4/D1.4M, "Structural Welding Code - Reinforcing Steel."

D. Materials and installed work may require testing and retesting at any time during progress of Work. Allow free access to material stockpiles and facilities. Tests not specifically indicated to be done at Owner's expense, including retesting of rejected materials and installed work, are Contractor's responsibility.

E. Certificates of material properties, indicating, compliance with specified requirements, may be submitted in lieu of testing when acceptable to Architect/Engineer. Certificates of compliance must be signed by materials producer and Contractor.

1.8 FIELD CONDITIONS

A. Existing Utilities: Locate existing underground utilities before excavating drilled piers. If utilities are to remain in place, provide protection from damage during drilled-pier operations.

1. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, adapt drilling procedure if necessary to prevent damage to utilities. Cooperate with Owner and utility companies in keeping services and facilities in operation without interruption. Repair damaged utilities to satisfaction of utility owner.

B. Interruption of Existing Utilities: Do not interrupt any utility to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:

1. Notify Architect/Engineer/Owner no fewer than two days in advance of proposed interruption of utility.
2. Do not proceed with interruption of utility without Architect/Engineer's and Owner's written permission.

C. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from this data.

1. Additional test borings and other exploratory operations necessary for drilled piers may be made by Contractor at no additional cost to Owner.
2. The geotechnical report is referenced elsewhere in the Project Manual.

D. Survey Work: Engage a qualified land surveyor or professional engineer to perform surveys, layouts, and measurements for drilled piers. Before excavating, lay out each drilled pier to lines and levels required. Record actual measurements of each drilled pier's location, shaft diameter, bottom and top elevations, deviations from specified tolerances, and other specified data.

1. Record and maintain information pertinent to each drilled pier and indicate on record Drawings. Cooperate with Owner's testing and inspecting agency to provide data for required reports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Drilled-Pier Standard: Comply with ACI 336.1 except as modified in this Section.

B. Where provisions of above standard conflict with building regulations in effect for this Project, building regulations will govern, but only to establish minimum requirements.

2.2 STEEL REINFORCEMENT

A. Reinforcing bars and related materials are specified in Division 3 Sections.

2.3 CONCRETE MATERIALS

A. Concrete and related materials are specified in Division 3 Sections.

2.4 STEEL CASINGS

A. Steel Pipe Casings: ASTM A 283/A 283M, Grade C, or ASTM A 36/A 36M, carbon-steel plate, with joints full-penetration welded according to AWS D1.1/D1.1M.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, vibration, and other hazards created by drilled-pier operations.

3.2 EXCAVATION

A. Classified Excavation: Excavation is classified as standard excavation, special excavation, and obstruction removal and includes excavation to bearing elevations as follows:

1. Standard excavation includes excavation accomplished with conventional augers fitted with soil or rock teeth, drilling buckets, or underreaming tools attached to drilling equipment of size, power, torque, and downthrust necessary for the Work.
2. Special excavation includes excavation that requires special equipment or procedures where drilled-pier excavation equipment used in standard excavation, operating at maximum power, torque, and downthrust, cannot advance the shaft.

    a. Special excavation requires use of special rock augers, core barrels, air tools, blasting, or other methods of hand excavation.
    b. Earth seams, rock fragments, and voids included in rock excavation area are considered rock for full volume of shaft from initial contact with rock.

3. Demolition and removal of rock boulders, concrete, masonry, and other subsurface obstructions which are clearly indicated by Contract Documents, or by available subsurface exploration data, are not considered a change in the Work.

B. Obstructions: Payment for removing unanticipated boulders, concrete, masonry, or other subsurface obstructions that cannot be removed by conventional augers fitted with soil or rock teeth, drilling buckets, or underreaming tools attached to drilling equipment of size, power, torque, and downthrust necessary for the Work is according to Contract provisions for changes in the Work.Prevent surface water from entering excavated shafts. Conduct water to site drainage facilities.

C. Pier design dimensions shown are minimums. The design of piers is based on assumed strata bearing capacity. If bearing stratum is not capable of maintaining bearing capacity assumed, foundation system will be revised as directed by Architect/Engineer. Revisions will be paid for in accordance with Contract conditions relative to changes in Work.

D. Excavate shafts for drilled piers to indicated elevations. Remove loose material from bottom of excavation.

1. Excavate bottom of drilled piers to level plane within 1:12 tolerance.
2. Remove water from excavated shafts before concreting.
3. Excavate rock sockets of dimensions indicated.

E. Dewatering: Provide and maintain pumping equipment to keep excavations free of water before placing concrete. If excessive water is encountered and drilling operations must be halted, consult with Architect/Engineer before using alternate methods of construction.

F. Conduct water to general site run off ditches and disposal areas with discharge lines. Provide ditching as required to conduct water to site drainage facilities.

G. Notify and allow Architect/Engineer and testing and inspecting agency to test and inspect bottom of excavation at least 24 hours prior to time excavations will be ready. If unsuitable bearing stratum is encountered, make adjustments to drilled piers as determined by Architect/Engineer.

1. Do not excavate shafts deeper than elevations indicated unless approved by Architect/Engineer.
2. Payment for additional authorized excavation is according to Contract provisions for changes in the Work.

H. Excavate shafts for closely spaced drilled piers and for drilled piers occurring in fragile or sand strata only after adjacent drilled piers are filled with concrete and allowed to set.

I. Temporary Casings: If required, install watertight steel casings of sufficient length and thickness to prevent water seepage into shaft; to withstand compressive, displacement, and withdrawal stresses; and to maintain stability of shaft walls.

1. Remove temporary casings, maintained in plumb position, during concrete placement and before initial set of concrete.
2. Casing length for payment for temporary casing shall be measured as the depth from the bottom of the casing to the ground surface.
3. When assumed elevation of top of bell portion is reached, casing may be stopped.

J. Bells: Excavate bells for drilled piers to shape, base thickness, and slope angle indicated. Excavate bottom of bells to level plane and remove loose material before placing concrete.

1. Shore bells in unstable soil conditions to prevent cave-in during excavation, inspection, and concreting.

K. Tolerances: Construct drilled piers to remain within ACI 336.1 tolerances.

1. If location or out-of-plumb tolerances are exceeded, provide corrective construction. Submit corrective construction proposals to Architect/Engineer for review before proceeding.

L. Depth of Bearing Stratum: If indicated depth of shaft excavation is reached without encountering required stratum bearing capacity, immediately suspend excavation operations and inform Architect/Engineer. Architect/Engineer will determine procedures to be followed.

M. Where changes in indicated depth or dimensions are required, or additional soil borings are required, proceed with such work when directed in writing by Architect/Engineer.

N. Overexcavation: No payment will be made for extra length, when pier shafts are excavated to a greater depth than required or authorized by Architect/Engineer, due to overdrilling by Contractor. Complete pier and fill extra depth with concrete if other conditions are satisfactory. Overexcavated shafts will be measured and paid for to original design or authorized depth.

3.3 STEEL REINFORCEMENT INSTALLATION

A. Comply with recommendations in CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy bond with concrete.

C. Fabricate and install reinforcing cages symmetrically about axis of shafts in a single unit.
1. No splices are allowed in the vertical reinforcement without the prior written permission of the Architect/Engineer.

D. Accurately position, support, and secure reinforcement against displacement during concreting and the extraction of the casing from the shaft when temporary casings are utilized. Maintain minimum cover over reinforcement.

E. Use templates to set anchor bolts, leveling plates, and other accessories furnished in work of other Sections. Provide blocking and holding devices to maintain required position during final concrete placement.

F. Place dowels in the pier as shown on the drawings.

G. Protect exposed ends of extended reinforcement, dowels, or anchor bolts from mechanical damage and exposure to weather.

3.4 CONCRETE PLACEMENT

A. Place concrete in continuous operation and without segregation immediately after inspection and approval of shaft by a qualified testing laboratory.
   1. Do not place cold joints in drilled piers. Should unforeseen field conditions interrupt placing operations of over one hour duration, a cold joint installation will be required. Level top surface of concrete and insert joint dowel bars. Before placing remainder of concrete, clean surface laitance, roughen, and slush concrete with commercial bonding agent or with sand-cement grout mixed at ratio of 1:1.

B. Dry Method: Place concrete to fall vertically down the center of drilled pier without striking sides of shaft or steel reinforcement.

   1. Where concrete cannot be directed down shaft without striking reinforcement and/or where a drop of more than 12 feet is required, place concrete with chutes, tremies, or pumps.
   2. Vibrate top 12 feet of concrete of each shaft, minimum.

C. Coordinate withdrawal of temporary casings with concrete placement to maintain at least a 60-inch head of concrete above bottom of casing.

   1. Vibrate top 12 feet of concrete after withdrawal of temporary casing.

D. Screed concrete at cutoff elevation level and apply scoured, rough finish. Where cutoff elevation is above the ground elevation, form top section above grade and extend shaft to required elevation.

E. Protect concrete work from frost, freezing, or low temperatures that could cause physical damage or reduced strength according to Division 3, Section “Cast in Place Concrete”.

   1. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
   2. Do not use calcium chloride, salt, or other mineral-containing antifreeze agents or chemical accelerators.

F. If hot-weather conditions exist that would seriously impair quality and strength of concrete, place concrete according to Division 3, Section “Cast in Place Concrete”.

   1. Place concrete immediately on delivery. Keep exposed concrete surfaces and formed shaft extensions moist by fog sprays, wet burlap, or other effective means for a minimum of seven days.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

   1. Drilled piers.
   2. Excavation.
   3. Concrete.

4. Steel reinforcement welding.
5. Special inspections required by the International Building Code 2009, Section 1705.8.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

C. Drilled-Pier Tests and Inspections: For each drilled pier, before concrete placement.

1. Soil Testing: Bottom elevations, bearing capacities, and lengths of drilled piers indicated have been estimated from available soil data. Actual elevations and drilled-pier lengths and bearing capacities are determined by testing and inspecting agency. Final evaluations and approval of data are determined by Architect/Engineer.

D. Concrete Tests and Inspections: Sample and test concrete for quality control during placement per Division 3 section, "Cast-In-Place Concrete."
1. Additional Tests: Testing and inspecting agency to make additional tests of concrete if test results indicate that slump, compressive strengths, or other requirements have not been met, as directed by Architect/Engineer.

a. Continuous coring of drilled piers may be required, at Contractor's expense, if temporary casings have not been withdrawn within specified time limits or if observations of placement operations indicate deficient concrete quality, presence of voids, segregation, or other possible defects.

2. Perform additional testing and inspecting, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.
3. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

E. An excavation, concrete, or a drilled pier will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports for each drilled pier as follows:

1. Actual top and bottom elevations.
2. Actual drilled-pier diameter at top, bottom, and bell.
3. Top of rock elevation.
4. Description of soil materials.
5. Description, location, and dimensions of obstructions.
6. Final top centerline location and deviations from requirements.
7. Variation of shaft from plumb.
8. Shaft excavating method.
9. Design and tested bearing capacity of bottom.
10. Depth of rock socket.
11. Levelness of bottom and adequacy of cleanout.
12. Ground-water conditions and water-infiltration rate, depth, and pumping.
13. Description, purpose, length, wall thickness, diameter, tip, and top and bottom elevations of temporary or permanent casings. Include anchorage and sealing methods used and condition and weather tightness of splices if any.
14. Description of soil or water movement, sidewall stability, loss of ground, and means of control.
15. Bell dimensions and variations from original design.
16. Date and time of starting and completing excavation.
17. Inspection report.
18. Condition of reinforcing steel and splices.
19. Position of reinforcing steel.
20. Concrete placing method, including elevation of consolidation and delays.
21. Elevation of concrete during removal of casings.

22. Locations of construction joints.
23. Concrete volume.
24. Concrete testing results.
25. Remarks, unusual conditions encountered, and deviations from requirements.

3.6 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION 31 63 29

SECTION 32 13 13 – CONCRETE SITE PAVING

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. THIS SECTION SPECIFIES THE REQUIREMENTS FOR FORMING AND PLACING REINFORCED VEHICULAR PAVEMENT, CURBS, SIDEWALKS, COURTYARDS AND PEDESTRIAN AREAS TO THE LINES AND GRADES SHOWN ON THE DRAWINGS AND CONSTRUCTED AS SPECIFIED HEREIN.

1.02 REGULATORY REQUIREMENTS

A. CONTRACTOR SHALL COMPLY WITH ALL CURRENT, APPLICABLE CODES AND REGULATIONS.

B. CONTRACTOR SHALL COMPLY WITH ALL STANDARD SPECIFICATIONS AND DETAILS OF AUTHORITIES HAVING JURISDICTION (HEREIN AFTER REFERRED TO AS "STANDARD SPECIFICATIONS") FOR WORK IN THE RIGHT-OF-WAY OR EASEMENTS.

C. PRIOR TO COMMENCEMENT OF WORK, THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING, AT THE CONTRACTOR'S OWN EXPENSE, ALL CONSTRUCTION PERMITS NECESSARY TO COMPLETE THE PROJECT ACCORDING TO THE PLANS AND SPECIFICATIONS.

1.03 SUBMITTALS

A. PRODUCT DATA: FOR EACH TYPE OF MANUFACTURED MATERIAL AND PRODUCT INDICATED.

B. DESIGN MIXTURES: FOR EACH CONCRETE PAVEMENT MIXTURE. INCLUDE ALTERNATE MIXTURE DESIGNS WHEN CHARACTERISTICS OF MATERIALS, PROJECT CONDITIONS, WEATHER, TEST RESULTS, OR OTHER CIRCUMSTANCES WARRANT ADJUSTMENTS.

C. MATERIAL TEST REPORTS: FROM A QUALIFIED TESTING LABORATORY INDICATING AND INTERPRETING TEST RESULTS FOR COMPLIANCE OF THE FOLLOWING WITH REQUIREMENTS INDICATED, BASED ON COMPREHENSIVE TESTING OF CURRENT MATERIALS:

D. MATERIAL CERTIFICATES: SIGNED BY MANUFACTURERS CERTIFYING THAT EACH OF THE FOLLOWING MATERIALS WHICH ARE PART OF THIS PROJECT, COMPLIES WITH REQUIREMENTS:
   1. CEMENTITIOUS MATERIALS.
   2. STEEL REINFORCEMENT AND REINFORCEMENT ACCESSORIES.
   3. ADMIXTURES.
   4. CURING COMPOUNDS.
   5. APPLIED FINISH MATERIALS.
   6. BONDING AGENT OR EPOXY ADHESIVE.
   7. JOINT FILLERS.

1.04 QUALITY ASSURANCE

A. MANUFACTURER QUALIFICATIONS: MANUFACTURER OF READY-MIXED CONCRETE PRODUCTS WHO COMPLIES WITH ASTM C 94/C 94M REQUIREMENTS FOR PRODUCTION FACILITIES AND EQUIPMENT.

B. OWNER WILL EMPLOY A QUALIFIED INDEPENDENT GEOTECHNICAL ENGINEERING TESTING AGENCY TO TAKE ALL FIELD SAMPLES AND DO ALL LABORATORY TESTING NECESSARY TO VERIFY COMPLIANCE OF THE WORK TO THE SPECIFICATIONS OR AS REQUIRED BY CITY OR OTHER REGULATORY AGENCIES. CONTRACTOR SHALL BE RESPONSIBLE TO COORDINATE WITH THE TESTING AGENCY PRIOR TO START OF WORK REQUIRING TESTING SO AS TO MINIMIZE UNNECESSARY COST OR DELAYS TO THE PROJECT.

C. TESTING:
   1. THE GEOTECHNICAL ENGINEER SHALL SUBMIT RESULTS OF ALL TESTING DONE DURING THE COURSE OF THE WORK TO THE OWNER, OWNER'S REPRESENTATIVE, AND CONTRACTOR.
   2. NOTIFY TESTING LAB A MINIMUM OF 48 HOURS IN ADVANCE OF THE TIME TESTING IS REQUIRED TO SATISFY REQUIREMENTS OF THIS SECTION.
   3. SHOULD TESTING SPECIFIED ABOVE SHOW WORK WHICH DOES NOT SATISFY THESE SPECIFICATIONS, THE CONTRACTOR SHALL PAY, THROUGH THE OWNER, FOR ALL ADDITIONAL TESTS REQUIRED TO DETERMINE THE EXTENT OF WORK THAT IS NOT SATISFACTORY AND FOR ALL ADDITIONAL TESTS NECESSARY TO DEMONSTRATE COMPLIANCE WITH THESE SPECIFICATIONS.

PART 2 – PRODUCTS

2.01 CONCRETE MATERIALS

A. PORTLAND CEMENT:
   1. SAMPLE AND TEST CEMENT TO VERIFY COMPLIANCE WITH STANDARDS OF ASTM C 150, TYPE I OR TYPE III.
   2. BULK CEMENT WHICH MEETS REFERENCED STANDARDS MAY BE USED WHEN METHOD OF HANDLING IS APPROVED BY THE OWNER'S REPRESENTATIVE. WHEN USING BULK CEMENT, PROVIDE SATISFACTORY WEIGHING DEVICES.
   3. FLY ASH WHICH MEETS STANDARDS OF ASTM C 618 MAY BE USED AS MINERAL FILL WHEN METHOD OF HANDLING IS APPROVED BY THE OWNER'S REPRESENTATIVE.

B. WATER: CONFORM TO REQUIREMENTS FOR WATER IN ASTM C 94.

C. COARSE AGGREGATE: CRUSHED STONE, GRAVEL, OR COMBINATION THEREOF, WHICH IS CLEAN, HARD, AND DURABLE, CONFORMS TO REQUIREMENTS OF ASTM C 33, AND HAS ABRASION LOSS NOT MORE THAN 45 PERCENT BY WEIGHT WHEN SUBJECTED TO LOS ANGELES ABRASION TEST (ASTM C 131).
   1. MAXIMUM PERCENTAGE BY WEIGHT OF DELETERIOUS SUBSTANCES SHALL NOT EXCEED FOLLOWING:

ITEM	PERCENT BY WEIGHT OF TOTAL SAMPLE MAXIMUM
CLAY LUMPS AND FRIABLE PARTICLES	3.0

MATERIAL FINER THAN 75-MM (NO. 200) SIEVE:	
CONCRETE SUBJECT TO ABRASION	3.0*
ALL OTHER CONCRETE	5.0*
COAL AND LIGNITE:	
WHERE SURFACE APPEARANCE OF CONCRETE IS OF IMPORTANCE	0.5
ALL OTHER CONCRETE	1.0

* IN CASE OF MANUFACTURED SAND, WHEN MATERIAL FINER THAN 75-MM (NO. 200) SIEVE CONSISTS OF DUST OF FRACTURE, ESSENTIALLY FREE FROM CLAY OR SHALE, THESE LIMITS MAY BE INCREASED TO 5 AND 7 PERCENT, RESPECTIVELY.

2. CONFORM COARSE AGGREGATE (SIZE 1 1/2 INCH TO NO. 4 SIEVE) TO REQUIREMENTS OF ASTM C 33. USE GRADATION WITHIN FOLLOWING LIMITS WHEN GRADED IN ACCORDANCE WITH ASTM C 136:

SIEVE DESIGNATION (SQUARE OPENINGS)	PERCENTAGE BY WEIGHT
RETAINED ON 1 3/4” SIEVE	0
RETAINED ON 1 1/2” SIEVE	0 – 5
RETAINED ON 3/4” SIEVE	30 – 65
RETAINED ON 3/8” SIEVE	70 – 90
RETAINED ON NO. 4 SIEVE	95 – 100
LOSS BY DECANTATION TEST (TEX-406-A)	1.0 MAXIMUM

* IN CASE OF AGGREGATES MADE PRIMARILY FROM CRUSHING OF STONE, WHEN MATERIAL FINER THAN 200 SIEVE IS DUST OF FRACTURE ESSENTIALLY FREE FROM CLAY OR SHALE AS ESTABLISHED BY PART III OF TXDOT TEX-406-A, PERCENT MAY BE INCREASED TO 1.5.

D. FINE AGGREGATE: SAND, MANUFACTURED SAND, OR COMBINATION THEREOF, COMPOSED OF CLEAN, HARD, DURABLE, UNCOATED GRAINS, FREE FROM LOAMS OR OTHER INJURIOUS FOREIGN MATTER. CONFORM FINE AGGREGATE FOR CONCRETE TO REQUIREMENTS OF ASTM C 33. USE GRADATION WITHIN FOLLOWING LIMITS WHEN GRADED IN ACCORDANCE WITH ASTM C 136:

SIEVE DESIGNATION (SQUARE OPENINGS)	PERCENTAGE BY WEIGHT
RETAINED ON 3/8" SIEVE	0
RETAINED ON NO. 4 SIEVE	0 – 5
RETAINED ON NO. 8 SIEVE	0 – 20
RETAINED ON NO. 16 SIEVE	15 – 50
RETAINED ON NO. 30 SIEVE	35 – 75
RETAINED ON NO. 50 SIEVE	65 -90
RETAINED ON NO. 100 SIEVE	90 – 100
RETAINED ON NO. 200 SIEVE	97 – 100

1. WHEN SUBJECTED TO COLOR TEST FOR ORGANIC IMPURITIES (ASTM C 40), FINE AGGREGATE SHALL NOT SHOW COLOR DARKER THAN STANDARD COLOR. FINE AGGREGATE SHALL BE SUBJECTED TO SAND EQUIVALENT TEST (TEX-203-F). SAND EQUIVALENT VALUE SHALL NOT BE LESS THAN 80, UNLESS HIGHER VALUE IS SHOWN ON DRAWINGS.

E. MINERAL FILLER: TYPE “C” OR TYPE “F” FLY ASH OF ACCEPTABLE QUALITY AND MEETING REQUIREMENTS OF ASTM C 618 MAY BE USED AS MINERAL ADMIXTURE IN CONCRETE MIXTURE. WHEN FLY ASH MINERAL FILLER IS USED, STORE AND INSPECT IN ACCORDANCE WITH ASTM C 618. DO NOT USE FLY ASH IN AMOUNTS TO EXCEED 20 PERCENT BY WEIGHT OF CEMENTATIOUS MATERIAL IN MIX DESIGN. CEMENT CONTENT MAY BE REDUCED WHEN STRENGTH REQUIREMENTS CAN BE MET. NOTE: WHEN FLY ASH IS USED, TERM "CEMENT" IS DEFINED AS CEMENT PLUS FLY ASH.

F. AIR ENTRAINING AGENT: FURNISH AIR ENTRAINING AGENT CONFORMING TO REQUIREMENTS OF ASTM C 260.

G. WATER REDUCER: WATER REDUCING ADMIXTURE CONFORMING TO REQUIREMENTS OF ASTM C 494 MAY BE USED WHEN REQUIRED TO IMPROVE WORKABILITY OF CONCRETE. AMOUNT AND TYPE OF ADMIXTURE IS SUBJECT TO APPROVAL BY THE OWNER'S REPRESENTATIVE.

2.02 MIXING

A. FLEXURAL STRENGTH SHALL BE AS SPECIFIED USING TEST SPECIMENS PREPARED IN ACCORDANCE WITH ASTM C 31 AND TESTED IN ACCORDANCE WITH ASTM C78 (USING SIMPLE BEAM WITH THIRD-POINT LOADING). COMPRESSIVE STRENGTH SHALL BE AS SPECIFIED USING TEST SPECIMENS PREPARED IN ACCORDANCE WITH ASTM C 31 AND TESTED IN ACCORDANCE WITH ASTM C 39. DETERMINE AND MEASURE BATCH QUANTITY OF EACH INGREDIENT, INCLUDING WATER FOR BATCH DESIGNS AND ALL CONCRETE PRODUCED FOR WORK. MIX SHALL CONFORM TO THESE SPECIFICATIONS AND OTHER REQUIREMENTS INDICATED ON DRAWINGS.

B. VEHICULAR PAVEMENT AND CURBS
   1. MIX DESIGN SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 3,000 POUNDS PER SQUARE INCH AT 7 DAYS AND 3,500 POUNDS PER SQUARE INCH AT 28 DAYS WHEN TESTED IN ACCORDANCE WITH ASTM C39. SLUMP OF CONCRETE SHALL BE AT LEAST 3 INCHES BUT NO MORE THAN 6 INCHES, WHEN TESTED IN ACCORDANCE WITH ASTM C143.
      a. DETERMINE CEMENT CONTENT IN ACCORDANCE WITH ASTM C 138 (WATER-CEMENT RATIO MAXIMUM 0.57). ADDITION OF MINERAL FILLER MAY BE USED TO IMPROVE WORKABILITY OR PLASTICITY OF CONCRETE TO LIMITS SPECIFIED.
      b. COARSE DRY AGGREGATE SHALL NOT EXCEED 85 PERCENT OF LOOSE VOLUME OF CONCRETE.
      c. ADD AIR-ENTRAINING ADMIXTURE TO ENSURE UNIFORM DISTRIBUTION OF AGENT THROUGHOUT BATCH. BASE AIR CONTENT OF FRESHLY MIXED AIR-ENTRAINED CONCRETE UPON TRIAL MIXES WITH MATERIALS TO BE USED IN WORK, ADJUSTED TO PRODUCE CONCRETE OF REQUIRED PLASTICITY AND WORKABILITY. PERCENTAGE OF AIR ENTRAINMENT IN MIX SHALL BE 4 1/2 PERCENT PLUS OR MINUS 1 1/2 PERCENT. DETERMINE AIR CONTENT BY TESTING IN ACCORDANCE WITH ASTM C 231.
      d. USE RETARDANT WHEN TEMPERATURE EXCEEDS 90 DEGREES F. PROPORTION AS RECOMMENDED BY MANUFACTURER. USE SAME BRAND AS USED FOR AIR-ENTRAINING AGENT. ADD AND BATCH MATERIAL USING SAME METHODS AS USED FOR AIR-ENTRAINING AGENT.

C. SIDEWALK, COURTYARD AND PEDESTRIAN AREA PAVEMENT
   1. MIX DESIGN SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 3,000 POUNDS PER SQUARE INCH AT 28 DAYS WHEN TESTED IN ACCORDANCE WITH ASTM C39. SLUMP OF CONCRETE SHALL BE AT LEAST 3 INCHES BUT NO MORE THAN 6 INCHES, WHEN TESTED IN ACCORDANCE WITH ASTM C143.
      a. DETERMINE CEMENT CONTENT IN ACCORDANCE WITH ASTM C 138 (WATER-CEMENT RATIO MAXIMUM 0.57). ADDITION OF MINERAL FILLER MAY BE USED TO IMPROVE WORKABILITY OR PLASTICITY OF CONCRETE TO LIMITS SPECIFIED.
      b. COARSE DRY AGGREGATE SHALL NOT EXCEED 85 PERCENT OF LOOSE VOLUME OF CONCRETE.

c. ADD AIR-ENTRAINING ADMIXTURE TO ENSURE UNIFORM DISTRIBUTION OF AGENT THROUGHOUT BATCH. BASE AIR CONTENT OF FRESHLY MIXED AIR-ENTRAINED CONCRETE UPON TRIAL MIXES WITH MATERIALS TO BE USED IN WORK, ADJUSTED TO PRODUCE CONCRETE OF REQUIRED PLASTICITY AND WORKABILITY. PERCENTAGE OF AIR ENTRAINMENT IN MIX SHALL BE 4 1/2 PERCENT PLUS OR MINUS 1 1/2 PERCENT. DETERMINE AIR CONTENT BY TESTING IN ACCORDANCE WITH ASTM C 231.

d. USE RETARDANT WHEN TEMPERATURE EXCEEDS 90 DEGREES F. PROPORTION AS RECOMMENDED BY MANUFACTURER. USE SAME BRAND AS USED FOR AIR-ENTRAINING AGENT. ADD AND BATCH MATERIAL USING SAME METHODS AS USED FOR AIR-ENTRAINING AGENT.

D. HIGH EARLY STRENGTH CONCRETE

1. USE HIGH EARLY STRENGTH CONCRETE PAVEMENT TO LIMITS SHOWN ON DRAWINGS OR AS REQUIRED TO MEET THE PROJECT SCHEDULE. DESIGN TO MEET THE FOLLOWING:
   a. CONCRETE MIX: FLEXURAL STRENGTH GREATER THAN OR EQUAL TO 500 PSI AT 72 HOURS.
   b. CEMENT: MINIMUM OF 7 SACKS OF CEMENT PER CUBIC YARD OF CONCRETE.
   c. WATER-CEMENT RATIO MAXIMUM OF 0.45. SLUMP OF CONCRETE SHALL A MAXIMUM OF 5 INCHES, WHEN TESTED IN ACCORDANCE WITH ASTM C 143.

E. NO ADDITIONAL WATER SHALL BE ADDED TO THE CONCRETE AT THE JOB SITE.

2.03 REINFORCING STEEL

A. PROVIDE NEW DEFORMED BILLET STEEL CONFORMING TO ASTM A 615, GRADE 60. STORE STEEL TO PROTECT IT FROM MECHANICAL INJURY AND RUST. AT TIME OF PLACEMENT, STEEL SHALL BE FREE FROM DIRT, SCALE, RUST, PAINT, OIL, OR OTHER INJURIOUS MATERIALS.

B. COLD BEND REINFORCING STEEL TO SHAPES SHOWN. ONCE STEEL HAS BEEN BENT, IT MAY NOT BE REBENT.

C. WELDED WIRE FABRIC MAY ONLY BE UTILIZED IF INDICATED ON THE DRAWINGS. IF WIRE FABRIC IS UTILIZED PROVIDE WIRE FABRIC CONFORMING TO ASTM A 82. USE FABRIC IN WHICH LONGITUDINAL AND TRANSVERSE WIRES HAVE BEEN ELECTRICALLY WELDED AT POINTS OF INTERSECTION. WELDS SHALL HAVE SUFFICIENT STRENGTH NOT TO BE BROKEN DURING HANDLING OR PLACING. CONFORM WELDING AND FABRICATION OF FABRIC SHEETS TO ASTM A 185.

D. EMPLOY SUPPORTS OF APPROVED SHAPE AND SIZE THAT WILL SECURE REINFORCING STEEL AND JOINT ASSEMBLY IN CORRECT POSITION DURING PLACING AND FINISHING OF CONCRETE. SPACE SUPPORTS AS DIRECTED BY THE OWNER'S REPRESENTATIVE. CHARIS SHALL BE W.H.C. PRODUCTS, INC. - SERIES "G" WITH SAND PLATES; OR DAYTON SUPERIOR - AZTEC "CASTLE".

2.04 ISOLATION JOINT MATERIAL

A. FILLER BOARD OF SELECTED STOCK. CLEAR, ALL-HEART REDWOOD WEIGHING NO MORE THAN 30 POUNDS PER CUBIC FOOT, AFTER BEING OVEN DRIED TO CONSTANT WEIGHT.

B. BOARD FILLER SHALL BE FREE OF DEFECTS WHICH WILL IMPAIR THEIR USEFULNESS AS EXPANSION JOINT FILLERS.

2.05 LOAD TRANSMISSION DEVICES

A. LOAD TRANSMISSION DEVICES SHALL BE AS DETAILED ON PLANS AND CONFORM TO THE PROPERTIES SPECIFIED IN ASTM A615, GRADE 60 STEEL.

2.06 STEEL DOWEL BARS

A. STEEL DOWEL BARS AND STEEL REINFORCEMENT SHALL BE DEFORMED OR SMOOTH BARS CONFORM IN PROPERTIES TO ASTM A 615 GRADE 40. UNLESS OTHERWISE SHOWN ON THE PLANS ALL REINFORCING STEEL SHALL BE DEFORMED BARS, ALL DOWEL BARS AT JOINTS SHALL BE SMOOTH BARS, AND ALL CURB DOWELS SHALL BE DEFORMED BARS.

B. GREENSTREAK TWO COMPONENT SPEED DOWEL SYSTEM CAN BE USED AT CONSTRUCTION JOINTS PENDING ENGINEER APPROVAL. PRODUCT SUBMITTAL REQUIRED FOR APPROVAL.

C. GREENSTREAK TWO COMPONENT SPEED LOAD SYSTEM CAN BE USED AT ISOLATION JOINTS PENDING ENGINEER APPROVAL. PRODUCT SUBMITTAL REQUIRED FOR APPROVAL.

2.07 NONSHRINK GROUT

A. NONMETALLIC, NONSHRINK GROUT CONTAINING NO CHLORIDE PRODUCING AGENTS CONFORMING TO FOLLOWING REQUIREMENTS.
   1. COMPRESSIVE STRENGTH
      a. AT 7 DAYS: 3,500 PSI
      b. AT 28 DAYS: 8,000 PSI
   2. INITIAL SET TIME: 45 MINUTES
   3. FINAL SET TIME: 1.5 HOURS

2.08 LIQUID MEMBRANE-FORMING COMPOUNDS

A. LIQUID MEMBRANE-FORMING COMPOUNDS SHALL CONFORM TO ASTM C 309, TYPE 1 OR TYPE 2, WHITE PIGMENTED. MEMBRANE SHALL RESTRICT LOSS OF WATER TO NOT MORE THAN 0.55 KG/M2 IN 72 HOURS USING TEST METHOD ASTM C 156.

2.09 COVER MATERIALS FOR CURING

A. POLYETHYLENE FILM: OPAQUE PIGMENTED WHITE FILM CONFORMING TO REQUIREMENTS OF ASTM C 171.

2.10 JOINT SEALING COMPOUND

A. SELF-LEVELING, LOW MODULUS SILICONE OR POLYURETHANE SEALANT FOR ASPHALTIC CONCRETE AND PORTLAND CEMENT CONCRETE JOINTS CONFORMING TO THE REQUIREMENTS OF TXDOT DMS-6310 FOR CLASS 5 JOINT SEALANTS.

PART 3 – EXECUTION

3.01 PREPERATION

A. VERIFY SUBGRADE LINES AND GRADES.

B. THE SUBGRADE SHALL BE A PREVIOUSLY PREPARED SUBGRADE, STABILIZED IF REQUIRED, COMPACTED TO A MINIMUM OF 95% STANDARD DENSITY ASTM D-698, AND GRADED TO THE REQUIRED SECTION AND GRADES SHOWN ON THE DRAWINGS AND AS SPECIFIED.

C. PROOF-ROLL PREPARED SUB-BASE SURFACE BELOW CONCRETE PAVEMENTS WITH HEAVY PNEUMATIC-TIRED EQUIPMENT TO IDENTIFY SOFT POCKETS AND AREAS OF EXCESS YIELDING.

D. ROLLING AND SPRINKLING SHALL BE PERFORMED TO MAINTAIN THE SPECIFIED MOISTURE CONTENT OF THE SUBGRADE AS NECESSARY PRIOR TO PLACING THE CONCRETE.

3.02 FORMS

A. FORMS SHALL BE OF WOOD OR METAL, PROPERLY TREATED TO ENSURE CONCRETE DOES NOT ADHERE TO THE FORMS, STRAIGHT, CLEAN, FREE FROM WARP OR DEFECT, AND OF SUFFICIENT DEPTH.

B. THE FORMS SHALL BE SO PLACED THAT WHEN PLACED EACH FORM SECTION WILL BE FIRMLY IN CONTACT FOR ITS WHOLE LENGTH AND BASE WIDTH AND EXACTLY AT THE ESTABLISHED GRADE.

C. ANY SUBGRADE UNDER THE FORMS BELOW ESTABLISHED GRADE SHALL BE CORRECTED USING SUITABLE MATERIAL, PLACED, SPRINKLED, AND ROLLED.

D. FORMS SHALL BE SECURELY STAKED AND TIGHTLY JOINTED AND KEYED TO PREVENT DISPLACEMENT.

E. SUFFICIENT STABILITY OF FORMS TO SUPPORT EQUIPMENT OPERATED THEREON AND TO WITHSTAND ITS VIBRATION WITHOUT SPRINGING SHALL BE REQUIRED.

F. FORMS SHALL REMAIN IN PLACE NOT LESS THAN 24 HOURS AFTER CONCRETE IS PLACED.

3.03 JOINTS

A. SHALL BE CONSTRUCTED IN THE PAVEMENT SLAB AT LOCATIONS AND ACCORDING TO DETAILS AS SHOWN ON THE DRAWINGS. STAKES, BRACES, BRACKETS OR OTHER DEVICES SHALL BE USED AS NECESSARY TO KEEP THE ENTIRE JOINT ASSEMBLY IN TRUE VERTICAL AND HORIZONTAL POSITION.

B. WHEN NEW WORK IS ADJACENT TO EXISTING CONCRETE, PLACE JOINTS AT SAME LOCATION AS EXISTING JOINTS IN ADJACENT PAVEMENT.

C. FORM CONSTRUCTION, ISOLATION, AND CONTRACTION JOINTS AND TOOL EDGINGS TRUE TO LINE WITH FACES PERPENDICULAR TO SURFACE PLANE OF CONCRETE. CONSTRUCT TRANSVERSE JOINTS AT RIGHT ANGLES TO CENTERLINE, UNLESS OTHERWISE INDICATED.

D. SET CONSTRUCTION JOINTS AT SIDE AND END TERMINATIONS OF PAVEMENT AND AT LOCATIONS WHERE PAVEMENT OPERATIONS ARE STOPPED FOR MORE THAN ONE-HALF HOUR UNLESS PAVEMENT TERMINATES AT ISOLATION JOINTS.

E. FORM ISOLATION JOINTS OF BOARD FILLER STRIPS ABUTTING CONCRETE CURBS, CATCH BASINS, MANHOLES, INLETS, STRUCTURES, WALKS, OTHER FIXED OBJECTS, AND WHERE INDICATED.

F. EXPANSION JOINTS SHALL BE CONSTRUCTED WITH BOARD FILLER AND SEALED AT TOP. BOARD FILLER MUST BE PERPENDICULAR TO PLANE OF CONCRETE SLAB. ALIGNMENT OF JOINT SHALL NOT VARY MORE THAN 1/4 INCH IN 10 FEET.

G. FORM WEAKENED-PLANE CONTRACTION JOINTS, SECTIONING CONCRETE INTO AREAS AS INDICATED. CONSTRUCT CONTRACTION JOINTS FOR A DEPTH EQUAL TO AT LEAST ONE-FOURTH OF THE CONCRETE THICKNESS. IF APPLICABLE, MATCH JOINTING OF EXISTING ADJACENT CONCRETE PAVEMENT.

H. TOOL EDGES OF PAVEMENT, GUTTERS, CURBS, AND JOINTS IN CONCRETE AFTER INITIAL FLOATING WITH AN EDGING TOOL TO A 3/16-INCH RADIUS. REPEAT TOOLING OF EDGES AFTER APPLYING SURFACE FINISHES. ELIMINATE TOOL MARKS ON CONCRETE SURFACES.

3.04 REINFORCING STEEL

A. COMPLY WITH CRSI'S "MANUAL OF STANDARD PRACTICE" FOR FABRICATING, PLACING, AND SUPPORTING REINFORCEMENT.

B. REINFORCING STEEL SHALL BE ACCURATELY PLACED AS SHOWN ON DRAWINGS AND SECURED IN PLACE. WIRE REINFORCING BARS SECURELY TOGETHER AT INTERSECTIONS AND SPLICES. ALL BARS SHALL BE SUPPORTED ON AND SECURED TO STEEL OR PLASTIC BAR CHAIRS. LAPS SHALL BE A MINIMUM OF TEN (10) INCHES AND TIED. BARS AND COATINGS SHALL BE FREE OF RUST, DIRT OR OTHER FOREIGN MATTER WHEN CONCRETE IS PLACED.

C. USE SUFFICIENT NUMBER OF CHAIRS FOR STEEL REINFORCEMENT BARS TO MAINTAIN POSITION OF BARS WITHIN ALLOWABLE TOLERANCES. PLACE REINFORCEMENT AS SHOWN ON DRAWINGS. IN PLANE OF STEEL PARALLEL TO NEAREST SURFACE OF CONCRETE, BARS SHALL NOT VARY FROM PLAN PLACEMENT BY MORE THAN 1/12 OF SPACING BETWEEN BARS. IN PLANE OF STEEL PERPENDICULAR TO NEAREST SURFACE OF CONCRETE, BARS SHALL NOT VARY FROM PLAN PLACEMENT BY MORE THAN 1/4 INCH.

D. DRILL DOWELS INTO EXISTING PAVEMENT, SECURE WITH EPOXY, AND PROVIDE PAVING HEADERS AS REQUIRED TO PROVIDE RIGID PAVEMENT SECTIONS.

3.05 CONCRETE PLACEMENT

A. CONCRETE NOT PLACED AS HEREIN PRESCRIBED WITHIN 90 MINUTES AFTER MIXING SHALL BE REJECTED.

B. CONCRETE SHALL NOT BE PLACED WHEN TEMPERATURE IS BELOW 40 DEGREES F AND FALLING, BUT MAY BE PLACED WHEN THE TEMPERATURE IS ABOVE 35 DEGREES F AND RISING, THE TEMPERATURE BEING TAKEN IN THE SHADE AND AWAY FROM ARTIFICIAL HEAT.

C. CONCRETE SHALL NOT BE PLACED BEFORE THE TIME OF SUNRISE, AND SHALL NOT BE PLACED LATER THAN WILL PERMIT THE FINISHING OF THE PAVEMENT DURING SUFFICIENT NATURAL LIGHT.

D. MOISTEN SUB-BASE TO PROVIDE A UNIFORM DAMPENED CONDITION AT TIME CONCRETE IS PLACED.

E. DEPOSIT CONCRETE CONTINUOUSLY IN SUCCESSIVE BATCHES. DISTRIBUTE CONCRETE IN MANNER THAT WILL REQUIRE AS LITTLE REHANDLING AS POSSIBLE. WHERE HAND SPREADING IS NECESSARY, DISTRIBUTE CONCRETE WITH SHOVELS OR BY OTHER APPROVED METHODS. USE ONLY CONCRETE RAKES IN HANDLING CONCRETE. AT PLACEMENT INTERRUPTION OF MORE THAN 30 MINUTES, PLACE TRANSVERSE CONSTRUCTION JOINT AT STOPPING POINT. REMOVE AND REPLACE SECTIONS LESS THAN 10 FEET LONG.

F. TAKE SPECIAL CARE IN PLACING AND SPADING CONCRETE AGAINST FORMS AND AT LONGITUDINAL AND TRANSVERSE JOINTS TO PREVENT HONEYCOMBING. VOIDS IN EDGE OF FINISHED PAVEMENT WILL BE CAUSE FOR REJECTION.

G. CONCRETE SHALL BE CONSOLIDATED BY A MECHANICAL VIBRATOR TO REMOVE ALL VOIDS. SPECIAL CARE SHALL BE EXERCISED IN PLACING AND SPADING CONCRETE AGAINST FORMS AND AT ALL JOINTS TO PREVENT THE FORMING OF HONEYCOMBS AND VOIDS AND TO PREVENT DISPLACEMENT OF STEEL REINFORCEMENT AND LOAD TRANSMISSION DEVICES.

H. THE CONCRETE SHALL BE STRUCK OFF WITH AN APPROVED STRIKE-OFF SCREED TO SUCH ELEVATION THAT WHEN CONSOLIDATED AND FINISHED, THE SURFACE OF PAVEMENT SHALL CONFORM TO THE REQUIRED SECTION AND GRADE. IN NO CASE SHALL THE MAXIMUM ORDINATE FROM A 10 FOOT STRAIGHT EDGE TO THE PAVEMENT BE GREATER THAN 1/8 INCH.

I. THE STRIKE TEMPLATE SHALL BE MOVED FORWARD WITH A COMBINED TRANSVERSE AND LONGITUDINAL MOTION IN THE DIRECTION THE WORK IS PROGRESSING, MAINTAINING THE TEMPLATE IN CONTACT WITH THE FORMS, AND MAINTAINING A SLIGHT EXCESS OF MATERIAL IN FRONT OF THE CUTTING EDGE.

3.06 FINISHING

A. DO NOT ADD WATER TO CONCRETE SURFACES DURING FINISHING OPERATIONS.

B. AFTER COMPLETION OF A STRIKE-OFF, CONSOLIDATION AND TRANSVERSE SCREEDING, A HAND-OPERATED LONGITUDINAL FLOAT SHALL BE OPERATED TO TEST AND LEVEL THE SURFACE TO THE REQUIRED GRADE. THE LONGITUDINAL FLOAT SHALL BE HELD IN CONTACT WITH THE SURFACE AND PARALLEL TO THE CENTER LINE, AND OPERATED WITH SHORT LONGITUDINAL STROKES WHILE BEING PASSED FROM ONE SIDE OF THE PAVEMENT TO THE OTHER. IF CONTACT WITH THE PAVEMENT IS NOT MADE AT ALL POINTS, ADDITIONAL CONCRETE SHALL BE PLACED IF REQUIRED, AND SCREEDED, AND THE FLOAT SHALL BE USED TO PRODUCE A SATISFACTORY SURFACE.

C. BEGIN THE SECOND FLOATING OPERATION WHEN BLEED-WATER SHEEN HAS DISAPPEARED AND CONCRETE SURFACE HAS STIFFENED SUFFICIENTLY TO PERMIT OPERATIONS. FLOAT SURFACE WITH POWER-DRIVEN FLOATS, OR BY HAND FLOATING

IF AREA IS SMALL OR INACCESSIBLE TO POWER UNITS. FINISH SURFACES TO TRUE PLANES. CUT DOWN HIGH SPOTS AND FILL LOW SPOTS. REFLOAT SURFACE IMMEDIATELY TO UNIFORM TEXTURE.

1. BURLAP FINISH: DRAG A SEAMLESS STRIP OF DAMP BURLAP ACROSS FLOAT-FINISHED CONCRETE, PERPENDICULAR TO LINE OF TRAFFIC, TO PROVIDE A UNIFORM, GRITTY TEXTURE.
2. MEDIUM-TO-COARSE-TEXTURED BROOM FINISH: PROVIDE A COARSE FINISH BY STRIATING FLOAT-FINISHED CONCRETE SURFACE 1/16 TO 1/8 INCH DEEP WITH A STIFF-BRISTLED BROOM, PERPENDICULAR TO LINE OF TRAFFIC.
3. MEDIUM-TO-FINE-TEXTURED BROOM FINISH: DRAW A SOFT BRISTLE BROOM ACROSS FLOAT-FINISHED CONCRETE SURFACE PERPENDICULAR TO LINE OF TRAFFIC TO PROVIDE A UNIFORM, FINE-LINE TEXTURE.

3.07 TOLERANCES

A. TEST ENTIRE SURFACE BEFORE INITIAL SET AND CORRECT IRREGULARITIES OR UNDULATIONS. BRING SURFACE WITHIN REQUIREMENTS OF FOLLOWING TEST AND THEN FINISH.

B. COMPLY WITH TOLERANCES OF ACI 117 AND AS FOLLOWS:
   1. ELEVATION: 1/4 INCH.
   2. THICKNESS: PLUS 3/8 INCH, MINUS 1/4 INCH.
   3. SURFACE: GAP BELOW 10-FOOT LONG, UNLEVELED STRAIGHTEDGE NOT TO EXCEED 1/16 INCH.
   4. JOINT SPACING: 3 INCHES.
   5. CONTRACTION JOINT DEPTH: PLUS 1/4 INCH, NO MINUS.
   6. JOINT WIDTH: PLUS 1/8 INCH, NO MINUS.

3.08 CONCRETE PROTECTION AND CURING

A. PROTECT FRESHLY PLACED CONCRETE FROM PREMATURE DRYING AND EXCESSIVE COLD OR HOT TEMPERATURES FOR A PERIOD OF NOT LESS THAN 72 HOURS FROM THE BEGINNING OF THE CURING OPERATION.

B. COMPLY WITH ACI 306.1 FOR COLD-WEATHER PROTECTION.

C. BEGIN CURING AFTER FINISHING CONCRETE BUT NOT BEFORE FREE WATER HAS DISAPPEARED FROM CONCRETE SURFACE.

D. APPLY LIQUID MEMBRANE-FORMING COMPOUND IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS.

E. MOISTEN CONCRETE BY WATER FOGGING PRIOR TO APPLICATION OF MEMBRANE WHEN SURFACE HAS BECOME DRY.

F. SEAL CONCRETE SURFACE WITH SINGLE COAT AT RATE OF COVERAGE RECOMMENDED BY MANUFACTURER AND DIRECTED BY THE OWNER’S REPRESENTATIVE, BUT NOT LESS THAN ONE GALLON PER 200 SQUARE FEET OF SURFACE AREA.

3.09 CURBS

A. DOWELLED ON CURB

1. AFTER CURING THE CONCRETE PAVEMENT, DOWELED ON CURBS, USING SECURE FORMS SHALL BE CONSTRUCTED TO THE SIZE SHOWN ON THE PLANS.
2. DOWELS MAY BE PLACED IN THE PAVEMENT SLAB BEFORE THE CONCRETE HAS SET, OR PLACED IN DRILLED HOLES USING EPOXY ADHESIVE TO SECURE THE BARS IN PLACE.
3. PAVEMENT JOINTS SHALL EXTEND THROUGH THE CURBS. EXPANSION JOINT MATERIAL SHALL BE THE SAME THICKNESS, TYPE AND QUALITY AS SPECIFIED FOR THE PAVEMENT.
4. WHEN SAWED JOINTS ARE PROVIDED, THE PLACEMENT OF CURB SHALL BE DELAYED UNTIL ALL TRANSVERSE JOINTS ARE SAWED.
5. ALL JOINTS SHOULD BE TOOL FINISHED AFTER SUFFICIENT CURING OF THE CONCRETE.
6. THE CONCRETE, REINFORCEMENT AND CURING OF THE CURBS SHALL CONFORM TO THE REQUIREMENTS SPECIFIED FOR THE CONCRETE PAVEMENT.
7. IN FINISHING THE CURBS, A THIN COATING OF MORTAR SHALL BE WORKED INTO THE EXPOSED FACE OF THE CURB IN ORDER TO OBTAIN A BRUSH FINISH FREE OF ALL BLEMISHES AND FORM OR TOOL MARKS.
8. CURBS SHALL HAVE A STRAIGHTNESS TOLERANCE OF 1/8 INCH IN 10 FEET, MEASURED LONGITUDINALLY ALONG THE BACK AND FACE OF THE CURB.
9. THE TOP OF THE CURB SHALL NOT VARY VERTICALLY IN HEIGHT MORE THAN 1/8" WHEN MEASURED UP FROM THE CONCRETE PAVEMENT.

B. MONOLITHIC CURBS AND CURB AND GUTTER
1. MONOLITHIC CURB AND CURB AND GUTTER SHALL CONFORM TO THE SPECIFICATIONS FOR DOWELED ON CURB AND THE DETAILS SHOWN ON THE PLANS.
2. MONOLITHIC CURB AND CURB AND GUTTER SHALL BE CONSTRUCTED AFTER FINAL GRADING OF THE SUBGRADE AND BEFORE PLACEMENT OF THE BASE MATERIAL.
3. THESE CURBS SHALL BE CURED FOR AT LEAST 72 HOURS AND SHALL BE PROPERLY BACKFILLED BEHIND THE CURB BY HAND TAMPING TO 95% STANDARD PROCTOR DENSITY ASTM D 698 BEFORE PLACING THE BASE MATERIAL.

3.10 APPLICATION OF JOINT SEALING COMPOUND

A. JOINTS SHALL BE THOROUGHLY CLEANED OF LOOSE SCALE, DIRT, DUST, AND CURING COMPOUND. WHEN NECESSARY, EXISTING JOINT MATERIAL SHALL BE REMOVED TO THE DEPTH AS SHOWN ON THE PLANS.

B. JOINTS SHALL BE FILLED TO THE FULL DEPTH OF THE JOINT OPENING. POURING SHALL BE DONE IN A NEAT AND WORKMAN LIKE MANNER TO GIVE SATISFACTORY RESULTS. SUFFICIENT JOINT SEALER SHALL BE POURED INTO THE JOINTS SO THAT UPON THE COMPLETION OF THE WORK THE SURFACE OF SEALER WITHIN THE JOINT SHALL BE 1/4" ABOVE TOP OF THE PAVEMENT SURFACE.

3.11 FIELD QUALITY CONTROL

A. COMPRESSIVE STRENGTH TEST SPECIMENS: MAKE FOUR TEST SPECIMENS FOR COMPRESSIVE STRENGTH TEST IN ACCORDANCE WITH ASTM C 31 FOR EACH 150 CUBIC YARDS OR LESS OF PAVEMENT THAT IS PLACED IN ONE DAY. TEST TWO SPECIMENS AT 7 DAYS OR AT NUMBER OF HOURS AS DIRECTED BY THE OWNER'S REPRESENTATIVE FOR HIGH EARLY STRENGTH CONCRETE. TEST REMAINING TWO SPECIMENS AT 28 DAYS. TEST SPECIMENS IN ACCORDANCE WITH ASTM C 39. LABORATORY TECHNICIAN WILL PREPARE CONCRETE TEST CYLINDERS.

B. WHEN COMPRESSIVE TEST INDICATES FAILURE, MAKE YIELD TEST IN ACCORDANCE WITH ASTM C 138 FOR CEMENT CONTENT PER CUBIC YARD OF CONCRETE. WHEN CEMENT CONTENT IS FOUND TO BE LESS THAN THAT SPECIFIED PER CUBIC YARD, INCREASE BATCH WEIGHTS UNTIL AMOUNT OF CEMENT PER CUBIC YARD OF CONCRETE CONFORMS TO REQUIREMENTS.

C. MINIMUM OF ONE 4 INCH CORE WILL BE TAKEN AT RANDOM LOCATIONS PER 5,000-SQUARE FEET OF PAVEMENT TO MEASURE IN-PLACE DEPTH. MEASURE DEPTH IN ACCORDANCE WITH ASTM C 174. EACH CORE MAY BE TESTED FOR 28 DAY COMPRESSIVE STRENGTH ACCORDING TO METHODS OF ASTM C 42. 28 DAY COMPRESSIVE STRENGTH OF EACH CORE TESTED SHALL BE A MINIMUM OF 3,000 POUNDS PER SQUARE INCH.

D. REQUEST, AT OPTION, THREE ADDITIONAL CORES IN VICINITY OF CORES INDICATING NONCONFORMING INPLACE DEPTHS AT NO COST TO THE OWNER. IN-PLACE DEPTH AT THESE LOCATIONS SHALL BE AVERAGE DEPTH OF FOUR CORES.

E. FILL CORES AND DENSITY TEST SECTIONS WITH NEW CONCRETE PAVING OR NON-SHRINK GROUT.

3.12 REPAIRS AND PROTECTION

A. REMOVE AND REPLACE CONCRETE PAVEMENT THAT IS BROKEN, DAMAGED, OR DEFECTIVE OR THAT DOES NOT COMPLY WITH REQUIREMENTS IN THIS SECTION.

B. PROTECT CONCRETE FROM DAMAGE.

C. THE PAVEMENT SHALL BE CLOSED TO ALL TRAFFIC, INCLUDING VEHICLES OF THE CONTRACTOR, UNTIL THE CONCRETE IS AT LEAST 7 DAYS OLD OR HAS ATTAINED A MINIMUM AVERAGE OF 3,000 PSI COMPRESSIVE STRENGTH.

D. MAINTAIN CONCRETE PAVEMENT FREE OF STAINS, DISCOLORATION, DIRT, AND OTHER FOREIGN MATERIAL. SWEEP CONCRETE PAVEMENT NOT MORE THAN TWO DAYS BEFORE DATE SCHEDULED FOR SUBSTANTIAL COMPLETION INSPECTIONS.

E. ANY DAMAGE TO THE PAVEMENT PRIOR TO ACCEPTANCE BY THE OWNER SHALL BE REPAIRED BY THE CONTRACTOR AT NO EXTRA COST TO THE OWNER.

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SECTION 32 17 23.13 – PAINTED PAVEMENT MARKINGS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. THIS SECTION PERTAINS TO THE APPLICATION OF PAVEMENT MARKING AS INDICATED ON THE DRAWINGS AND AS SPECIFIED HEREIN.

1.02 REGULATORY REQUIREMENTS

A. CONTRACTOR SHALL COMPLY WITH ALL CURRENT, APPLICABLE CODES AND REGULATIONS.

B. CONTRACTOR SHALL COMPLY WITH ALL STANDARD SPECIFICATIONS AND DETAILS OF AUTHORITIES HAVING JURISDICTION (HEREIN AFTER REFERRED TO AS "STANDARD SPECIFICATIONS") FOR WORK IN THE RIGHT-OF-WAY OR EASEMENTS.

C. PRIOR TO COMMENCEMENT OF WORK, THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING, AT THE CONTRACTOR'S OWN EXPENSE, ALL CONSTRUCTION PERMITS NECESSARY TO COMPLETE THE PROJECT ACCORDING TO THE PLANS AND SPECIFICATIONS.

1.03 SUBMITTALS

A. PRODUCT DATA: FOR EACH TYPE OF PRODUCT; INCLUDE TECHNICAL DATA AND TESTED PHYSICAL AND PERFORMANCE PROPERTIES.

B. AS REQUESTED BY THE OWNER'S REPRESENTATIVE SUBMIT SHOP DRAWINGS FOR PAVEMENT MARKINGS.
   1. INDICATE PAVEMENT MARKINGS, COLORS, LANE SEPARATIONS, DEFINED PARKING SPACES, AND DIMENSIONS TO ADJACENT WORK.
   2. INDICATE, WITH INTERNATIONAL SYMBOL OF ACCESSIBILITY, SPACES ALLOCATED FOR PEOPLE WITH DISABILITIES.

C. AS REQUESTED BY THE OWNER'S REPRESENTATIVE SUBMIT SAMPLES FOR EACH PRODUCT AND FOR EACH COLOR AND TEXTURE SPECIFIED; ON RIGID BACKING, 8 INCHES (200 MM) SQUARE.

1.04 QUALITY ASSURANCE

A. COMPLY WITH MATERIALS, WORKMANSHIP, AND OTHER APPLICABLE REQUIREMENTS OF THE HARRIS COUNTY ENGINEERING SPECIFICATIONS LATEST EDITION FOR PAVEMENT-MARKING WORK.

PART 2 – PRODUCTS

2.01 CONFORMANCE OF FINISHED PRODUCTS

A. CONFORMANCE OF FINISHED PRODUCTS. COATINGS SHALL CONFORM ON A WEIGHT BASIS, TO THE COMPOSITION REQUIREMENTS OF THE STANDARD FORMULA. NO VARIATION FROM THE STANDARD FORMULA WILL BE PERMITTED EXCEPT FOR REPLACEMENT OF MATERIALS LOST IN PROCESSING, OR THOSE APPROVED BY THE

ENGINEER. THE FINISHED COATINGS SHALL CONFORM WITH ALL REQUIREMENTS STIPULATED FOR EACH STANDARD FORMULA AND IN ADDITION SHALL EQUAL A WET STANDARD IN CHARACTERISTICS SUCH AS COLOR, DRYING, FLOW, SETTLING, BRUSH ABILITY, CAN STABILITY, HIDING, ETC.

B. FILM CHARACTERISTICS SUCH AS GLOSS, HARDNESS, LIGHT PERMANENCY, ADHESION, ETC., SHALL ALSO CONFORM. WHEN TESTING FOR SUCH CONFORMITY, THE COATING SHALL BE APPLIED AND TESTED UNDER PARALLEL CONDITIONS WITH THE WET STANDARD.

C. THE FINISHED PRODUCT SHALL BE FREE OF SKINS AND FOREIGN MATERIALS.

2.02 PAINTS

A. PAINT FOR STRIPPING SHALL BE 100% ACRYLIC PREMIUM GRADE TRAFFIC PAINT CONFORMING TO THE REQUIREMENTS OF FS TT-P-1952 TYPE 1; LATEST EDITION.

B. COLORS SHALL BE AS SHOWN ON THE DRAWINGS OR DESIGNATED BY THE OWNER'S REPRESENTATIVE FROM THE FOLLOWING:
   1. WHITE
   2. YELLOW
   3. BLUE
   4. RED
   5. BLACK
   6. GREEN

2.03 GLASS REFLECTIVE BEADS

A. GLASS REFLECTIVE BEADS SHALL CONFORM TO THE REQUIREMENTS OF FS TT-B1325 - TYPE 1; LATEST EDITION.

PART 3 – EXECUTION

3.01 PREPERATION

A. DO NOT APPLY PAVEMENT-MARKING PAINT UNTIL LAYOUT, COLORS, AND PLACEMENT HAVE BEEN VERIFIED WITH OWNER'S REPRESENTATIVE.

B. ALLOW PAVING TO AGE FOR A MINIMUM OF 30 DAYS BEFORE STARTING PAVEMENT MARKING.

C. THE PAVEMENT SURFACE TO RECEIVE THE STRIPING SHALL BE THOROUGHLY CLEANED OF ALL DIRT, ORGANIC GROWTH, OIL, GREASE, OR OTHER MATERIALS THAT WILL PREVENT ADHESION OF THE PAINT TO THE ROADWAY SURFACE.

3.02 LAYOUT

A. THE PAVEMENT MARKINGS SHALL BE PLACED IN PROPER ALIGNMENT WITH GUIDELINES ESTABLISHED ON THE ROADWAY. DEVIATION FROM THE ALIGNMENT ESTABLISHED SHALL NOT EXCEED 2 INCHES AND, IN ADDITION, THE DEVIATION IN ALIGNMENT OF THE MARKING BEING PLACED SHALL NOT EXCEED 1 INCH PER 200 FEET OF ROADWAY NOR SHALL ANY DEVIATION BE ABRUPT.

1. NO STRIPING MATERIAL SHALL BE APPLIED OVER A GUIDE CORD; ONLY LONGITUDINAL JOINTS, EXISTING STRIPES, PRIMER, OR OTHER APPROVED TYPE GUIDES WILL BE PERMITTED. IN THE ABSENCE OF A LONGITUDINAL JOINT OR EXISTING STRIPE, THE CONTRACTOR SHALL MARK THE POINTS NECESSARY FOR THE PLACING OF THE PROPOSED STRIPE. EDGE STRIPING SHALL BE ADJUSTED AS NECESSARY SO THAT THE EDGE STRIPE WILL BE PARALLEL TO THE CENTERLINE AND SHALL NOT BE PLACED OFF THE EDGE OF THE PAVEMENT.
2. LONGITUDINAL MARKINGS SHALL BE OFFSET AT LEAST 2-INCHES FROM CONSTRUCTION JOINTS OF PORTLAND CEMENT CONCRETE SURFACES AND JOINTS AND SHOULDER BREAKS OF ASPHALT SURFACES.

3.03 APPLICATION

A. PAINTS SHALL BE APPLIED BY BRUSH, SPRAY, OR FLOW METHODS TO CLEAN AND DRY SURFACES WITH SURFACE TEMPERATURE 50 F OR ABOVE.

B. TRAFFIC PAINT SHALL BE APPLIED WITH A MINIMUM THICKNESS OF 10 MILS, MEASURED IN DRY CONDITION, PRIOR TO ADDING ANY GLASS REFLECTIVE SPHERES.

C. PAINT STRIPING SHALL BE APPLIED AND MEASURED TO ± 1/4" OF THE SPECIFIED WIDTHS.

D. PAINT SHALL BE APPLIED AS SHOWN ON DRAWINGS.

E. WHERE REQUIRED GLASS SPHERES OR REFLECTORIZED GRANULES SHALL BE APPLIED, BEFORE THE PAINT SETS OR DRIES, EVENLY AT A RATE OF 6 POUNDS OF GLASS SPHERES OR 1.7 POUNDS OF REFLECTORIZED GRANULES PER GALLON OF PAINT.

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SECTION 32 31 13

CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Fence framework, fabric, and accessories.
   2. Excavation for post bases.
   3. Concrete foundation for posts and center drop for gates.
   4. Manual swing gates and related hardware.
   5. Privacy slats at dumpster gates.

B. Related Sections:
   1. Section 03 33 00 – Cast-in-Place Concrete: Concrete requirements for fencing footings.

1.02 REFERENCE STANDARDS

A. ASTM International:

B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

D. ASTM A392 - Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric; 2011a (Reapproved 2022).

E. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2019.

F. ASTM F567 - Standard Practice for Installation of Chain-Link Fence; 2023.

G. Chain Link Fence Manufacturers Institute
   1.

1.03 SYSTEM DESCRIPTION

A. Fence Height: as indicated on Drawings.

B. Line Post Spacing: At intervals not exceeding 10 feet (304.8 cm).

1.04 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, gates, and schedule of components.

C. Product Data: Submit data on fabric, posts, accessories, fittings and hardware.

D. Product Certificates: Signed by manufacturers of chain-link fences and gates certifying that products furnished comply with requirements.

E. Manufacturer's Installation Instructions: Submit installation requirements.
   1. PRE-INSTALLATION MEETING

F. Section 01 31 19 – Project Meetings: Schedule and coordinate pre-installation meeting that includes the trade(s) for the work of this Section and other trades that whose work is related to the work of this Section.
   1. Convene minimum one week prior to commencing work of this Section.

1.05 QUALITY ASSURANCE

A. Supply material in accordance with CLFMI - Product Manual.

B. Perform installation in accordance with ASTM F567.

C. Emergency Access Requirements: Comply with requirements of authorities having jurisdiction for gates and lock boxes for emergency access.

D. Source Limitations for Chain-Link Fences and Gates: Obtain each color, grade, finish, type, and variety of component for chain-link fences and gates from one source with resources to provide chain-link fences and gates of consistent quality in appearance and physical properties.

1.06 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years’ experience.

B. Installer: An experienced installer who has completed chain-link fences and gates similar in material, design, and extent to those indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

1.07 DELIVERY, STORAGE AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Deliver fence fabric and accessories in packed cartons or firmly tied rolls.

C. Identify each package with manufacturer’s name.

D. Store fence fabric and accessories in secure and dry place.

1.08 PROJECT CONDITIONS

A. Existing Utilities: 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 7 days in advance of proposed utility interruptions.

2. Do not proceed with utility interruptions without Owner's written permission.

B. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

PART 2 PRODUCTS

2.01 MATERIALS AND COMPONENTS

A. Materials and Components: Conform to CLFMI Product Manual.

B. Fabric: CLFMI Standard Industrial, Residential service.
1. Mesh size: 2 inch (50.8 mm).
2. Selvage: Knuckled at both selvages.

C. Intermediate Posts: Type I round.

D. Terminal, Corner, Rail, Brace, and Gate Posts: Type I round.

2.02 ACCESSORIES

A. Caps: Cast steel galvanized; sized to post diameter, set screw retainer.

B. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; galvanized steel.

C. Gate Hardware: Fork latch with gravity drop, center gate stop and drop rod, two 180 degree gate hinges for each leaf, and hardware for padlock keyed to match hardware specified in Section 08 71 00.

D. Base Plate Fasteners: For portions of fencing or gates located on paved areas, provide galvanized pipe flanges at posts that are bolted to concrete paving using 3/8" diameter x 3" series 300 stainless steel expansion bolts and lock washers. Keep bolt holes minimum 3" away from edge of paving to avoid spalling of concrete.

2.03 GATES

A. General:
1. Gate Types, Opening Widths and Directions of Operation: As indicated on Drawings.
2. Shop-assemble gates.
3. Design gates for operation by one person.

B. Swing Gates:
1. Fabricate gates to permit 180-degree swing.
2. Gates Construction: ASTM F900 with welded corners. Use of corner fittings is not permitted.

2.04 FINISHES

A. Galvanized Components: Galvanized to ASTM A123/A123M for components; ASTM A153/A153M for hardware; ASTM A392 for fabric; 2.0 oz/sq ft coating.

B. Hardware: Galvanized to ASTM A153/A153M, 2.0 oz/sq ft coating.

C. Vinyl-Coated Components and Fabric: Vinyl coating, black color in accordance with ASTM F934 over specified galvanized coating.

D. Posts, Rails, Frames, and Accessories: Provide manufacturer's powder coat color finish in on all metal exposed to view. The coating material shall be thermoset glycidal-polyester supplied as a homogeneous free-flowing powder applied by electrostatic spray. Cured coating shall be capable of withstanding 500 hours of salt spray without creep when tested according to ASTM B117.
   1. Coating shall achieve a dry film thickness of 2 to 4 mils (0.1016 mm).
   2. Color: Match black color of vinyl coated fence fabric.

2.05 PRIVACY SLATS

A. Components: Vinyl strips, flat-faced hollow-core construction with continuous side wings for self-anchoring and nominal 95% privacy closure in a 2” diamond fabric.

B. Basis of Design: Winged PVC Slats as manufactured by Hoover Fence www.hooverfence.com.

C. Color: Black color to match vinyl faced fabric.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install framework, fabric, accessories and gates in accordance with ASTM F567.

B. Set intermediate, terminal, and gate posts plumb, in concrete footings with top of footing 1 inch (25.4 mm) above finish grade. Slope top of concrete for water runoff. For posts located on concrete paving, provide galvanized flanges mounted with stainless steel expansion bolts as specified.

C. Line Post Footing Depth Below Finish Grade: ASTM F567.

D. Corner, Gate and Terminal Post Footing Depth Below Finish Grade: ASTM F567.

E. Brace each gate and corner post to adjacent line post with horizontal center brace rail and diagonal truss rods. Install brace rail one bay from end and gate posts.

F. Install top rail through line post tops and splice with 6 inch (152.4 mm) long rail sleeves.

G. Install center and bottom brace rail on corner gate leaves.

H. Place fabric on outside of posts and rails.

I. Stretch fabric between terminal posts or at intervals of 100 feet (3048 cm) maximum, whichever is less.

J. Position bottom of fabric 2 inches (50.8 mm) above finished grade.

K. Fasten fabric to top rail, line posts, braces, and bottom tension wire with tie wire at maximum 15 inches (381 mm) on centers.

L. Attach fabric to end, corner, and gate posts with tension bars and tension bar clips.

M. Install bottom tension wire stretched taut between terminal posts.

N. Support gates from gate posts. Do not attach hinged side of gate from building wall.

O. Install gate with fabric to match fence. Install three hinges on each gate leaf, latch, catches, drop bolt, retainer and locking clamp.

P. Provide concrete center drop to footing depth and drop rod retainers at center of double gate openings.

Q. Install gates with fabric and barbed wire overhang to match fence

R. Install posts with 6 inches (152.4 mm) maximum clear opening from end posts to buildings, fences and other structures.

S. Excavate holes for posts without disturbing underlying materials.

T. Center and align posts. Place concrete around posts and vibrate or tamp for consolidation. Verify vertical and top alignment of posts and make necessary corrections.

U. Allow footings to cure minimum 7 days before installing fabric and other materials attached to posts.

3.02 ERECTION TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Maximum Variation From Plumb: 1/4 inch (6.35 mm).

C. Maximum Offset From Indicated Position: 1 inch (25.4 mm).

D. Minimum distance from property line: 6 inches (152.4 mm).

3.03 PRIVACY SLATS

A. Install privacy slat inserts vertically within open “tunnels” formed by woven wire fence fabric. Ensure side wings are snug with fabric for self-anchoring.

B. Replace any slats that become scuffed, creased or otherwise damaged until accepted by the Owner.

1. ADJUSTING AND CLEANING

C. Clean welds, bolted connections, and abraded areas and apply zinc-rich galvanizing repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 32 31 19

DECORATIVE METAL FENCES AND GATES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Premanufactured steel fences and swing gates.

B. Related Sections:
   1. Section 32 31 13 - Chain Link Fences and Gates.
   2. Section 04 20 00 - Unit Masonry Assemblies: Masonry pilasters between steel fence and gate sections.

1.02 SYSTEM PERFORMANCE REQUIREMENTS

A. Structural Performance: Design, engineer, fabricate, and install the steel fencing to withstand the following structural loads without exceeding the allowable design working stress of the materials involved, including anchors and connections:
   1. Concentrated load of 400 lb applied at panel mid-span.

1.03 SUBMITTALS

A. Product data for each type of fencing specified, with installation instructions for each unit built-in or connected to other construction. Include methods of installation for each type of substrate.
   1. Gate operators, including operating instructions.
   2. Motors: Show nameplate data, ratings, characteristics, and mounting arrangements.

B. Shop drawings showing installation details of fencing, including full scale installation details of special conditions.
   1. Where installed metal fencing is indicated to comply with certain design loadings, include structural computations, material properties, and other information presenting the complete structural analysis that has been signed and sealed by the qualified professional engineer who was responsible for their preparation.

C. Samples for initial selection purposes consisting of manufacturer's standard size samples showing full range of colors, textures, and patterns available for each type of fencing and accessory required.

D. Samples representative of materials and finished products as may be requested by Architect.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firm (material producer) with not less than 3 years of production experience, who’s published literature clearly indicates general compliance of products with requirements of this section.

B. Engineer Qualifications: Professional engineer licensed to practice in jurisdiction where project is located and experienced in providing engineering services of the kind indicated that have resulted in the successful installation of metal fencing similar in material, design, and extent to that indicated for this Project.

C. Single Source Responsibility: Provide material produced by a single manufacturer.

1.05 PRE-INSTALLATION MEETING

A. Section 01 31 19 - Project Meetings: Schedule and coordinate pre-installation meeting that includes the trade(s) for the work of this Section and other trades that whose work is related to the work of this section.

B. Convene minimum one week prior to cmmencing work of this Section.

1.06 PROJECT CONDITIONS

A. Field Measurements: Check actual locations of walls and other construction to which metal fencing must fit, by accurate field measurements before fabrication; show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of Work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to project site in original factory wrappings and containers, clearly labeled with identification of manufacturer, brand name, and lot number. Store materials in original undamaged packages and containers, inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity; laid flat, blocked off ground to prevent sagging and warping.

B. Comply with instructions and recommendations of manufacturer for special delivery, storage, and handling requirements.

1.08 SEQUENCE AND SCHEDULING

A. Inserts and Anchorages: Furnish inserts and anchoring devices that must be set in concrete or built into masonry; coordinate delivery with other work to avoid delay.

B. Sequence outdoor metal fencing installation with other work to minimize possibility of damage and soiling during remainder of construction period.

1.09 MAINTENANCE

A. Maintenance Instructions: Submit manufacturer's printed instructions for maintenance of installed work, including methods and frequency recommended for maintaining optimum condition under anticipated use conditions. Include precautions against materials and method which may be detrimental to finishes and performance.

1.10 WARRANTY

A. Submit a written warranty, executed by the manufacturer, agreeing to repair or replace units that fail in materials or workmanship within the specified warranty period. Failures include, but are not necessarily limited to:

1. Structural failures, including excessive deflection.
2. Faulty operation.
3. Deterioration of metals, metal finishes and other materials beyond normal weathering.

B. .Warranty Period: 10 years after the date of Substantial Completion.
   1. The warranty shall not deprive the Owner of other rights or remedies the Owner may have under other provisions of the Contract Documents and is in addition to and runs concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Manufacturers:
   1. Ameristar www.ameristarfence.com
   2. Fortress www.fortressfence.com
   3. Substitutions: Section 01 60 00 - Product Requirements.

2.02 METALS

A. Sheet Steel: ASTM A924, yield strength 50,000 psi.
   1. REVISE BELOW AS REQUIRED.Hot-dip galvanized per ASTM A653, .90 oz/sf coating thickness.

B. Extruded Aluminum: ASTM B221, 6063 alloy, T6 temper; yield strength of 25,000 psi and tensile strength of 30,000 psi.

C. Brackets, Flanges and Anchors: Cast or formed metal of the same type material and finish as supported rails, unless otherwise indicated.

D. Concrete Inserts: Threaded or wedge type; galvanized ferrous castings, either malleable iron, ASTM A 47, or cast steel, ASTM A 27. Provide bolts, washers, and shims as required, hot-dip galvanized per ASTM A 153.

E. Welding Rods and Bare Electrodes: Select in accordance with AWS specifications for the metal alloy to be welded.

2.03 GROUT AND ANCHORING CEMENT

A. Nonshrink Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with CE CRD-C 621. Provide grout specifically recommended by manufacturer for interior and exterior applications of type specified in this section.

B. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include but are not limited to the following:
   1. Nonshrink Nonmetallic Grouts:
      a. "Bonsal Construction Grout"; W.R. Bonsal Co. www.bonsal.com
      b. "Diamond-Crete Grout"; Concrete Service Materials Co.
      c. "Euco N-S Grout"; Euclid Chemical Co. www.euclidchemical.com

d. "Kemset"; Chem-Masters Corp. www.chemmasters.net
e. "Crystex"; L & M Construction Chemicals, Inc. www.lmcc.com
f. "Masterflow 713"; Master Builders. www.masterbuilders.com
g. "Sealtight 588 Grout"; W.R. Meadows, Inc. www.wrmeadows.com
h. "Sonogrout"; Sonneborn Building Products Div., Rexnord Chemical Products, Inc. www.chemrex.com/sonneborn/so_abo.htm
i. "Stoncrete NM1"; Stonhard, Inc. www.stonhard.com
j. "Five Star Grout"; U.S. Grout Corp. www.fivestarproducts.com
k. "Vibropruf #11"; Lambert Corp. www.lambertusa.com

2.04 PAINT

A. Galvanizing Repair Paint: High zinc dust content paint for regalvanizing damaged surfaces in galvanized steel, with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035 or SSPC-Paint-20.

2.05 FASTENERS

A. General: Provide zinc-coated fasteners with polymer coating to match the fencing system. Select fasteners for the type, grade, and class required. Equip items with theft-proof fasteners where accessible to tampering.

B. Pop-rivets shall not be used.

2.06 COMPONENTS

A. Design Criteria: The drawings indicate the size, profile, and dimensional requirements of metal fencing work required and are based on the specific types and models indicated. Metal fencing by other manufacturers may be considered, provided deviations in dimensions and profiles are minor and do not change the design concept as judged solely by the Architect.

B. Basis-of-Design - Fence Panels and Swing Gates: Ameristar Montage Plus in Majestic style, welded and rackable.
1. Pattern: Three rails with top smooth rail.
2. Pickets: 3/4 inch square steel tube, 18 gage; spaced nominal 4.70 inches oc,
3. Rails: 1-1/2 inch x nominal 1.5-inch steel channel, 14 gage. Pre-punched holes to accept vertical pickets.
4. Fence Posts: Minimum 3-inch square steel tube, 12 gage.
5. Post Caps: Pressed steel.
6. Swing Gates: Manufacturer's standard fully-welded gate construction with wrap-around frame hinges, fully pad-lockable fork latch, and cane bolt. Manual operation.
    1) Fully-welded construction to form rigid one-piece unit.
    2) Frame Size: Per manufacturer’s recommendations, but no less than 2” x 2” x 13 ga.
    3) Rails and pickets: Sizes and spacings same as fence panels.
    4) Bracing: Provide permanent welded diagonal steel bracing rod or tube at each gate leaf from top hinge location diagonally to opposite bottom corner of frame.

C. Gate Posts: Structural quality galvanized steel tube per ASTM A787, 45,000 psi.

1. Galvanizing: G90 zinc coated inside and outside. Paint only for inside is not acceptable.
2. Height above grade: Same as adjacent fencing.
3. Minimum sizes for up to 8 ft. high fencing: Gate fabricator shall determine actual size and wall thickness requirements for gate posts, but in no case shall posts or footings be less than the following:
   a. Leaf up to 6 ft. wide: 4” x 4” x 12 ga, set minimum 42” in footing.
   b. Leaf over 6 ft. to 12 ft. wide: 6” x 6” x 3/16”, set minimum 48” in footing.
   c. Leaf over 12 ft. to 16 ft. wide: 6” x 6” x 1/4”, set minimum 48” in footing.

2.07 FABRICATION, GENERAL

A. Provide metal fencing and accessory items, both free standing and permanently installed, equipped with functions as specified. Fabricate units with tight seams and joints, exposed metal edges rolled. Manufacturer or product identification on exposed surfaces is unacceptable. Provide products with smooth welds, consistent finish with no evidence of wrinkling, chipping, uneven coloration, dents, or other imperfections.
   1. Pickets, rails, and posts shall be pre-cut to specified lengths. Posts shall be pre-punched to accept rails and fasteners; rails shall be pre-punched and pre-drilled to accept pickets and fasteners.
   2. Swing gates shall be fabricated using the same materials as for the complete fencing system. Gate frames shall be made from tubing having the same cross-section as that for the fence rails. Provide number of hinges as recommended by the manufacturer, but in no case less than three hinges per gate.
   3. Cantilever gates shall be fabricated of extruded aluminum tracks and pickets, in design compatible with steel fencing. Provide operating hardware and fittings required for complete gate assembly.

2.08 FINISHES

A. Galvanizing: All iron and steel fencing components shall be galvanized. Apply zinc-coating by the hot-dip process in compliance with the following requirements:
   1. ASTM A 153 for galvanizing iron and steel hardware.
   2. ASTM A 526 for galvanizing all other iron and steel products, with minimum zinc coating weight of 0.60 oz. per square foot (Coating Designation G-60)

B. Provide manufacturer's polyester powder coating on all metal exposed to view. The coating material shall be thermoset glycidal-polyester supplied as a homogeneous free-flowing powder applied by electrostatic spray. Cured coating shall be capable of withstanding 500 hours of salt spray without creep when tested according to ASTM B117. Coating shall achieve a dry film thickness of 2 to 4 mils.
   1. Color: As selected by Architect from manufacturer's standard and custom colors.

PART 3 - EXECUTION

3.01 PREPARATION

A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, including concrete inserts, sleeves, anchor bolts, and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

B. Set sleeves in concrete with tops flush with finish surface elevations; protect sleeves from water and concrete entry.

3.02 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing pre-manufactured fencing to in-place construction; include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors as required.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installation of pre-manufactured fencing. Set fencing accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete masonry or similar construction.

D. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units which have been hot-dip galvanized after fabrication, and are intended for bolted or screwed field connections.

E. Field Welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, methods used in correcting welding work, and the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing and contour of welded surface matches those adjacent.

3.03 INSTALLATION OF PREMANUFACTURED FENCING

A. Adjust fencing prior to anchoring to ensure matching alignment at abutting joints.

B. Space posts at spacing indicated, or if not indicated, as required by design loadings. Plumb posts in each direction. Secure posts and railing ends to building construction as follows:
   1. Anchor posts in concrete by means of tube sleeves preset and anchored into concrete. After posts have been inserted into sleeves, fill annular space between post and sleeve solid with the following anchoring material, mixed and placed to comply with anchoring material manufacturer's directions.
   2. Non-shrink, nonmetallic grout: Leave anchorage joint exposed, wipe off surplus anchoring material, and leave 1/8 inch build-up, sloped away from post. Seal anchoring material to comply with grout manufacturer's directions.

3.04 ADJUSTING AND CLEANING

A. Touch-Up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 requirements for touch-up of field painted surfaces.
   1. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. For galvanized surfaces clean welds, bolted connections and abraded areas and apply galvanizing repair paint to comply with ASTM A 780.

C. Test gate rollers, hardware, and other operable components and adjust for proper alignment and operation. Replace damaged or malfunctioning operable components.

END OF SECTION

SECTION 32 92 00 – TURF AND GRASSES

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. THIS SECTION PERTAINS TO THE ESTABLISHMENT OF VEGETATIVE COVER BY HYDROMULCHING OR SODDING AS INDICATED ON THE DRAWINGS AND AS SPECIFIED HEREIN.

1.02 DEFINITIONS

A. FINISH GRADE: ELEVATION OF FINISHED SURFACE OF PLANTING SOIL.

B. MANUFACTURED SOIL: SOIL PRODUCED OFF-SITE BY HOMOGENEOUSLY BLENDING MINERAL SOILS OR SAND WITH STABILIZED ORGANIC SOIL AMENDMENTS TO PRODUCE TOPSOIL OR PLANTING SOIL.

C. PLANTING SOIL: NATIVE OR IMPORTED TOPSOIL, MANUFACTURED TOPSOIL, OR SURFACE SOIL MODIFIED TO BECOME TOPSOIL; MIXED WITH SOIL AMENDMENTS.

D. SUBGRADE: SURFACE OR ELEVATION OF SUBSOIL REMAINING AFTER COMPLETING EXCAVATION, OR TOP SURFACE OF A FILL OR BACKFILL IMMEDIATELY BENEATH PLANTING SOIL.

E. SUBSOIL: ALL SOIL BENEATH THE TOPSOIL LAYER OF THE SOIL PROFILE, AND TYPIFIED BY THE LACK OF ORGANIC MATTER AND SOIL ORGANISMS.

1.03 REGULATORY REQUIREMENTS

A. CONTRACTOR SHALL COMPLY WITH ALL CURRENT, APPLICABLE CODES AND REGULATIONS.

B. CONTRACTOR SHALL COMPLY WITH ALL STANDARD SPECIFICATIONS AND DETAILS OF AUTHORITIES HAVING JURISDICTION (HEREIN AFTER REFERRED TO AS "STANDARD SPECIFICATIONS") FOR WORK IN THE RIGHT-OF-WAY OR EASEMENTS.

C. PRIOR TO COMMENCEMENT OF WORK, THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING, AT THE CONTRACTOR’S OWN EXPENSE, ALL CONSTRUCTION PERMITS NECESSARY TO COMPLETE THE PROJECT ACCORDING TO THE PLANS AND SPECIFICATIONS.

1.04 SUBMITTALS

A. SUBMIT CERTIFICATION FROM SUPPLIER THAT EACH TYPE OF SEED CONFORMS TO THESE SPECIFICATIONS AND REQUIREMENTS OF TEXAS SEED LAW. CERTIFICATION SHALL ACCOMPANY SEED DELIVERY.

B. SUBMIT CERTIFICATE STATING THAT FERTILIZER COMPLIES WITH THESE SPECIFICATIONS AND REQUIREMENTS OF TEXAS FERTILIZER LAW.

C. PESTICIDES AND HERBICIDES: PRODUCT LABEL AND MANUFACTURER'S APPLICATION INSTRUCTIONS SPECIFIC TO PROJECT.

D. PLANTING SCHEDULE: INDICATING ANTICIPATED PLANTING DATES FOR EACH TYPE OF PLANTING.

1.05 QUALITY ASSURANCE

A. INSTALLER'S FIELD SUPERVISION: REQUIRE INSTALLER TO MAINTAIN AN EXPERIENCED FULL-TIME SUPERVISOR ON PROJECT SITE WHEN PLANTING IS IN PROGRESS.

B. TOPSOIL ANALYSIS: FURNISH SOIL ANALYSIS BY A QUALIFIED SOIL-TESTING LABORATORY.
   1. REPORT SUITABILITY OF TOPSOIL FOR LAWN GROWTH. STATE-RECOMMENDED QUANTITIES OF NITROGEN, PHOSPHORUS, AND POTASH NUTRIENTS AND SOIL AMENDMENTS TO BE ADDED TO PRODUCE SATISFACTORY TOPSOIL.

PART 2 – PRODUCTS

2.01 HYDROMULCH

A. SEED: CONFORM TO U.S. DEPARTMENT OF AGRICULTURE RULES AND REGULATIONS OF FEDERAL SEED ACT AND TEXAS SEED LAW. SEED SHALL BE CERTIFIED 90 PERCENT PURE AND FURNISH 80 PERCENT GERMINATION AND MEET FOLLOWING REQUIREMENTS:
   1. RYE: FRESH, CLEAN, ITALIAN RYE GRASS SEED (LOLLIUM MULTI-FLORUM), MIXED IN LABELED PROPORTIONS. AS TESTED, MINIMUM PERCENTAGES OF IMPURITIES AND GERMINATION MUST BE LABELED. DELIVER IN ORIGINAL UNOPENED CONTAINERS.
   2. BERMUDA: EXTRA-FANCY, TREATED, LAWN TYPE COMMON BERMUDA (CYNODON DACTYLON). DELIVER IN ORIGINAL, UNOPENED CONTAINER SHOWING WEIGHT, ANALYSIS, NAME OF VENDOR, AND GERMINATION TEST RESULTS.
   3. WET, MOLDY, OR OTHERWISE DAMAGED SEED WILL NOT BE ACCEPTED.
   4. SEED REQUIREMENTS, APPLICATION RATES, AND PLANTING DATES ARE:

TYPE	APPLICATION RATE (LB/AC)	PLANTING DATE
HULLED COMMON BERMUDA GRASS 98/88 UNHULLED COMMON BERMUDA GRASS 98/88	40 40	JAN 1 TO MAR 31
HULLED COMMON BERMUDA GRASS 98/88	40	APR 1 TO SEP 30
HULLED COMMON BERMUDA GRASS 98/88 UNHULLED COMMON BERMUDA GRASS 98/88 ANNUAL RYE GRASS (GULF)	40 40 30	OCT 1 TO DEC 31

B. SHALL BE 13-13-13 GRADE, PELLETED, UNIFORM ON COMPOSITION, FREE-FLOWING, AND SUITABLE FOR APPLICATION WITH APPROVED EQUIPMENT. THE FERTILIZER SHALL BE DELIVERED TO THE SITE IN BAGS OR OTHER CONVENIENT CONTAINERS, EACH FULLY LABELED, CONFORMING TO THE APPLICABLE STATE FERTILIZER LAWS, AND BEARING THE NAME OR TRADEMARK AND WARRANT OF THE PRODUCER.

C. WOOD CELLULOSE FIBER MULCH, FOR USE WITH THE HYDRAULIC APPLICATION OF GRASS SEED AND FERTILIZER, SHALL CONSIST OF SPECIALLY PREPARED WOOD CELLULOSE FIBER. IT SHALL BE PROCESSED IN SUCH A MANNER THAT IT WILL NOT CONTAIN GERMINATION OF GROWTH INHIBITING FACTORS. IT SHALL BE DYED A GREEN COLOR TO ALLOW VISUAL METERING OF ITS APPLICATION. THE WOOD CELLULOSE FIBERS SHALL HAVE THE PROPERTY OF BECOMING EVENLY DISPERSED AND SUSPENDED WHEN AGITATED IN WATER. WHEN SPRAYED UNIFORMLY ON THE SURFACE OF THE SOIL, THE FIBERS SHALL FORM A BLOTTER-LIKE GROUNDCOVER WHICH READILY ABSORBS WATER AND ALLOWS INFILTRATION TO THE UNDERLYING SOIL. WEIGHT SPECIFICATIONS FROM SUPPLIERS FOR ALL APPLICATIONS SHALL REFER ONLY TO AIR DRY WEIGHT OF THE FIBER, A STANDARD EQUIVALENT TO EIGHTEEN (18%) PERCENT MOISTURE. THE MULCH MATERIAL SHALL BE SUPPLIED IN PACKAGES HAVING A GROSS WEIGHT NOT IN EXCESS OF 100 POUNDS AND BE MARKED BY THE MANUFACTURER TO SHOW THE DRY WEIGHT CONTENT. SUPPLIERS SHALL BE PREPARED TO CERTIFY THAT LABORATORY AND FIELD TESTING OF THEIR PRODUCT HAS BEEN ACCOMPLISHED AND THAT MEETS ALL OF THE FOREGOING REQUIREMENTS.

D. SOIL STABILIZER: "TERRA TACK 1" OR APPROVED EQUAL.

E. WEED CONTROL AGENT: PRE-EMERGENT HERBICIDE FOR GRASS AREAS, SUCH AS "BENEFIN," OR APPROVED EQUAL.

2.02 SOD

A. SPECIES: BERMUDA (CYNODON DACTYLON), BUFFALO (BUCHLOE DACTYLOIDES), OR ST. AUGUSTINE (STENOTAPHRUM SECUNDATUM) GULF COAST VARIETY TO MATCH EXISTING SOD OR AS INDICATED ON THE DRAWINGS.

B. CONTENTS: 95 PERCENT PERMANENT GRASS SUITABLE TO CLIMATE IN WHICH IT IS TO BE PLACED; NOT MORE THAN 5 PERCENT WEEDS AND UNDESIRABLE GRASSES; GOOD TEXTURE, FREE FROM OBNOXIOUS GRASSES, ROOTS, STONES AND FOREIGN MATERIALS.
   1. SOD SHALL BE REJECTED IF FOUND TO CONTAIN ANY AMOUNT OF THE FOLLOWING WEEDS:
      a. QUACKGRASS.
      b. JOHNSON GRASS.
      c. POISON IVY.
      d. NIMBLEWEED.
      e. THISTLE.
      f. BINDWEED.
      g. BENTGRASS.
      h. PERENNIAL SORREL.
      i. BROMEGRASS.

C. SIZE: 12 INCH WIDE STRIPS, UNIFORMLY 2 INCHES THICK WITH CLEAN-CUT EDGES. RHIZOME DEVELOPMENT SHOULD BE APPARENT.

D. SOD IS TO BE SUPPLIED AND MAINTAINED IN HEALTHY CONDITION AS EVIDENCED BY GRASS BEING NORMAL GREEN COLOR.

2.03 TOP DRESS FERTILIZER

A. (DELAYED APPLICATION) COMPLETE FERTILIZER, FIFTY (50%) PERCENT OF THE NITROGEN TO THE DERIVED FROM NATURAL ORGANIC SOURCES OR UREA-FORM. AVAILABLE PHOSPHORIC ACID SHALL BE FROM SUPERPHOSPHATE, BOND, OR TANKAGE. POTASH SHALL BE DERIVED FROM MURIATE OF POTASH CONTAINING SIXTY (60%) PERCENT POTASH:
   1. 16% NITROGEN
   2. 6% PHOSPHORIC ACID
   3. 8% POTASH

PART 3 – EXECUTION

3.01 PREPERATION

A. VERIFY THAT GRADES ARE WITHIN 1-INCH PLUS OR MINUS THE REQUIRED FINISHED GRADES. VERIFY THAT ALL SOIL PREPARATION HAS BEEN COMPLETED AND APPROVED. REPORT ALL VARIATIONS IN WRITING.

B. STONES, WEEDS, DEBRIS: VERIFY THAT ALL AREAS TO RECEIVE LAWNS AND GRASSES ARE CLEAR OF STONES LARGER THAN 1/2 INCH IN DIAMETER, WEEDS, DEBRIS, AND OTHER EXTRANEOUS MATERIALS.

C. MOISTEN PREPARED LAWN AREAS BEFORE PLANTING IF SOIL IS DRY. WATER THOROUGHLY AND ALLOW SURFACE TO DRY BEFORE PLANTING. DO NOT CREATE MUDDY SOIL.

D. BEFORE PLANTING, RESTORE AREAS IF ERODED OR OTHERWISE DISTURBED AFTER FINISH GRADING.

E. CONTRACTOR SHALL OBTAIN APPROVAL OF HYDROMULCH AREA PREPARATION FROM THE OWNER'S REPRESENTATIVE PRIOR TO BEGINNING TURF ESTABLISHMENT.

3.02 SODDING

A. SOD BED PREPARATION:
   1. ROLLING: ROLL AMENDED SOIL WITH 200 POUND WATER-BALLAST ROLLER.
   2. MOISTENING SOIL SURFACE: AFTER ALL UNEVENNESS IN THE SOIL SURFACE HAS BEEN CORRECTED, LIGHTLY MOISTEN THE SOIL IMMEDIATELY PRIOR TO LAYING THE SOD.
   3. TIMING: SOD IMMEDIATELY THEREAFTER, PROVIDED THE SOD BED HAS REMAINED IN FRIABLE CONDITION.

B. SODDING OPERATIONS :
   1. BIG ROLL SOD SHALL BE INSTALLED BY TRACTORS WITH PROPER FLOTATION TIRES OF BY AN APPROVED BIG ROLL SOD INSTALLATION MACHINE. CARE SHOULD BE TAKEN TO ROLL OUT SOD AT A PROPER SPEED SO THAT NO HUMPING OR TEARING OF SOD OCCURS. SOD WILL BE MANUALLY PULLED TOGETHER BY STIFF RAKES TO INSURE NO GAPS REMAIN IN THE SEAMS. JOINTS SHOULD BE STAGGERED. DAMAGED OR PROBLEM AREAS SHALL BE CUT OUT AND REPLACED IN A PROFESSIONAL MATTER.
   2. STARTER STRIP:

a. LAY FIRST ROW OF SOD IN A STRAIGHT LINE, WITH SUBSEQUENT ROWS PARALLEL TO AND TIGHTLY AGAINST EACH OTHER.
b. STAGGER LATERAL JOINTS.
c. DO NOT STRETCH OR OVERLAP SOD.
d. BUTT ALL JOINTS TIGHTLY TO ELIMINATE ALL VOIDS.

3. CUTTING: USE A SHARP KNIFE TO CUT SOD TO FIT CURVES, SURFACE COMPONENTS OF THE IRRIGATION SYSTEM OR OTHER ITEMS.
4. TAMPING AND ROLLING: THOROUGHLY TAMP AND ROLL SOD TO MAKE CONTACT WITH SOD BED. ROLL EACH ENTIRE SECTION OF COMPLETED SOD.
5. WATERING: THOROUGHLY WATER SOD IMMEDIATELY AFTER INSTALLATION TO WET THE UNDERSIDE OF THE NEW SOD PAD AND THE SOIL IMMEDIATELY BELOW TO A DEPTH OF 6 INCHES. MAINTAIN CONSTANT MOISTURE FOR 2 WEEKS OR UNTIL SOD IS FULLY ROOTED.
6. TOP-DRESS FERTILIZER: APPLY AT THE RATE OF (6) TO (8) POUNDS PER 1,000 SQUARE FEET AT 25 DAYS AND AT 50 DAYS AFTER SODDING.

3.03 HYDROMULCH SEEDING

A. OPERATORS OF HYDROMULCHING EQUIPMENT SHALL BE THOROUGHLY EXPERIENCED IN THIS TYPE OF APPLICATION. APPLY SPECIFIED SLURRY MIX IN A MOTION TO FORM A UNIFORM MAT AT SPECIFIED RATE.

B. MIXING: CARE SHALL BE TAKEN THAT THE SLURRY PREPARATION SHOULD BE ACCOMPLISHED PER THE MATERIAL SUPPLIER'S RECOMMENDATIONS AND THE EQUIPMENT MANUFACTURER'S WRITTEN OPERATIONS MANUAL. SPRAYING SHALL COMMENCE IMMEDIATELY WHEN THE SLURRY IS MIXED AND THE TANK IS FULL. THE OPERATOR SHALL SPRAY THE AREA WITH A UNIFORM, VISIBLE COAT BY USING THE GREEN COLOR OF THE WOOD PULP AS A GUIDE.

C. KEEP HYDROMULCH WITHIN AREAS DESIGNATED AND KEEP FROM CONTACT WITH OTHER PLANT MATERIAL.

D. SLURRY MIXTURE WHICH HAS NOT BEEN APPLIED WITHIN FOUR (4) HOURS OF MIXING SHALL NOT BE USED AND SHALL BE REMOVED FROM THE SITE.

E. AFTER APPLICATION, THE CONTRACTOR SHALL NOT OPERATE ANY EQUIPMENT OVER THE COVERED AREA.

F. IMMEDIATELY AFTER APPLICATION, THOROUGHLY WASH OFF ANY PLANT MATERIAL, PLANTING AREAS, OR PAVED AREAS NOT INTENDED TO RECEIVE SLURRY MIX. KEEP ALL PAVED AND PLANTING AREAS CLEAN DURING MAINTENANCE OPERATIONS.

G. REFER ALSO TO THE MAINTENANCE PORTION OF THIS SECTION.

H. ALL AREAS DESIGNED ON DRAWINGS SHALL BE COVERED UNIFORMLY WITH SPECIFIED MATERIALS USING HYDROMULCHING PROCESSES. IF SURFACES REMAIN UNCOVERED WITHIN THE DESIGNATED AREA, THE CONTRACTOR SHALL SEED WITH REQUIRED GRASSES OR GROUND COVER MATERIALS THOSE AREAS MISSED BY THE HYDROMULCH APPLICATION. METHOD USED TO SEED THESE MISSED SURFACES SHALL BE AN ALTERNATE SEEDING OPERATION APPROVED BY THE ARCHITECT/ENGINEER/OWNER'S REPRESENTATIVE AND SHALL BE ACCOMPLISHED AT NO ADDITIONAL COST TO THE OWNER.

3.04 MAINTENANCE

A. THE CONTRACTOR SHALL PROVIDE FULL MAINTENANCE BY SKILLED EMPLOYEES OF THE LANDSCAPE INSTALLER TO MAINTAIN AND ESTABLISH LAWN BY WATERING, FERTILIZING, WEEDING, MOWING, TRIMMING, REPLANTING, AND OTHER OPERATIONS. ROLL, RE-GRADE, AND REPLANT BARE OR ERODED AREAS AND RE-MULCH TO PRODUCE A UNIFORMLY SMOOTH LAWN. PROVIDE MATERIALS AND INSTALLATION THE SAME AS THOSE USED IN THE ORIGINAL INSTALLATION.

B. BEGIN MAINTENANCE IMMEDIATELY AFTER EACH AREA IS PLANTED AND CONTINUE UNTIL ACCEPTABLE LAWN IS ESTABLISHED, BUT FOR NOT LESS THAN THE FOLLOWING PERIODS:
   1. SEEDED LAWNS: 90 DAYS FROM DATE OF PLANTING COMPLETION.
   2. FOR AREAS SEEDED IN FALL OR IF LAWN IS NOT FULLY ESTABLISHED, CONTINUE MAINTENANCE FOLLOWING SPRING UNTIL ACCEPTABLE LAWN IS ESTABLISHED.
   3. SODDED LAWNS: 30 DAYS FROM DATE OF PLANTING COMPLETION.

C. REPAIR AREAS DAMAGED BY EROSION BY REGRADING, ROLLING AND REPLANTING.

D. RESEED SMALL, SPARSE GRASS AREAS. WHEN SPARSE AREAS EXCEED 20 PERCENT OF PLANTED AREA, RESEED BY HYDROMULCH.

E. MOW LAWN AS SOON AS TOP GROWTH IS TALL ENOUGH TO CUT. REPEAT MOWING TO MAINTAIN SPECIFIED HEIGHT WITHOUT CUTTING MORE THAN 1/3 OF GRASS HEIGHT. REMOVE NO MORE THAN 1/3 OF GRASS-LEAF GROWTH IN INITIAL OR SUBSEQUENT MOWING.

3.05 WARRANTY

A. TIME PERIOD: WARRANT THAT LAWNS ARE IN HEALTHY AND FLOURISHING CONDITION OF VIGOROUS ACTIVE GROWTH ONE YEAR FROM DATE OF FINAL ACCEPTANCE.

B. APPEARANCE DURING WARRANTY: LAWNS SHALL BE FREE OF DEAD OR DYING PATCHES, AND ALL AREAS SHALL SHOW FOLIAGE OF A NORMAL DENSITY, SIZE AND COLOR.

C. DELAYS: DELAYS CAUSED BY THE CONTRACTOR IN COMPLETING PLANTING OPERATIONS WHICH EXTEND THE PLANTING INTO MORE THAN ONE PLANTING SEASON SHALL EXTEND THE WARRANTY PERIOD CORRESPONDINGLY.

D. EXCEPTIONS: CONTRACTOR SHALL NOT BE HELD RESPONSIBLE FOR FAILURES DUE TO NEGLECT BY OWNER, VANDALISM, OR ACTS OF GOD DURING WARRANTY PERIOD. REPORT SUCH CONDITIONS IN WRITING.

3.06 FINAL ACCEPTANCE

A. WORK UNDER THIS SECTION WILL BE ACCEPTED BY THE OWNER'S REPRESENTATIVE UPON SATISFACTORY COMPLETION OF ALL WORK, BUT EXCLUSIVE OF RE-APPLICATION UNDER THE GUARANTEE PERIOD. FINAL ACCEPTANCE OF LAWN ESTABLISHMENT SHALL BE AS FOLLOWS:
   1. FOR SEED: NINETY FIVE (95%) PERCENT UNIFORM COVERAGE OF GRASS IN EXCESS OF ONE (1") INCH HEIGHT. NO BARE SPOTS OF GREATER THAN TWO (2) SQUARE FEET WILL BE ACCEPTED.

2. FOR SOD: AT END OF MAINTENANCE PERIOD, A HEALTHY, WELL-ROOTED, EVEN-COLORED, VIABLE LAWN HAS BEEN ESTABLISHED, FREE OF WEEDS, OPEN JOINTS, BARE AREAS, AND SURFACE IRREGULARITIES.

B. THE OWNER'S REPRESENTATIVE SHALL INTERPRET THE ABOVE. UPON FINAL ACCEPTANCE, THE OWNER WILL ASSUME THE RESPONSIBILITY FOR MAINTENANCE OF THE WORK.

END OF SECTION 32 92 00

SECTION 33 10 00 – WATER DISTRIBUTION

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. THIS SECTION SPECIFIES THE REQUIREMENTS FOR FURNISHING AND INSTALLING WATER LINES, LATERALS, STUBS, AND APPURTENANCES FOR BOTH POTABLE AND NON-POTABLE WATER DISTRIBUTION SYSTEMS. THE PIPE SHALL BE OF THE SIZE, TYPE AND LOCATION, AND TO THE LINES, GRADES AND ELEVATIONS SHOWN ON THE PLANS AND CONSTRUCTED IN ACCORDANCE WITH THESE SPECIFICATIONS.

1.02 DEFINITIONS

A. PVC: POLYVINYL CHLORIDE PLASTIC.

1.03 REGULATORY REQUIREMENTS

A. CONTRACTOR SHALL COMPLY WITH ALL STANDARD SPECIFICATIONS AND DETAILS OF AUTHORITIES HAVING JURISDICTION (HEREIN AFTER REFERRED TO AS "STANDARD SPECIFICATIONS") FOR WORK IN THE RIGHT-OF-WAY OR EASEMENTS.

B. PRIOR TO COMMENCEMENT OF WORK, THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING, AT THE CONTRACTOR'S OWN EXPENSE, ALL CONSTRUCTION PERMITS NECESSARY TO COMPLETE THE PROJECT ACCORDING TO THE PLANS AND SPECIFICATIONS.

C. REGULATORY REQUIREMENTS FOR POTABLE WATER SYSTEMS:
   1. CONTRACTOR SHALL COMPLY WITH REQUIREMENTS OF UTILITY COMPANY SUPPLYING WATER; INCLUDING TAPPING OF WATER MAINS AND BACKFLOW PREVENTION.
   2. CONTRACTOR SHALL COMPLY WITH STANDARDS OF AUTHORITIES HAVING JURISDICTION FOR POTABLE WATER SERVICE PIPING, INCLUDING MATERIALS, INSTALLATION, TESTING, AND DISINFECTION.

D. REGULATORY REQUIREMENTS FOR NON-POTABLE WATER SYSTEMS:
   1. THE SYSTEM SHALL BE COMPRISED OF PURPLE COMPONENTS. USE PURPLE COLORED PIPE, PANTONE 522 EMBOSSED OR INTEGRALLY STAMPED/MARKED IN ENGLISH AND IN SPANISH "CAUTION RECLAIMED WATER DO NOT DRINK" AND "AGUA DE RECUPERACIÓN - NO BEBER".
   2. A MINIMUM OF AN EIGHT INCH BY EIGHT-INCH SIGN, IN ENGLISH AND SPANISH, IS PROMINENTLY POSTED ON/IN THE AREA THAT READS "RECLAIMED WATER – DO NOT DRINK" AND "AGUA DE RECUPERACIÓN - NO BEBER" ON THE STORAGE TANK OF SUCH NON-POTABLE SYSTEM IF WITHIN THE CONSTRUCTION SITE.
   3. COMPLY WITH STANDARDS OF AUTHORITIES HAVING JURISDICTION FOR FIRE-SUPPRESSION WATER-SERVICE PIPING, INCLUDING MATERIALS, HOSE THREADS, INSTALLATION, AND TESTING.

1.04 SUBMITTALS

A. PRODUCT DATA: FOR EACH TYPE OF PRODUCT INDICATED.

B. COORDINATION DRAWINGS: FOR PIPING AND SPECIALTIES INCLUDING RELATION TO OTHER SERVICES IN SAME AREA, DRAWN TO SCALE. SHOW PIPING AND SPECIALTY SIZES AND VALVES, METER AND SPECIALTY LOCATIONS, AND ELEVATIONS.

C. FIELD QUALITY-CONTROL TEST REPORTS.

1.05 QUALITY ASSURANCE

A. PIPING MATERIALS SHALL BEAR LABEL, STAMP, OR OTHER MARKINGS OF SPECIFIED TESTING AGENCY.

B. COMPLY WITH ASTM F 645 FOR SELECTION, DESIGN, AND INSTALLATION OF THERMOPLASTIC WATER PIPING.

C. COMPLY WITH FMG'S "APPROVAL GUIDE" OR UL'S "FIRE PROTECTION EQUIPMENT DIRECTORY" FOR FIRE-SERVICE-MAIN PRODUCTS.

D. NFPA COMPLIANCE: COMPLY WITH NFPA 24 FOR MATERIALS, INSTALLATIONS, TESTS, FLUSHING, AND VALVE AND HYDRANT SUPERVISION FOR FIRE-SERVICE-MAIN PIPING FOR FIRE SUPPRESSION.

E. NSF COMPLIANCE:
   1. COMPLY WITH NSF 14 FOR PLASTIC POTABLE-WATER-SERVICE PIPING.[INCLUDE MARKING "NSF-PW" ON PIPING.]
   2. COMPLY WITH NSF 61 ANNEX G FOR MATERIALS FOR WATER-SERVICE PIPING AND SPECIALTIES FOR DOMESTIC WATER.

PART 2 – PRODUCTS

2.01 PVC PIPE

A. PROVIDE SELF-EXTINGUISHING PVC PIPE THAT BEARS UNDERWRITERS' LABORATORIES MARK OF APPROVAL AND IS ACCEPTABLE WITHOUT PENALTY TO TEXAS STATE FIRE INSURANCE COMMITTEE FOR USE IN FIRE PROTECTION LINES.

B. BEAR NATIONAL SANITATION FOUNDATION SEAL OF APPROVAL (NSF-PW).

C. PIPE 3-INCH DIAMETER AND LESS: PVC I.P.S. ASTM D2241, SDR 26; SDR 21 AS ALTERNATE TO OFFSET PIPE SECTIONS OR FOR CONSTRUCTION WITHIN 9 FEET OF ANY EXISTING OR PROPOSED SANITARY SEWER; NOMINAL 20-FOOT LENGTHS; CAST-IRON EQUIVALENT OUTSIDE DIAMETERS.

D. PIPE 4-INCH THROUGH 12-INCH: AWWA C 900, DR 18; DR 14 AS ALTERNATE TO OFFSET PIPE SECTIONS OR FOR CONSTRUCTION WITHIN 9 FEET OF ANY EXISTING OR PROPOSED SANITARY SEWER; NOMINAL 20-FOOT LENGTHS; CAST-IRON EQUIVALENT OUTSIDE DIAMETERS.

E. PIPE 14-INCH THROUGH 20-INCH: AWWA C 905; 235 PSI; DR 18; NOMINAL 20-FOOT LENGTHS; CAST IRON EQUIVALENT OUTSIDE DIAMETER.

F. GASKETS:
   1. GASKETS SHALL MEET REQUIREMENTS OF ASTM F 477. USE ELASTOMERIC FACTORY-INSTALLED GASKETS TO MAKE JOINTS FLEXIBLE AND WATERTIGHT.

2. FLAT FACE MATING FLANGE: FULL FACES 1/8-INCH-THICK ETHYLENE PROPYLENE (EPR) RUBBER.
3. RAISED FACE MATING FLANGE: FLAT RING 1/8-INCH ETHYLENE PROPYLENE (EDR) RUBBER, WITH FILLER GASKET BETWEEN OD OF RAISED FACE AND FLANGE OD TO PROTECT FLANGE FROM BOLTING MOMENT.

G. DO NOT USE PVC IN POTENTIALLY OR KNOWN CONTAMINATED AREAS.

H. DO NOT USE PVC IN AREAS EXPOSED TO DIRECT SUNLIGHT.

I. MAKE CURVES AND BENDS BY BENDING THE PIPE, DO NOT EXCEED MAXIMUM LIMITS OF CURVATURE RECOMMENDED BY PIPE MANUFACTURER. SUBMIT DETAILS OF OTHER METHODS OF PROVIDING CURVES AND BENDS FOR REVIEW BY THE OWNER'S REPRESENTATIVE

2.02 DUCTILE IRON PIPE

A. DUCTILE IRON PIPE SHALL CONFORM TO AWWA C115, C150 AND C151 AND BEAR MARK OF UNDERWRITERS' LABORATORIES APPROVAL. UNLESS OTHERWISE SHOWN ON DRAWINGS, USE MINIMUM PRESSURE CLASS 250 FOR WATER LINES OR THICKNESS CLASS 52 FOR WATER LINES IN CASING OR AUGURED HOLE. PROVIDE MINIMUM PRESSURE CLASS 350 FOR FLANGED PIPE.

B. PROVIDE STANDARD OUTSIDE COATING WITH CEMENT MORTAR LINING TO AWWA C 104 STANDARDS.

C. PROVIDE PIPE SECTIONS IN STANDARD LENGTHS, NOT LESS THAN 18 FEET LONG, EXCEPT FOR SPECIAL FITTINGS AND CLOSURE SECTIONS AS INDICATED ON SHOP DRAWINGS.

D. PROVIDE FLANGE ADAPTER WITH INSULATING KIT AS REQUIRED WHEN CONNECTING NEW PIPING TO EXISTING PIPING AND PIPING OF DIFFERENT MATERIALS, UNLESS OTHERWISE APPROVED BY THE OWNER'S REPRESENTATIVE.

E. NO WELDING WILL BE PERMITTED ON DUCTILE IRON PIPE EXCEPT AT RESTRAINED JOINT SPIGOTS. NO FIELD WELDING IS ALLOWED.

F. GASKETS
1. FURNISH, WHEN NO CONTAMINANT IS IDENTIFIED, PLAIN RUBBER (SBR) GASKET MATERIAL IN ACCORDANCE WITH ANSI A21.11 OR ASTM F 477 (ONE BOLT ONLY); FOR FLANGED JOINTS 1/8-INCH-THICK GASKET IN ACCORDANCE WITH ANSI A 21.15.
2. FOR PIPES TO BE INSTALLED IN CONTAMINATED AREAS, USE GASKETS AS RECOMMENDED BY THE PIPE MANUFACTURER, AND APPROVED BY THE OWNER'S REPRESENTATIVE PRIOR TO INSTALLATION.

G. ALL DUCTILE IRON PIPE AND FITTINGS SHALL BE WRAPPED WITH POLYETHYLENE PER AWWA C 105.

2.03 JOINTS

A. JOINT TYPES: ANSI A 21.11 PUSH-ON; ANSI A 21.11 MECHANICAL JOINT; OR ANSI A 21.16 FLANGED END. PROVIDE PUSH-ON RESTRAINED JOINTS UNLESS OTHERWISE INDICATED ON THE DRAWINGS OR REQUIRED BY THESE SPECIFICATIONS. FOR

BOLTED JOINTS, CONFORM TO REQUIREMENTS OF AWWA C111; PROVIDE MINIMUM 304 STAINLESS STEEL FOR RESTRAINT JOINTS.

B. WHERE REQUIRED BY DRAWINGS, PROVIDE APPROVED RESTRAINED JOINTS FOR BURIED SERVICE.

C. THREADED OR GROOVED-TYPE JOINTS WHICH REDUCE PIPE WALL THICKNESS BELOW MINIMUM REQUIRED ARE NOT ACCEPTABLE.

D. PROVIDE FOR RESTRAINED JOINTS DESIGNED TO MEET TEST PRESSURES REQUIRED UNDER 3.8 OF THIS SECTION. PROVIDE RESTRAINED JOINTS FOR TEST PRESSURE OR MAXIMUM SURGE PRESSURE AS SPECIFIED, WHICHEVER IS GREATER FOR WATER LINES. DO NOT USE PASSIVE RESISTANCE OF SOIL IN DETERMINING MINIMUM RESTRAINT LENGTHS.

2.04 FITTINGS

A. USE FITTINGS OF SAME SIZE AS PIPE. REDUCERS ARE NOT PERMITTED TO FACILITATE AN OFF-SIZE FITTING. REDUCING BUSHINGS ARE ALSO PROHIBITED. MAKE REDUCTIONS IN PIPING SIZE BY REDUCING FITTINGS. LINE AND COAT FITTINGS AS SPECIFIED FOR PIPE THEY CONNECT TO.

B. FITTINGS SHALL CONFORM TO AWWA C 153, LATEST EDITION, PRESSURE RATED AT 250 PSI AND SHALL BE FUSION BONDED EPOXY LINED OR CEMENT MORTAR LINED. UNLESS OTHERWISE NOTED ON THE DRAWINGS OR REQUIRED BY THE AUTHORITY HAVING JURISDICTION PROVIDE MECHANICAL JOINT FITTINGS.

C. MECHANICAL JOINT FITTINGS: ANSI A 21.11; PRESSURE RATED AT 250 PSI.

D. PUSH-ON FITTINGS: ANSI A 21.10; DUCTILE IRON ANSI A 21.11 JOINTS, GASKETS, AND LUBRICANTS; PRESSURE RATED AT 250 PSI.

2.05 GATE VALVES

A. GATE VALVES 2 INCHES IN DIAMETER: IRON BODY RESILIENT-SEATED, NON-RISING STEM, 150-POUND TEST, 2-INCH SQUARE NUT OPERATING CLOCKWISE TO OPEN.

B. GATE VALVES 3 INCHES TO 12 INCHES IN DIAMETER: NON-DIRECTIONAL, STANDARD-WALL RESILIENT SEATED (AWWA C 509), 200 PSI PRESSURE RATING, BRONZE MOUNTING, MECHANICAL JOINT ENDS WITH RUBBER JOINT RINGS, AND NUT-OPERATED UNLESS OTHERWISE SPECIFIED.

C. GATE VALVES 14 INCH AND LARGER IN DIAMETER: AWWA C 500; PARALLEL SEAT DOUBLE DISC GATE VALVES; MECHANICAL JOINT ENDS WITH RUBBER RINGS AND NUT-OPERATED UNLESS OTHERWISE SPECIFIED. PROVIDE APPROVED DOUBLE DISC VALVES WITH 150 PSI PRESSURE RATING.

D. GATE VALVES EXTENSION STEM: PROVIDE NON-RISING, EXTENSION STEM HAVING COUPLING SUFFICIENT TO ATTACH SECURELY TO OPERATING NUT OF VALVE. UPPER END OF EXTENSION STEM SHALL TERMINATE IN SQUARE WRENCH NUT NO DEEPER THAN 4 FEET FROM FINISHED GRADE OR AS SHOWN ON DRAWINGS. SUPPORT EXTENSION STEM WITH AN ARM ATTACHED TO WALL OF MANHOLE OR STRUCTURE THAT LOOSELY HOLDS EXTENSION STEM AND ALLOWS ROTATION IN THE AXIAL DIRECTION ONLY.

E. GATE VALVES IN FACTORY MUTUAL (FIRE SERVICE) TYPE METER INSTALLATIONS: CONFORM TO PROVISIONS OF THIS SPECIFICATION; OUTSIDE SCREW AND YOKE VALVES; CARRY LABEL OF UNDERWRITERS' LABORATORIES, INC.; FLANGED, CLASS 125; CLOCKWISE TO CLOSE.

F. THE OPERATING NUT SHALL BE 2-INCH SQUARE AND SHALL HAVE AN ARROW, CAST IN THE METAL, INDICATING THE COUNTER-CLOCKWISE DIRECTION OF OPENING.

G. GATE VALVES FOR TAPPING STEEL PIPE: PROVIDE DOUBLE DISC GATE VALVE. RESILIENT WEDGE GATE VALVE SHALL ONLY BE INSTALLED IN A VERTICAL POSITION.

H. PROVIDE FLANGED JOINTS WHEN VALVE IS CONNECTED TO STEEL OR PCCP.

I. KEY VALVE STEM INTO THE OPERATOR NUT.

J. UNLESS OTHERWISE SPECIFIED, ALL GATE VALVES SHALL BE INSTALLED COMPLETE WITH VALVE BOX.

K. DO NOT EXCEED 600 FT-LBS OF TORQUE ON OPERATOR NUT ON GATE VALVE.

2.06 TAPPING SLEEVES AND VALVES

A. TAPPING SLEEVES:
   1. TAPPING SLEEVE BODIES: AWWA C 110 CAST OR DUCTILE IRON OR AWWA C 200 CARBON STEEL IN TWO SECTIONS TO BE BOLTED TOGETHER WITH HIGH-STRENGTH, CORROSION-RESISTANT, LOW-ALLOY STEEL BOLTS WITH MECHANICAL JOINT ENDS.
   2. BRANCH OUTLET OF TAPPING SLEEVE:
   3. FLANGED, MACHINED RECESS, AWWA C 207, CLASS D, ANSI 150 POUND DRILLING.
   4. GASKET: AFFIXED AROUND RECESS OF TAP OPENING TO PREVENT ROLLING OR BINDING DURING INSTALLATION.
   5. USE CAST IRON SPLIT SLEEVE WHERE FIRE SERVICE FROM 6-INCH WATER LINE IS APPROVED.

B. TAPPING VALVES: MEET REQUIREMENTS OF 2.05 ABOVE WITH THE FOLLOWING EXCEPTIONS:
   1. INLET FLANGES:
   2. AWWA C 110; CLASS 125.
   3. AWWA C 110; CLASS 150 AND HIGHER: MINIMUM 8-HOLE FLANGE.
   4. OUTLET: STANDARD MECHANICAL OR PUSH-ON JOINT TO FIT ANY STANDARD TAPPING MACHINE.
   5. VALVE SEAT OPENING: ACCOMMODATE FULL-SIZE SHELL CUTTER FOR NOMINAL SIZE TAP WITHOUT CONTACT WITH VALVE BODY; DOUBLE DISC.

2.07 VALVE BOXES

A. PROVIDE APPROVED TYPE A, CAST-IRON/DUCTILE-IRON, SLIDE-TYPE, VALVE BOXES. DESIGN OF VALVE BOX SHALL MINIMIZE STRESSES ON VALVE IMPOSED BY LOADS ON BOX LID.

B. CAST LETTER “W” INTO LID, 1/2 INCH IN HEIGHT AND RAISED 3/32 INCH, FOR VALVES SERVING POTABLE WATER LINES.

C. UNLESS OTHERWISE SPECIFIED, UNCOATED CAST IRON.

D. RISER PIPE.
   1. PROVIDE 6-INCH PVC, DR 18, RISER PIPES IN ACCORDANCE WITH 2.01 ABOVE.
   2. 6-INCH DUCTILE-IRON, THICKNESS CLASS 51 RISER PIPES IN ACCORDANCE WITH 2.02 ABOVE.
   3. PROVIDE SINGLE SECTION OF PIPE.

E. CONCRETE FOR VALVE BOX PLACEMENT:
   1. FOR LOCATIONS IN NEW CONCRETE PAVEMENT, PROVIDE STRENGTH AND MIX DESIGN OF NEW PAVEMENT.
   2. FOR OTHER LOCATIONS, PROVIDE CONCRETE FOR SIDEWALKS CONFORMING TO REQUIREMENTS OF SECTION 32 13 13 CONCRETE PAVING.

2.08 FIRE HYDRANTS

A. FIRE HYDRANTS SHALL BE MUELLER SUPER CENTURION OR AN APPROVED EQUIVALENT.

B. EACH HYDRANT SHALL BE FACTORY TESTED TO A HYDROSTATIC PRESSURE OF 300 PSI WITH VALVE IN BOTH THE OPEN AND CLOSED POSITIONS. THE DIRECTION OF OPENING NUT SHALL BE COUNTERCLOCKWISE AND SHALL BE CAST ON THE HEAD OF THE HYDRANT. HOSE NOZZLES SHALL BE BRONZE OR NON-CORROSIVE METAL AND THREADS SHALL BE NATIONAL STANDARD. THE MAIN VALVE OPENING SHALL BE EITHER FIVE AND ONE FOURTH (5 1/4) INCHES IN DIAMETER OR SIX AND ONE FOURTH CAPS SHALL BE PROVIDED WITH GASKETS. BURY LENGTH SHALL BE THREE AND ONE HALF (3 1/2) FEET UNLESS OTHERWISE NOTED ON THE PLANS. HYDRANTS SHALL BE PROVIDED WITH "DRY TOP" WHICH PREVENTS STEM THREADS FROM CONTACTING WATER, AND "BREAK OFF" TYPE BARREL AND STEM.

C. HYDRANTS SHALL BE PAINTED WITH SHOP COATING IN ACCORDANCE WITH AWWA C502 SPECIFICATION. FINAL COATS OF PAINT WILL BE APPLIED BY CONTRACTOR IN ACCORDANCE WITH THE REQUIREMENTS OF THE AUTHORITY HAVING JURISDICTION.

D. CONTRACTOR SHALL VERIFY AND PROVIDE NOZZLE THREADS CONSISTENT WITH THE REQUIREMENTS OF THE AUTHORITY HAVING JURISDICTION.

2.09 MANUFACTURERS

A. USE APPROVED AMERICAN MANUFACTURERS.

PART 3 – EXECUTION

3.01 PREPERATION

A. PROTECT STRUCTURES, UTILITIES, SIDEWALKS, PAVEMENTS, AND OTHER FACILITIES FROM DAMAGE AND DISPLACEMENT.

B. VERIFY ALL EXISTING UTILITIES PRIOR TO BEGINNING CONSTRUCTION. INFORM THE OWNER'S REPRESENTATIVE IF EXISTING UTILITIES ARE NOT AS SHOWN IN THE PLANS.

C. WATER SERVICE TO THE SITE OR ADJACENT LANDOWNERS SHALL NOT BE SHUT DOWN WITHOUT PRIOR APPROVAL OF THE OWNER'S REPRESENTATIVE AND THE

AUTHORITY HAVING JURISDICTION. AT NO ADDITIONAL COST TO THE OWNER THE CONTRACTOR SHALL INSTALL NECESSARY VALVES SO AS NOT TO DISRUPT SERVICE OUTSIDE LIMITS OF WATER LINES TO BE LOWERED/RELOCATED WHETHER OR NOT INDICATED ON THE PLANS.

D. CONFIRM THAT NINE FEET MINIMUM SEPARATION FROM GRAVITY SANITARY SEWERS AND MANHOLES OR SEPARATION OF FOUR FEET MINIMUM FROM FORCE MAINS IN ALL DIRECTIONS. WHERE ABOVE CLEARANCES CANNOT BE ATTAINED, PROVIDE PROTECTION PER THE REQUIREMENTS OF THE DRAWINGS AND OBTAIN ADDITIONAL INSTRUCTIONS AS REQUIRED FROM THE OWNER'S REPRESENTATIVE BEFORE PROCEEDING WITH CONSTRUCTION.

3.02 GENERAL

A. UNLESS OTHERWISE SPECIFIED, THE PROVISIONS OF THIS SECTION SHALL CONFORM TO AWWA C600 AND C605, LATEST EDITIONS.

B.

3.03 CLEANING AND INSPECTION

A. CLEANING: THOROUGHLY CLEAN AND DRY INTERIOR OF PIPE AND FITTINGS OF FOREIGN MATTER BEFORE INSTALLATION, AND KEEP INTERIOR CLEAN UNTIL WORK HAS BEEN ACCEPTED. KEEP JOINT CONTACT SURFACES CLEAN UNTIL JOINTING IS COMPLETED. DO NOT PLACE DEBRIS, TOOLS, CLOTHING OR OTHER MATERIALS IN PIPE. AFTER PIPE LAYING AND JOINING OPERATIONS ARE COMPLETED, CLEAN INSIDE OF PIPE AND REMOVE DEBRIS. THE INTERIOR OF THE PIPE SHALL BE KEPT CLEAN THROUGHOUT THE DURATION OF THE WORK.

B. INSPECTION: BEFORE INSTALLATION, INSPECT EACH PIPE AND FITTING FOR DEFECTS. REJECT DEFECTIVE, DAMAGED OR UNSOUND PIPE AND FITTINGS AND REMOVE THEM FROM SITE.

3.04 EARTHWORK

A. CONFORM TO APPLICABLE PROVISIONS OF SECTION 31 23 33 TRENCHING, BACKFILLING AND COMPACTION.

B. BACKFILL EXCAVATED AREAS IN SAME DAY EXCAVATED. WHEN NOT POSSIBLE, COVER EXCAVATED AREAS USING STEEL PLATES ON PAVED AREAS AND OTHER PROTECTIVE MEASURES ELSEWHERE.

C. PLACE MATERIAL IN UNIFORM LAYERS OF PRESCRIBED MAXIMUM LOOSE THICKNESS AND WET OR DRY MATERIAL TO APPROXIMATELY OPTIMUM MOISTURE CONTENT. COMPACT TO PRESCRIBED DENSITY WATER TAMPING IS NOT ALLOWED.

D. WHEN TRENCHES EXCEED FIVE FEET IN DEPTH CONTRACTOR SHALL UTILIZE TRENCH SAFETY MEASURES PER SECTION 31 41 33 TRENCH SAFETY.

3.05 PIPE CUTTING

A. CUT PIPE 12 INCHES AND SMALLER WITH STANDARD WHEEL PIPE CUTTERS. CUT PIPE LARGER THAN 12 INCHES IN MANNER APPROVED BY THE OWNER'S REPRESENTATIVE. MAKE CUTS SMOOTH AND AT RIGHT ANGLES TO AXIS OF PIPE. BEVEL PLAIN END WITH HEAVY FILE OR GRINDER TO REMOVE SHARP EDGES.

3.06 LOWERING/RELOCATING EXISTING WATER LINES

A. WATER LINES TO BE LOWERED/RELOCATED SHALL NOT BE SHUT DOWN WITHOUT PRIOR APPROVAL OF THE LOCAL GOVERNING AGENCY.

B. WHETHER OR NOT INDICATED ON THE PLANS, ANY EXISTING WATER LINES THAT ARE IN CONFLICT WITH PROPOSED UTILITIES SHALL BE THE LOWERED/RELOCATED AS NECESSARY TO FACILITATE CONSTRUCTION, AT NO ADDITIONAL COST TO THE OWNER.

C. CONTRACTOR SHALL INSTALL NECESSARY VALVES SO AS NOT TO DISRUPT SERVICE OUTSIDE LIMITS OF WATER LINES TO BE LOWERED/RELOCATED WHETHER OR NOT INDICATED ON THE PLANS.

D. WHETHER OR NOT INDICATED ON THE PLANS, THE LOWERED/RELOCATED WATER LINE SHALL HAVE MINIMUM OF FOUR (4) FEET OF COVER. LOCATION SHALL BE A MINIMUM DISTANCE FROM EXISTING LOCATION AS NECESSARY TO FACILITATE CONSTRUCTION.

E. IF THE LOWERED/RELOCATED WATER LINES ARE OF POTABLE WATER SYSTEMS, THEY SHALL BE REQUIRED TO MEET SAME HYDROSTATIC AND STERILIZATION TEST RESULTS AS NEW WATER LINES.

F. INSTALLATION OF LOWERED/RELOCATED WATER LINES SHALL MEET THE SAME REQUIREMENTS OF NEW WATER LINES AS IN PARAGRAPH 3.07 BELOW.

3.07 PIPING INSTALLATION

A. GENERAL REQUIREMENTS:
   1. LAY PIPE IN SUBGRADE FREE OF WATER.
   2. MAKE ADJUSTMENTS OF PIPE TO LINE AND GRADE BY SCRAPING AWAY SUBGRADE OR FILLING IN WITH GRANULAR MATERIAL.
   3. FOR POTABLE WATER LINE INSTALLATION, WHEN A WATER LINE IS BEING INSTALLED PARALLEL TO A SANITARY SEWER, A HORIZONTAL DISTANCE OF SEPARATION OF NINE (9) FEET (OUTSIDE TO OUTSIDE) MUST BE MAINTAINED.
   4. A MINIMUM CLEARANCE OF 12" MUST BE MAINTAINED BETWEEN WATER LINES AND ALL OTHER UTILITY LINES.
   5. FOR POTABLE WATER LINE INSTALLATION, WHEN A WATER LINE IS TO BE INSTALLED SUCH THAT IT WILL CROSS OVER AN EXISTING OR PROPOSED SANITARY SEWER, A SECTION OF PIPE AT LEAST 18' LONG OF EITHER DUCTILE IRON OR PVC PIPE C-900 DR-18 SHALL BE INSTALLED SUCH THAT IT WILL BE CENTERED OVER THE SANITARY SEWER. WATER LINES SHALL IN NO CASE BE INSTALLED BELOW A SANITARY SEWER.
   6. PROPERLY FORM BEDDING TO FULLY SUPPORT BELL WITHOUT WEDGING OR BLOCKING UP BELL.
   7. OPEN CUT CONSTRUCTION: KEEP PIPE TRENCHES FREE OF WATER WHICH MIGHT IMPAIR PIPE LAYING OPERATIONS. GRADE TRENCH TO PROVIDE UNIFORM SUPPORT ALONG BOTTOM OF PIPE. EXCAVATE FOR BELL HOLES AFTER BOTTOM HAS BEEN GRADED AND IN ADVANCE OF PLACING PIPE. LAY NOT MORE THAN 500 FEET OF PIPE IN TRENCH AHEAD OF BACKFILLING OPERATIONS. COVER OR BACKFILL LAID PIPE IF PIPE LAYING OPERATIONS ARE INTERRUPTED AND DURING NON-WORKING HOURS. PLACE BACKFILL CAREFULLY AND SIMULTANEOUSLY ON EACH SIDE OF PIPE TO AVOID LATERAL DISPLACEMENT OF PIPE AND DAMAGE TO

JOINTS. IF ADJUSTMENT OF PIPE IS REQUIRED AFTER IT HAS BEEN LAID, REMOVE AND RE-LAY AS NEW PIPE.

B. PROTECTION OF PIPELINE: SECURELY PLACE STOPPERS OR BULKHEADS IN OPENINGS AND IN END OF LINE WHEN CONSTRUCTION IS STOPPED TEMPORARILY AND AT END OF EACH DAY'S WORK.

C. FOR TIE-INS TO EXISTING WATER LINES, PROVIDE NECESSARY MATERIAL ON HAND TO FACILITATE CONNECTION PRIOR TO CONNECTING TO OR SHUTTING DOWN EXISTING WATER LINE. PROVIDE THE AUTHORITY HAVING JURISDICTION AND THE OWNER'S REPRESENTATIVE A MINIMUM OF TWO WEEKS NOTICE PRIOR TO CONNECTING TO OR SHUTTING DOWN EXISTING WATER LINE.

D. MAKE CURVES AND BENDS AS RECOMMENDED BY MANUFACTURER AND APPROVED BY THE OWNER'S REPRESENTATIVE.

E. DEFLECTION OF PIPE JOINTS SHALL NOT EXCEED MAXIMUM DEFLECTION RECOMMENDED BY PIPE MANUFACTURER.

F. WHEN RUBBER GASKETED PIPE IS LAID ON CURVE, JOIN PIPE IN STRAIGHT ALIGNMENT AND THEN DEFLECT TO CURVED ALIGNMENT.

G. EVERY VALVE, INCLUDING BYPASS VALVES, SHALL BE PROVIDED WITH A VALVE BOX. THE VALVE BOX SHALL NOT TRANSMIT SHOCK OR STRESS TO THE VALVE AND SHALL BE CENTERED AND PLUMB OVER THE OPERATING NUT, WITH THE COVER FLUSH WITH THE PAVEMENT SURFACE OR SUCH OTHER LEVEL AS DIRECTED.

H. HYDRANTS SHALL BE LOCATED AS SHOWN ON THE PLANS AND IN A MANNER THAT WILL PROVIDE COMPLETE ACCESSIBILITY AND WILL PREVENT DAMAGE FROM VEHICLES. ALL HYDRANTS SHALL STAND PLUMB AND SHALL HAVE THEIR PUMPER CONNECTIONS AT RIGHT ANGLES TO THE STREET.

I. MINIMUM COVER ON WATER LINES SHALL BE 48 INCHES UNLESS OTHERWISE SPECIFIED, BUT IN NO CASE SHALL THE TOP OF ANY WATER LINE BE LESS THAN 24 INCHES BELOW THE FINISHED GROUND SURFACE.

3.08 JOINTS AND JOINTING

A. RUBBER GASKETED BELL-AND-SPIGOT JOINTS:
   1. AFTER RUBBER GASKET IS PLACED IN SPIGOT GROOVE OF PIPE, EQUALIZE RUBBER GASKET CROSS SECTION BY INSERTING TOOL OR BAR RECOMMENDED BY MANUFACTURER UNDER RUBBER GASKET AND MOVING IT AROUND PERIPHERY OF PIPE SPIGOT.
   2. LUBRICATE GASKETS WITH NONTOXIC WATER-SOLUBLE LUBRICANT BEFORE PIPE UNITS ARE JOINED.
   3. FIT PIPE UNITS TOGETHER IN MANNER TO AVOID TWISTING OR OTHERWISE DISPLACING OR DAMAGING RUBBER GASKET.
   4. AFTER PIPE SECTIONS ARE JOINED, CHECK GASKETS TO ENSURE THAT NO DISPLACEMENT OF GASKET HAS OCCURRED. IF DISPLACEMENT HAS OCCURRED, REMOVE PIPE SECTION AND REMAKE JOINT AS FOR NEW PIPE. REMOVE OLD GASKET, INSPECT FOR DAMAGE AND REPLACE IF NECESSARY BEFORE REMAKING JOINT.
   5. USE RESTRAINED JOINTS AS SHOWN ON DRAWINGS.

a. INCLUDE BUOYANCY CONDITIONS FOR SOIL UNIT WEIGHT WHEN COMPUTING THRUST RESTRAINT CALCULATIONS.
b. DO NOT INCLUDE PASSIVE RESISTANCE OF SOIL IN THRUST RESTRAINT CALCULATIONS.

6. EXCEPT FOR PVC PIPE, PROVIDE MEANS TO PREVENT FULL ENGAGEMENT OF SPIGOT INTO BELL AS SHOWN ON DRAWINGS. MEANS MAY CONSIST OF WEDGES OR OTHER TYPES OF STOPS AS APPROVED BY THE OWNER'S REPRESENTATIVE.

B. RESTRAINED JOINTS
1. INSTALLATION.
a. INSTALL RESTRAINED JOINTS MECHANISM IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS.
b. EXAMINE AND CLEAN MECHANISM; REMOVE DIRT, DEBRIS AND OTHER FOREIGN MATERIAL.
c. APPLY GASKET AND JOINT NSF 61 FDA FOOD GRADE APPROVED LUBRICANT.
d. VERIFY GASKET IS EVENLY SEATED.
e. DO NOT OVER STAB PIPE INTO MECHANISM.
2. PREVENT ANY LATERAL MOVEMENT OF THRUST RESTRAINTS THROUGHOUT PRESSURE TESTING AND OPERATION.

C. ALL BENDS, TEES, VALVES, AND PLUGS SHALL HAVE THRUST BLOCKS INSTALLED IN ACCORDANCE WITH THE DETAILS ON THE PLANS. THRUST BLOCKING WILL BE INSTALLED SUCH THAT JOINTS WILL BE ACCESSIBLE FOR INSPECTION AND REPAIR. CONCRETE USED IN THRUST BLOCKING SHALL HAVE A COMPRESSIVE STRENGTH OF AT LEAST 3,000 PSI AND CONFORM TO THE REQUIREMENTS OF SECTION 32 13 13 CONCRETE PAVING.

3.09 HYDROSTATIC TESTING OF WATER LINES

A. AFTER THE PIPE HAS BEEN LAID AND INITIAL BACKFILL COMPLETED, THE WATER LINE SHALL BE SUBJECTED TO A HYDROSTATIC TEST PER AWWA C600 OR AWWA C605 AT A MINIMUM PRESSURE OF 150 PSI. JOINTS SHALL REMAIN EXPOSED DURING TESTING WHENEVER POSSIBLE.

B. THE CONTRACTOR SHALL FURNISH, INSTALL, AND OPERATE, AT HIS EXPENSE, THE NECESSARY CONNECTIONS, PUMPS, METERS, AND GAUGES NECESSARY TO CONDUCT THE TEST. THE METERS USED IN THE TESTING SHALL BE TESTED, SEALED AND APPROVED AT THE CONTRACTOR'S EXPENSE PRIOR TO RUNNING ANY TEST.

C. PROCEDURE
1. WHERE PRACTICABLE, PIPELINES SHALL BE TESTED IN LENGTHS BETWEEN VALVES OR PLUGS OF NO MORE THAN 1,500 FEET. CONTRACTOR MUST HAVE WRITTEN APPROVAL FOR TEST SECTIONS GREATER THAN 1,500 FEET.
2. MINIMUM DURATION OF TESTING FOR EACH SECTION SHALL BE 2 HOURS WHEN JOINTS ARE EXPOSED AND 8 HOURS WHEN JOINTS ARE COVERED.
3. ALLOWABLE LEAKAGE SHALL BE AS CALCULATED BY THE FOLLOWING FORMULA:
$L=(S)(D)(P^{.05})/133,200$
L= ALLOWABLE LEAKAGE IN GALLONS PER HOUR
S=LENGTH OF PIPE IN FEET
D=INSIDE DIAMETER OF PIPE IN INCHES
P=PRESSURE IN POUNDS PER SQUARE INCH
4. CORRECT DEFECTS, CRACKS, OR LEAKAGE BY REPLACEMENT OF DEFECTIVE ITEMS. ALL VISIBLE LEAKS AT EXPOSED JOINTS AND ALL LEAKS EVIDENT ON THE

SURFACE WHERE JOINTS ARE COVERED SHALL BE REPLACED, REGARDLESS OF TOTAL LEAKAGE SHOWN.

5. REPEAT TEST UNTIL SATISFACTORY RESULTS ARE OBTAINED.
6. UPON SATISFACTORY COMPLETION OF TESTING, REMOVE RISERS REMAINING FROM DISINFECTION AND HYDROSTATIC TESTING, AND BACKFILL EXCAVATION PROMPTLY.

3.10 DISINFECTION OF WATER LINES

A. PROMPTLY DISINFECT WATER LINES AFTER APPROVED COMPLETION OF THE HYDROSTATIC TESTS.

B. CONTRACTOR SHALL PAY FOR AND PROVIDE WATER FOR DISINFECTION AND FLUSHING.

C. CONTRACTOR WILL CONDUCT DISINFECTION OPERATIONS.

D. COORDINATE CHLORINATION OPERATIONS WITH THE AUTHORITY HAVING JURISDICTION AND THE OWNER'S REPRESENTATIVE.

E. PROVIDE TEMPORARY BLIND FLANGES, CAST-IRON SLEEVES, PLUGS, NECESSARY SERVICE TAPS, COPPER SERVICE LEADS, RISERS AND JUMPERS OF SIZES, LOCATION AND MATERIALS, AND OTHER ITEMS NEEDED TO FACILITATE DISINFECTION OF NEW WATER LINES PRIOR TO CONNECTION TO THE EXISTING WATER DISTRIBUTION SYSTEM. NORMALLY, EACH VALVED SECTION OF WATER LINE REQUIRES TWO EACH 3/4-INCH TAPS. A 2-INCH MINIMUM BLOW-OFF IS REQUIRED FOR WATER LINES UP TO AND INCLUDING 6-INCH DIAMETER.

F. USE FIRE HYDRANTS AS BLOW-OFFS TO FLUSH NEWLY CONSTRUCTED WATER LINES 6 INCH DIAMETERS AND ABOVE. WHERE FIRE HYDRANTS ARE NOT AVAILABLE ON WATER LINES, INSTALL TEMPORARY BLOW-OFF VALVES AS APPROVED BY THE OWNER'S REPRESENTATIVE AND REMOVE PROMPTLY UPON SUCCESSFUL COMPLETION OF DISINFECTION AND TESTING.

G. SLOWLY FILL EACH SECTION OF PIPE WITH WATER IN MANNER APPROVED BY OWNER'S REPRESENTATIVE. AVERAGE WATER VELOCITY WHEN FILLING PIPELINE SHOULD BE LESS THAN ONE FOOT PER SECOND AND SHALL NOT, UNDER ANY CIRCUMSTANCE, EXCEED 2 FEET PER SECOND. BEFORE BEGINNING DISINFECTION OPERATIONS, EXPEL AIR FROM PIPELINE.

H. BACKFILL EXCAVATIONS IMMEDIATELY AFTER INSTALLATION OF RISERS OR BLOW-OFFS.

I. INSTALL BLOW-OFF VALVES AT END OF WATER LINE TO FACILITATE FLUSHING OF DEAD-END WATER LINES. INSTALL PERMANENT BLOW-OFF VALVES ACCORDING TO DRAWINGS.

J. PROCEDURE
1. USE NOT LESS THAN 100 PARTS OF CHLORINE PER MILLION PARTS OF WATER.
2. INTRODUCE CHLORINATING MATERIAL TO WATER LINES IN ACCORDANCE WITH AWWA C 651.
3. AFTER CONTACT PERIOD OF NOT LESS THAN 24 HOURS, FLUSH SYSTEM WITH CLEAN WATER UNTIL RESIDUAL CHLORINE IS NO GREATER THAN 1.0 PARTS PER MILLION PARTS OF WATER.

4. OPEN AND CLOSE VALVES IN LINES BEING STERILIZED SEVERAL TIMES DURING CONTACT PERIOD.
5. AFTER DISINFECTION AND FLUSHING OF WATER LINES, THE CONTRACTOR SHALL HAVE BACTERIOLOGICAL TESTS PERFORMED BY AN APPROVED TESTING LABORATORY. WHEN TEST RESULTS INDICATE NEED FOR ADDITIONAL DISINFECTION OF WATER LINES BASED UPON TEXAS COMMISSION ON ENVIRONMENTAL QUALITY AND/OR TEXAS DEPARTMENT OF HEALTH REQUIREMENTS, PROVIDE ADDITIONAL DISINFECTION OPERATIONS.
6. UPON SATISFACTORY COMPLETION OF TESTING, REMOVE TEMPORARY RISERS REMAINING DISINFECTION AND HYDROSTATIC TESTING, AND BACKFILL EXCAVATION PROMPTLY.

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SECTION 33 30 00 – SANITARY SEWER

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. THIS SECTION SPECIFIES THE REQUIREMENTS FOR FURNISHING AND PLACING SANITARY SEWER PIPE, LATERALS, STUBS, AND APPURTENANCES. THE PIPE SHALL BE OF THE SIZE, TYPE AND LOCATION, AND TO THE LINES, GRADES AND ELEVATIONS SHOWN ON THE PLANS AND CONSTRUCTED IN ACCORDANCE WITH THESE SPECIFICATIONS.

1.02 DEFINITIONS

A. PVC: POLYVINYL CHLORIDE PLASTIC.

1.03 REGULATORY REQUIREMENTS

A. CONTRACTOR SHALL COMPLY WITH ALL CURRENT, APPLICABLE CODES AND REGULATIONS.
   1. CONTRACTOR SHALL COMPLY WITH REQUIREMENTS OF UTILITY COMPANY RECEIVING WASTE WATER. INCLUDE TAPPING OF EXISTING STRUCTURES OR SERVICE LINES.
   2. CONTRACTOR SHALL COMPLY WITH STANDARDS OF AUTHORITIES HAVING JURISDICTION FOR SANITARY SEWER PIPING, INCLUDING MATERIALS, INSTALLATION AND TESTING.

B. CONTRACTOR SHALL COMPLY WITH ALL STANDARD SPECIFICATIONS AND DETAILS OF AUTHORITIES HAVING JURISDICTION (HEREIN AFTER REFERRED TO AS "STANDARD SPECIFICATIONS") FOR WORK IN THE RIGHT-OF-WAY OR EASEMENTS.

C. INSTALL SEWER LINES TO MEET MINIMUM SEPARATION DISTANCE FROM POTABLE WATER LINE, AS SHOWN IN THE DRAWINGS. SEPARATION DISTANCE IS DEFINED AS DISTANCE BETWEEN OUTSIDE OF WATER PIPE AND OUTSIDE OF SEWER PIPE. WHEN POSSIBLE, INSTALL NEW SANITARY SEWERS NO CLOSER TO WATER LINES THAN 9 FEET IN ALL DIRECTIONS. WHERE THIS SEPARATION DISTANCE CANNOT BE ACHIEVED, NEW SANITARY SEWERS SHALL BE INSTALLED AS SHOWN IN THE DRAWINGS.

D. PRIOR TO COMMENCEMENT OF WORK, THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING, AT THE CONTRACTOR'S OWN EXPENSE, ALL CONSTRUCTION PERMITS NECESSARY TO COMPLETE THE PROJECT ACCORDING TO THE PLANS AND SPECIFICATIONS.

1.04 SUBMITTALS

A. PRODUCT DATA: FOR EACH TYPE OF PRODUCT INDICATED.

B. COORDINATION DRAWINGS: FOR PIPING AND SPECIALTIES INCLUDING RELATION TO OTHER SERVICES IN SAME AREA, DRAWN TO SCALE. SHOW PIPING AND SPECIALTY SIZES AND VALVES, METER AND SPECIALTY LOCATIONS, AND ELEVATIONS.

C. FIELD QUALITY-CONTROL TEST REPORTS.

1.05 QUALITY ASSURANCE

A. PIPING MATERIALS SHALL BEAR LABEL, STAMP, OR OTHER MARKINGS OF SPECIFIED TESTING AGENCY.

B. CONTRACTOR IS RESPONSIBLE FOR PROTECTING MATERIALS PER MANUFACTURES RECOMMENDATIONS
   1. DO NOT STORE PLASTIC MANHOLES, PIPE, AND FITTINGS IN DIRECT SUNLIGHT.
   2. PROTECT PIPE, PIPE FITTINGS, AND SEALS FROM DIRT AND DAMAGE.
   3. HANDLE PRECAST STRUCTURES ACCORDING TO MANUFACTURER'S WRITTEN RIGGING INSTRUCTIONS.

C. INSTALL SANITARY SEWER THAT IS WATERTIGHT BOTH IN PIPE-TO-PIPE JOINTS AND IN PIPE TO-MANHOLE CONNECTIONS.

PART 2 – PRODUCTS

2.01 PVC PIPE

A. PVC PIPE FOR GRAVITY SANITARY SEWERS SHALL CONFORM TO ASTM D3034, SDR 26. ALL DIAMETERS SHALL USE BELL AND SPIGOT ENDS FOR GASKETED JOINTS. FOR SEWERS UP TO 12” DIAMETER CROSSING OVER OR UNDER WATERLINES, PROVIDE MINIMUM 150 PSI PRESSURE-RATED PIPE CONFORMING TO ASTM D2241 WITH SUITABLE PVC COUPLINGS.

B. PVC PIPE FOR SANITARY SEWER FORCE MAINS SHALL CONFORM TO ASTM D2241, SDR 21 OR AWWA C 900, DR 18 AND PROVIDE A MINIMUM PRESSURE RATING OF 150 PSI. PIPE SHALL BE GREEN IN COLOR.

C. GASKETS SHALL MEET REQUIREMENTS OF ASTM F 477. USE ELASTOMERIC FACTORY-INSTALLED GASKETS TO MAKE JOINTS FLEXIBLE AND WATERTIGHT.

D. DO NOT USE PVC IN POTENTIALLY OR KNOWN CONTAMINATED AREAS.

E. DO NOT USE PVC IN AREAS EXPOSED TO DIRECT SUNLIGHT.

F. MAKE CURVES AND BENDS BY BENDING THE PIPE, DO NOT EXCEED MAXIMUM LIMITS OF CURVATURE RECOMMENDED BY PIPE MANUFACTURER. SUBMIT DETAILS OF OTHER METHODS OF PROVIDING CURVES AND BENDS FOR REVIEW BY THE OWNER’S REPRESENTATIVE.

2.02 DUCTILE IRON PIPE

A. DUCTILE IRON PIPE FOR GRAVITY SANITARY SEWERS SHALL CONFORM TO ASTM A746, THICKNESS CLASS 50, PRESSURE RATED FOR 150 PSI UNLESS OTHERWISE INDICATED ON THE PLANS. PIPE SHALL BE LINED WITH 20 MILS OF EPOXY EXTENDING FROM PLAIN OR BEVELED END TO REAR OF GASKET SOCKET. THE EXTERIOR OF THE PIPE SHALL HAVE A BITUMINOUS COATING APPROXIMATELY ONE MIL IN THICKNESS.

B. DUCTILE IRON PIPE FOR SANITARY SEWER FORCE MAINS SHALL CONFORM TO ASTM C151, THICKNESS CLASS 50, PRESSURE RATED FOR 150 PSI. PIPE SHALL BE LINED WITH 20 MILS OF EPOXY EXTENDING FROM PLAIN OR BEVELED END TO REAR OF GASKET SOCKET. THE EXTERIOR OF THE PIPE SHALL HAVE A BITUMINOUS COATING APPROXIMATELY ONE MIL IN THICKNESS.

C. GASKETS SHALL CONFORM TO AWWA C111, RUBBER.

D. ALL DUCTILE IRON PIPE AND FITTINGS SHALL BE WRAPPED WITH POLYETHYLENE PER AWWA C 105.

2.03 JOINTS

A. PVC PIPE JOINTS SHALL CONFORM TO ASTM D3212 WITH A SDR MATCHING THE PIPE.

B. DUCTILE IRON PIPE JOINTS SHALL BE PUSH-ON TYPE UNLESS OTHERWISE INDICATED ON THE PLANS.

2.04 MANHOLES

A. PRECAST CONCRETE MANHOLES IN ACCORDANCE WITH THE DETAILS SHOWN ON THE DRAWINGS SHALL CONFORM TO ASTM C-478.

B. CAST-IN-PLACE-CONCRETE MANHOLES: CONSTRUCT OF REINFORCED-CONCRETE BOTTOM, WALLS, AND TOP; DESIGNED ACCORDING TO ASTM C 890 FOR A-16 (ASSHTO HS20-44), HEAVY-TRAFFIC, STRUCTURAL LOADING; OF DEPTH, SHAPE, DIMENSIONS, AND APPURTENANCES INDICATED. THE MINIMUM COMPRESSIVE STRENGTH OF CONCRETE MANHOLE SHALL BE 4,000 PSI.

C. BALLAST: INCREASE THICKNESS OF CONCRETE AS REQUIRED TO PREVENT FLOTATION.

D. RESILIENT PIPE CONNECTORS: ASTM C 923 CAST OR FITTED INTO MANHOLE WALLS, FOR EACH PIPE CONNECTION.

E. ADJUSTING RINGS: INTERLOCKING RINGS WITH LEVEL OR SLOPED EDGE IN THICKNESS AND DIAMETER MATCHING MANHOLE FRAME AND COVER. INCLUDE SEALANT RECOMMENDED BY RING MANUFACTURER.

F. GRADE RINGS: REINFORCED-CONCRETE RINGS, 6- TO 9-INCH TOTAL THICKNESS, TO MATCH DIAMETER OF MANHOLE FRAME AND COVER.

G. ALL MANHOLES SHALL HAVE STAINLESS STEEL MANHOLE INSERTS (INFLOW PREVENTERS).

2.05 MORTAR

A. MORTAR FOR CONSTRUCTION OF THE BENCH AND INVERT IN ALL MANHOLES SHALL CONFORM TO ASTM C 476.

2.06 CLEANOUTS

A. CLEANOUTS IN ACCORDANCE WITH THE DETAILS SHOWN ON THE DRAWINGS SHALL CONSIST OF PVC BODY WITH PVC THREADED PLUG. INCLUDE PVC SEWER PIPE FITTING AND RISER TO CLEANOUT OF SAME MATERIAL AS SEWER PIPING.

2.07 RIMS, GRATES AND FRAMES

A. CASTINGS FOR MANHOLE RIMS, COVERS AND FRAMES SHALL CONFORM TO ASTM A 48, CLASS 35B GRAY IRON OR BETTER QUALITY.

2.08 FITTINGS

A. FITTINGS SHALL BE MECHANICAL JOINT CONFORMING TO AWWA C153 LINED WITH 20 MILS OF EPOXY EXTENDING FROM PLAIN OR BEVELED END TO REAR OF GASKET SOCKET. THE EXTERIOR OF THE FITTING SHALL HAVE A BITUMINOUS COATING APPROXIMATELY ONE MIL IN THICKNESS.

B. GASKETS SHALL CONFORM TO AWWA C111, RUBBER.

C. ALL DUCTILE IRON FITTINGS SHALL BE WRAPPED WITH POLYETHYLENE PER AWWA C 105.

2.09 MANUFACTURERS

A. USE APPROVED AMERICAN MANUFACTURERS.

PART 3 – EXECUTION

3.01 PREPERATION

A. PROTECT STRUCTURES, UTILITIES, SIDEWALKS, PAVEMENTS, AND OTHER FACILITIES FROM DAMAGE AND DISPLACEMENT.

B. VERIFY ALL EXISTING UTILITIES PRIOR TO BEGINNING CONSTRUCTION. INFORM THE OWNER'S REPRESENTATIVE IF EXISTING UTILITIES ARE NOT AS SHOWN IN THE PLANS.

C. PERFORM WORK IN ACCORDANCE WITH OSHA STANDARDS.

D. SEWER SERVICE TO THE SITE OR ADJACENT LANDOWNERS SHALL NOT BE SHUT DOWN WITHOUT PRIOR APPROVAL OF THE OWNER'S REPRESENTATIVE AND THE AUTHORITY HAVING JURISDICTION. AT NO ADDITIONAL COST TO THE OWNER THE CONTRACTOR SHALL INSTALL NECESSARY PIPING AND ACCESSORIES SO AS NOT TO DISRUPT SERVICE OUTSIDE TO OTHER FACILITIES OR LANDOWNERS WHETHER OR NOT INDICATED ON THE PLANS.

E. CONFIRM THAT NINE FEET MINIMUM SEPARATION FROM WATER LINES AND ACCESSORIES. WHERE ABOVE CLEARANCES CANNOT BE ATTAINED, PROVIDE PROTECTION PER THE REQUIREMENTS OF THIS SECTION AND OBTAIN ADDITIONAL INSTRUCTIONS AS REQUIRED FROM THE OWNER'S REPRESENTATIVE BEFORE PROCEEDING WITH CONSTRUCTION.

F. BEFORE INSTALLATION, INSPECT EACH PIPE, FITTING AND STRUCTURE FOR DEFECTS. REJECT DEFECTIVE, DAMAGED OR UNSOUND PIPE, FITTINGS OR STRUCTURES AND REMOVE THEM FROM SITE.

3.02 GENERAL

A. NO PIPE SHALL BE INSTALLED IN THE TRENCH UNTIL EXCAVATION HAS BEEN PROPERLY CONSTRUCTED PER THE PLANS AND DETAILS TO AT LEAST TWO (2) PIPE

LENGTHS BEYOND THE SECTION OF PIPE BEING INSTALLED AND THE BOTTOM OF THE TRENCH HAS BEEN PROPERLY SHAPED.

B. PIPE SHALL BE SO LAID THAT AFTER THE SEWER IS COMPLETED THE INTERIOR SURFACE SHALL CONFORM ACCURATELY TO THE GRADES AND ALIGNMENTS FIXED AND GIVEN IN THE PLANS.

C. ALL SEWERS MUST BE LAID ACCURATELY TO LINE AND GRADE, WITH TONGUE OR SPIGOT END DOWNSTREAM. ESTABLISH REQUIRED UNIFORM LINE AND GRADE IN TRENCH FROM BENCHMARKS IDENTIFIED BY THE OWNER'S REPRESENTATIVE. USE LASER BEAM EQUIPMENT TO ESTABLISH AND MAINTAIN PROPER LINE AND GRADE OF WORK.

D. PIPES SHALL BE FITTED TOGETHER AND MATCHED SO THAT WHEN LAID, THEY FORM A SEWER WITH A SMOOTH AND UNIFORM INVERT.

E. A MINIMUM CLEARANCE OF TWELVE (12) INCHES MUST BE MAINTAINED BETWEEN THE SEWER AND ALL OTHER LINES. SANITARY SEWERS SHALL NOT BE ROUTED OVER WATER LINES.

F. WHERE CONDITIONS ARE SUCH THAT RUNNING OR STANDING WATER OCCURS IN THE TRENCH BOTTOM OR THE SOIL IN THE TRENCH BOTTOM DISPLAYS A "QUICK" TENDENCY, THE WATER SHALL BE REMOVED BY PUMPS AND SUITABLE MEANS SUCH AS WELL POINTS OR PERVIOUS UNDERDRAIN BEDDING UNTIL THE PIPE HAS BEEN INSTALLED AND THE BACKFILL HAS BEEN PLACED TO A SUFFICIENT HEIGHT TO PREVENT PIPE FLOTATION. CARE SHOULD BE TAKEN THAT ANY UNDERDRAIN IS OF PROPER GRADATION AND THICKNESS TO PREVENT MIGRATION OF MATERIAL BETWEEN THE UNDERDRAIN, PIPE EMBEDMENT AND NATIVE SOILS IN THE TRENCH BELOW AND AT THE SIDES OF THE PIPE.

G. DO NOT ALLOW SAND, DEBRIS, RUNOFF OR OTHER FOREIGN MATERIALS TO ENTER SEWER SYSTEM.

3.03 DIVERSION PUMPING

A. INSTALL AND OPERATE REQUIRED BULKHEADS, PLUGS, PIPING, AND DIVERSION PUMPING EQUIPMENT TO MAINTAIN SEWAGE FLOW AND TO PREVENT BACKUP OR OVERFLOW. OBTAIN APPROVAL FOR DIVERSION PUMPING EQUIPMENT AND PROCEDURES FROM THE OWNER'S REPRESENTATIVE.

B. DESIGN PIPING, JOINTS AND ACCESSORIES TO WITHSTAND TWICE MAXIMUM SYSTEM PRESSURE OR 50 PSI, WHICHEVER IS GREATER.

C. IN EVENT OF ACCIDENTAL SPILL OR OVERFLOW, IMMEDIATELY STOP OVERFLOW AND TAKE ACTION TO CLEAN UP AND DISINFECT SPILLAGE AND PROMPTLY NOTIFY THE OWNER'S REPRESENTATIVE.

3.04 EARTHWORK

A. CONFORM TO APPLICABLE PROVISIONS OF SECTION 31 23 33 TRENCHING, BACKFILLING AND COMPACTION.

B. BACKFILL EXCAVATED AREAS IN SAME DAY EXCAVATED. WHEN NOT POSSIBLE, COVER EXCAVATED AREAS USING STEEL PLATES ON PAVED AREAS AND OTHER PROTECTIVE MEASURES ELSEWHERE.

C. PLACE MATERIAL IN UNIFORM LAYERS OF PRESCRIBED MAXIMUM LOOSE THICKNESS AND WET OR DRY MATERIAL TO APPROXIMATELY OPTIMUM MOISTURE CONTENT. COMPACT TO PRESCRIBED DENSITY WATER TAMPING IS NOT ALLOWED.

D. WHEN TRENCHES EXCEED FIVE FEET IN DEPTH CONTRACTOR SHALL UTILIZE TRENCH SAFETY MEASURES PER SECTION 31 41 33 TRENCH SAFETY.

3.05 PIPE CUTTING

A. CUT PIPE 12 INCHES AND SMALLER WITH STANDARD WHEEL PIPE CUTTERS. CUT PIPE LARGER THAN 12 INCHES IN MANNER APPROVED BY THE OWNER'S REPRESENTATIVE. MAKE CUTS SMOOTH AND AT RIGHT ANGLES TO AXIS OF PIPE. BEVEL PLAIN END WITH HEAVY FILE OR GRINDER TO REMOVE SHARP EDGES.

3.06 PIPE INSTALLATION BY OPEN CUT

A. INSTALL PIPE IN ACCORDANCE WITH PIPE MANUFACTURER'S RECOMMENDATIONS AND AS SPECIFIED IN FOLLOWING PARAGRAPHS.

B. INSTALL PIPE ONLY AFTER EXCAVATION IS COMPLETED, BOTTOM OF TRENCH FINE GRADED, BEDDING MATERIAL IS INSTALLED.

C. INSTALL PIPE TO LINE AND GRADE INDICATED. PLACE PIPE SO THAT IT HAS CONTINUOUS BEARING OF BARREL ON BEDDING MATERIAL AND IS LAID IN TRENCH SO INTERIOR SURFACES OF PIPE FOLLOW GRADES AND ALIGNMENT INDICATED. PROVIDE BELL HOLES WHERE NECESSARY.

D. FORM CONCENTRIC JOINT WITH EACH SECTION OF ADJOINING PIPE SO AS TO PREVENT OFFSETS.

E. KEEP INTERIOR OF PIPE CLEAN AS INSTALLATION PROGRESSES. REMOVE FOREIGN MATERIAL AND DEBRIS FROM PIPE.

F. PROVIDE LUBRICANT, PLACE AND DRIVE HOME NEWLY LAID SECTIONS SO AS TO ELIMINATE DAMAGE TO SECTIONS. INSTALL PIPE TO "HOME" MARK WHERE PROVIDED.

G. KEEP EXCAVATIONS FREE OF WATER DURING CONSTRUCTION AND UNTIL FINAL INSPECTION.

H. WHEN WORK IS NOT IN PROGRESS, COVER EXPOSED ENDS OF PIPES WITH APPROVED PLUG TO PREVENT FOREIGN MATERIAL FROM ENTERING PIPE.

I. WHERE GRAVITY SANITARY SEWER IS TO BE INSTALLED UNDER EXISTING WATER LINE WITH SEPARATION DISTANCE OF AT LEAST 2 FEET AND LESS THAN 9 FEET, INSTALL NEW SEWER PIPE SO THAT ONE FULL 20 FOOT LONG PIPE IS CENTERED ON WATER LINE CROSSING. EMBED SEWER PIPE IN CEMENT STABILIZED SAND FOR MINIMUM DISTANCE OF 10 FEET ON EACH SIDE OF CROSSING.

J. WHERE GRAVITY SANITARY SEWER IS TO BE INSTALLED UNDER EXISTING WATER LINE WITH SEPARATION DISTANCE OF LESS THAN 2 FEET, INSTALL NEW SEWER USING

PRESSURE-RATED PIPE AS SHOWN ON DRAWINGS. MAINTAIN MINIMUM 1 FOOT SEPARATION DISTANCE.

3.07 PIPE INSTALLATION OTHER THAN OPEN CUT

A. CONTRACTOR SHALL UTILIZE METHODS OF PIPE INSTALLATION OTHER THAN OPEN CUT AS SHOWN ON THE DRAWINGS OR AS OTHERWISE REQUIRED TO INSTALL THE SEWER.

B. PIPE SHALL BE OF THE SIZE, TYPE, AND CLASS SPECIFIED ON THE PLANS, OR OTHER TYPES AS MAY BE SPECIFIED BY THE ENGINEER OR DESIGNATED ON THE PLANS.

C. JACKING
1. IF THE GRADE OF THE PIPE AT THE JACKING END IS BELOW THE GROUND SURFACE, SUITABLE PITS OR TRENCHES SHALL BE EXCAVATED FOR THE PURPOSE OF CONDUCTING THE JACKING OPERATIONS AND FOR PLACING END JOINTS OF THE PIPE. WHEREVER END TRENCHES ARE CUT IN THE SIDES OF THE EMBANKMENT OR BEYOND IT, SUCH WORK SHALL BE SHEETED SECURELY AND BRACED IN A MANNER SATISFACTORY TO THE OWNER'S REPRESENTATIVE TO PREVENT EARTH CAVING.
2. WHERE PIPE IS REQUIRED TO BE INSTALLED UNDER RAILROAD EMBANKMENTS OR UNDER HIGHWAYS, STREETS, OR OTHER FACILITIES BY JACKING OR BORING METHODS, CONSTRUCTION SHALL BE MADE IN SUCH A MANNER THAT WILL NOT INTERFERE WITH THE OPERATION OF THE RAILROAD, STREET, HIGHWAY, OR OTHER FACILITY, AND SHALL NOT WEAKEN OR DAMAGE ANY EMBANKMENT OR STRUCTURE. DURING CONSTRUCTION OPERATIONS, BARRICADES AND LIGHTS TO SAFEGUARD TRAFFIC AND PEDESTRIANS SHALL BE FURNISHED AND MAINTAINED, AS DIRECTED BY THE OWNER'S REPRESENTATIVE, UNTIL SUCH TIME AS THE BACKFILL HAS BEEN COMPLETED AND THEN SHALL BE REMOVED FROM THE SITE.
3. HEAVY DUTY JACKS SUITABLE FOR FORCING THE PIPE THROUGH THE EMBANKMENT SHALL BE PROVIDED. IN OPERATING JACKS, EVEN PRESSURE SHALL BE APPLIED TO ALL JACKS USED. A SUITABLE JACKING HEAD, USUALLY OF TIMBER, AND SUITABLE BRACING BETWEEN JACKS AND JACKING HEAD SHALL BE PROVIDED SO THAT PRESSURE WILL BE APPLIED TO THE PIPE UNIFORMLY AROUND THE RING OF THE PIPE. A SUITABLE JACKING FRAME OR BACK STOP SHALL BE PROVIDED. THE PIPE TO BE JACKED SHALL BE SET ON GUIDES, PROPERLY BRACED TOGETHER, TO SUPPORT THE SECTION OF THE PIPE AND TO DIRECT IT IN THE PROPER LINE AND GRADE. THE WHOLE JACKING ASSEMBLY SHALL BE PLACED SO AS TO LINE UP WITH THE DIRECTION AND GRADE OF THE PIPE. IN GENERAL, EMBANKMENT MATERIAL SHALL BE EXCAVATED JUST AHEAD OF THE PIPE AND MATERIAL REMOVED THROUGH THE PIPE, AND THE PIPE FORCED THROUGH THE EMBANKMENT WITH JACKS, INTO THE SPACE THUS PROVIDED.
4. THE CONTRACTOR SHALL FURNISH FOR THE OWNER'S REPRESENTATIVE'S REVIEW, A PLAN SHOWING HIS PROPOSED METHOD OF HANDLING, INCLUDING THE DESIGN FOR THE JACKING HEAD, JACKING SUPPORT OF BACK STOP, ARRANGEMENT AND POSITION OF JACKS, PIPE GUIDES, ETC., COMPLETE IN ASSEMBLED POSITION. THE REVIEW OF THIS PLAN BY THE OWNER'S REPRESENTATIVE'S WILL NOT RELIEVE THE CONTRACTOR FROM HIS RESPONSIBILITY TO OBTAIN THE SPECIFIED RESULTS.
5. THE EXCAVATION FOR THE UNDERSIDE OF THE PIPE, FOR AT LEAST ONE THIRD OF THE CIRCUMFERENCE OF THE PIPE, SHALL CONFORM TO THE CONTOUR AND GRADE OF THE PIPE. A CLEARANCE OF NOT MORE THAN TWO INCHES (2") MAY

BE PROVIDED FOR THE UPPER HALF OF THE PIPE. THIS CLEARANCE IS TO BE TAPERED OFF TO ZERO AT THE POINT WHERE THE EXCAVATION CONFORMS TO THE CONTOUR OF THE PIPE. THE DISTANCE THAT THE EXCAVATION SHALL EXTEND BEYOND THE END OF THE PIPE DEPENDS ON THE CHARACTER OF THE MATERIAL, BUT IT SHALL NOT EXCEED TWO FEET (2') IN ANY CASE. THIS DISTANCE SHALL BE DECREASED ON INSTRUCTIONS FROM THE ENGINEER, IF THE CHARACTER OF THE MATERIAL BEING EXCAVATED MAKES IT DESIRABLE TO KEEP THE ADVANCE EXCAVATION CLOSER TO THE END OF THE PIPE.

6. THE PIPE, PREFERABLY, SHALL BE JACKED FROM THE LOW OR DOWNSTREAM END. LATERAL OR VERTICAL VARIATION IN THE FINAL POSITION OF THE PIPE FROM THE LINE AND GRADE ESTABLISHED WILL BE PERMITTED AT THE DISCRETION OF THE OWNER'S REPRESENTATIVE PROVIDED THAT SUCH VARIATION SHALL BE REGULAR, ONLY IN ONE DIRECTION AND THAT THE FINAL GRADE OF FLOW LINE SHALL BE IN THE DIRECTION INDICATED ON THE PLANS.
7. IF THE CONTRACTOR DESIRES, HE MAY USE A CUTTING EDGE OF STEEL PLATE AROUND THE HEAD END OF THE PIPE EXTENDING A SHORT DISTANCE BEYOND THE END OF THE PIPE WITH INSIDE ANGLES OR LUGS TO KEEP THE CUTTING EDGE FROM SLIPPING BACK ONTO PIPE.
8. WHEN JACKING OF PIPE IS ONCE BEGUN, THE OPERATION SHALL BE CARRIED ON WITHOUT INTERRUPTION, INSOFAR AS PRACTICABLE, TO PREVENT THE PIPE FROM BECOMING FIRMLY SET IN THE EMBANKMENT.
9. ANY PIPE DAMAGED IN JACKING OPERATIONS SHALL BE REMOVED AND REPLACED BY THE CONTRACTOR AT NO ADDITIONAL COST TO THE OWNER.
10. THE PITS OR TRENCHES EXCAVATED TO FACILITATE JACKING OPERATIONS SHALL BE BACKFILLED IN ACCORDANCE WITH THE DETAILS FOR BACKFILLING SEWER LINES SHOWN IN THE DRAWINGS IMMEDIATELY AFTER THE JACKING OF THE PIPE HAS BEEN COMPLETED.

D. BORING

1. THE BORING SHALL PROCEED FROM A PIT PROVIDED FOR THE BORING EQUIPMENT AND WORKMEN. EXCAVATION FOR PITS AND INSTALLATION OF SHORING SHALL BE AS OUTLINED ABOVE UNDER 3.5.C. THE LOCATION OF THE PIT SHALL MEET THE APPROVAL OF THE OWNER'S REPRESENTATIVE. THE HOLES ARE TO BE BORED MECHANICALLY. THE BORING SHALL BE DONE USING A PILOT HOLE. BY THIS METHOD APPROXIMATELY A TWO INCH (2") PILOT HOLE SHALL BE BORED THE ENTIRE LENGTH OF THE CROSSING AND SHALL BE CHECKED FOR LINE AND GRADE ON THE OPPOSITE END OF THE BORE FROM THE WORK PIT.
2. THIS PILOT HOLE SHALL SERVE AS THE CENTERLINE OF THE LARGER DIAMETER HOLE TO BE BORED. EXCAVATED MATERIAL WILL BE PLACED NEAR THE TOP OF THE WORKING PIT AND DISPOSED OF AS REQUIRED. THE USE OF WATER OR OTHER FLUIDS IN CONNECTION WITH THE BORING OPERATION WILL BE PERMITTED ONLY TO THE EXTENT TO LUBRICATE CUTTINGS. JETTING WILL NOT BE PERMITTED.
3. IN UNCONSOLIDATED SOIL FORMATIONS A GEL FORMING COLLOIDAL DRILLING FLUID CONSISTING OF AT LEAST 10% OF HIGH GRADE CAREFULLY PROCESSED BENTONITE MAY BE USED TO CONSOLIDATE CUTTINGS OF THE BIT, SEAL THE WALLS OF THE HOLE, AND FURNISH LUBRICATION FOR SUBSEQUENT REMOVAL OF CUTTINGS AND INSTALLATION OF THE PIPE IMMEDIATELY THEREAFTER.
4. ALLOWABLE VARIATION FROM LINE AND GRADE SHALL BE AS SPECIFIED UNDER 3.5.C. ABOVE. OVER CUTTING IN EXCESS OF ONE INCH (1") SHALL BE REMEDIED BY PRESSURE GROUTING THE ENTIRE LENGTH OF THE INSTALLATION.

3.08 MANHOLES

A. MANHOLES SHALL BE CONSTRUCTED AT LOCATIONS SHOWN ON THE PLANS AND TO THE DEPTH INDICATED THEREON.

B. MANHOLES SHALL BE CONSTRUCTED TO THE DIMENSIONS SHOWN ON THE PLANS. WHERE CONCRETE OR PRECAST CONCRETE SECTIONS ARE USED, THE INTERIOR WALL SHALL BE COATED WITH 80 MILS THICKNESS RAVEN 405.

C. JOINTS BETWEEN PRECAST CONCRETE SECTIONS SHALL BE MADE BY UNIFORMLY PLACING "RAM-NEK" FLEXIBLE PLASTIC GASKETS OR APPROVED EQUAL ON ALL FACES OF THE LOWER PART OF THE JOINT AND LOWERING THE UPPER RING EVENLY INTO PLACE TO PRODUCE UNIFORM BEARING AND COMPRESSION ON THE SEALER.

D. THE CONSTRUCTION OF MANHOLES SHALL BE DONE AS SOON AS PRACTICAL AFTER SEWER LINES INTO OR THROUGH THE MANHOLE ARE COMPLETED.

E. ALL SEWERS SHALL BE CUT NEATLY AT THE INSIDE FACE OF THE WALLS OF THE MANHOLE AND POINTED UP WITH MORTAR.

F. AFTER THE MASONRY WORK HAS BEEN COMPLETED TO THE PROPER ELEVATION, THE CAST IRON MANHOLE COVER FRAME SHALL BE SET IN A FULL MORTAR BED AND ADJUSTED TO THE ELEVATION ESTABLISHED ON THE DRAWINGS.

G. THE INVERTS OF THE SEWER LINE OR SEVERAL SEWER LINES ENTERING THE MANHOLE AT OR NEAR THE FLOW LINE ELEVATION OF THE MANHOLE SHALL BE SHAPED AND ROUTED ACROSS THE FLOOR OF THE MANHOLE USING MORTAR TO OBTAIN THE PROPER CONTOUR.

H. WHEN SANITARY SEWER PIPES ENTER A MANHOLE TWO (2) FEET OR GREATER ABOVE THE BOTTOM OF THE MANHOLE, A DROP PIPE OF EQUAL DIAMETER SHALL BE CONSTRUCTED OUTSIDE THE MANHOLE TO THE BOTTOM OF THE MANHOLE PER THE DETAILS ON THE PLANS.

I. ALL MANHOLES ARE TO BE BACKFILLED PER THE DETAILS SHOWN IN THE DRAWINGS AND THE REQUIREMENTS OF SECTION 31 23 33 – TRENCHING, BACKFILL AND COMPACTION.

3.09 FRAMES, GRATES, RINGS AND COVERS

A. CASTING SHALL CONFORM TO THE TYPE SHOWN ON THE DRAWINGS AND SHALL BE CLEAN CASTINGS, FREE FROM SAND OR BLOW HOLES OR OTHER DEFECTS. MATERIALS SHALL BE NOT LESS THAN CLASS 30B GRAY IRON CONFORMING TO ASTM A-48.

B. SURFACES OF THE CASTINGS SHALL BE FREE FROM BURNT-ON SAND AND SHALL BE REASONABLY SMOOTH.

C. BEARING SURFACES BETWEEN MANHOLE RINGS AND COVERS AND FRAMES SHALL BE CAST OR MACHINED WITH SUCH PRECISION THAT UNIFORM BEARING SHALL BE PROVIDED THROUGHOUT THE PERIMETER AREA OF CONTACT.

3.10 INSPECTION AND TESTING OF GRAVITY SANITARY SEWERS

A. TEST NEW PIPING SYSTEMS, AND PARTS OF EXISTING SYSTEMS THAT HAVE BEEN ALTERED, EXTENDED, OR REPAIRED, FOR LEAKS AND DEFECTS.

B. DO NOT PUT INTO SERVICE BEFORE INSPECTION AND APPROVAL.

C. TEST COMPLETED PIPING SYSTEMS ACCORDING TO REQUIREMENTS OF THIS SECTION AND AUTHORITIES HAVING JURISDICTION.

D. SCHEDULE TESTS AND INSPECTIONS BY THE OWNER'S REPRESENTATIVE AND AUTHORITIES HAVING JURISDICTION WITH AT LEAST 48 HOURS' ADVANCE NOTICE.

E. SUBMIT SEPARATE REPORT FOR EACH TEST.

F. SANITARY SEWER CLEANING AND TELEVISION INSPECTION
   1. CLEANING:
      a. TAKE PRECAUTIONS TO PROTECT SANITARY SEWER MAINS AND MANHOLES FROM DAMAGE THAT MIGHT BE INFLICTED BY THE IMPROPER SELECTION OF CLEANING PROCESSES OR IMPROPER USE OF EQUIPMENT. WHEN USING HYDRAULICALLY-PROPELLED DEVICES TAKE PRECAUTIONS TO ENSURE THAT THE WATER PRESSURE CREATED DOES NOT CAUSE DAMAGE TO OR FLOODING OF PUBLIC OR PRIVATE PROPERTY. DO NOT SURCHARGE ANY SANITARY SEWER TO AN ELEVATION THAT COULD CAUSE OVERFLOW OF SEWAGE INTO AREA WATERWAYS, HOMES OR BUILDINGS, OR ONTO THE SURFACE.
      b. EXERCISE CARE TO PREVENT CONTAMINATION OF THE POTABLE WATER SYSTEM. USE AN APPROPRIATELY SIZED BACKFLOW PREVENTER AS REQUIRED BY THE AUTHORITY HAVING JURISDICTION WHEN DRAWING WATER FROM A PUBLIC HYDRANT.
      c. DEBRIS DISPOSAL: REMOVE SLUDGE, SOIL, SAND, ROCKS, GREASE, ROOTS AND OTHER SOLID OR SEMI-SOLID MATERIAL RESULTING FROM THE CLEANING OPERATION AT THE DOWNSTREAM MANHOLE OF THE SECTION BEING CLEANED. PASSING DEBRIS FROM ANY SEWER SECTION TO ANY OTHER SEWER SECTION IS NOT ALLOWED. LOAD DEBRIS FROM THE MANHOLES INTO AN ENCLOSED CONTAINER PERMITTED FOR LIQUID WASTE HAULING. REMOVE SOLIDS AND SEMI-SOLIDS RESULTING FROM CLEANING OPERATIONS FROM THE SITE AND DISPOSE OF LAWFULLY AT THE END OF EACH WORK DAY. DO NOT ACCUMULATE DEBRIS, LIQUID WASTE, OR SLUDGE ON THE SITE.
   2. TELEVISION INSPECTION
      a. IMMEDIATELY AFTER CLEANING, VIDEO INSPECT THE SANITARY SEWER LINE TO DOCUMENT THE CONDITION OF THE LINE. NOTIFY THE OWNER'S REPRESENTATIVE 48 HOURS IN ADVANCE OF ANY TELEVISION INSPECTION SO THAT THEY MAY OBSERVE INSPECTION OPERATIONS.
      b. PERFORM TELEVISION INSPECTION ON ONE MANHOLE SECTION AT A TIME. ADEQUATELY CONTROL THE FLOW IN THE SECTION BEING INSPECTED. NO FLOW IS ALLOWED IN THE LINE WHILE PERFORMING POST-INSTALLATION VIDEO INSPECTION.
      c. PERFORM TELEVISION INSPECTION OF SANITARY SEWERS AS FOLLOWS:
      d. VIDEOS SHALL PAN ALL MANHOLES SHOWING BENCHES, WALLS, ANNULAR SPACES, AND DEBRIS REMOVAL. CAMERA OPERATOR SHALL SLOWLY PAN EACH SERVICE CONNECTION, CLAMPED JOINT AND PIPE MATERIAL TRANSITION FROM ONE MATERIAL TO ANOTHER. COMPLETE AND SUBMIT A TELEVISION INSPECTION REPORT FOR EVERY SEWER SEGMENT VIDEO SUBMITTED TO THE OWNER'S REPRESENTATIVE.
      e. PROVIDE A VIDEO SHOWING THE COMPLETED WORK INCLUDING THE CONDITION OF ANY SERVICE CONNECTIONS. PREPARE AND SUBMIT

TELEVISION INSPECTION REPORT FORMS PROVIDING THE LOCATION OF SERVICE CONNECTIONS ALONG WITH THE LOCATION OF ANY DISCREPANCIES.

f. DOCUMENT RESULTS OF VIDEO INSPECTIONS USING A TELEVISION INSPECTION REPORT FORM APPROVED BY THE OWNER'S REPRESENTATIVE.

G. SANITARY SEWER DEFLECTION TESTING

1. PERFORM DEFLECTION TESTING ON FLEXIBLE AND SEMI-RIGID PIPE TO CONFIRM PIPE HAS NO MORE THAN 5 PERCENT DEFLECTION. MANDREL TESTING SHALL CONFORM TO ASTM D 3034. PERFORM TESTING NO SOONER THAN 30 DAYS AFTER BACKFILLING OF LINE SEGMENT, BUT PRIOR TO FINAL ACCEPTANCE TESTING OF LINE SEGMENT.
2. RIGID MANDREL SHALL HAVE OUTSIDE DIAMETER (O.D.) EQUAL TO 95 PERCENT OF INSIDE DIAMETER (I.D.) OF PIPE. MANDREL SHALL BE CONSTRUCTED OF METAL OR RIGID PLASTIC MATERIAL THAT CAN WITHSTAND 200 PSI WITHOUT BEING DEFORMED. MANDREL SHALL HAVE NINE OR MORE "RUNNERS" OR "LEGS" AS LONG AS TOTAL NUMBER OF LEGS IS ODD NUMBER. BARREL SECTION OF MANDREL SHALL HAVE LENGTH OF AT LEAST 75 PERCENT OF INSIDE DIAMETER OF PIPE. RIGID MANDREL SHALL NOT HAVE ADJUSTABLE OR COLLAPSIBLE LEGS WHICH WOULD ALLOW REDUCTION IN MANDREL DIAMETER DURING TESTING.
3. PULL APPROVED MANDREL BY HAND THROUGH SEWER SECTIONS. MANDREL TESTING IS NOT REQUIRED FOR STUBS.
4. DOCUMENT RESULTS OF DEFLECTION TESTING USING A SANITARY SEWER DEFLECTION TEST REPORT FORM APPROVED BY THE OWNER'S REPRESENTATIVE.

H. SANITARY SEWER LEAKAGE TESTING

1. LOW AIR PRESSURE TEST: WHEN USING THIS TEST CONFORM TO ASTM C 828, ASTM C 924, OR ASTM F 1417, AS APPLICABLE, WITH HOLDING TIME NOT LESS THAN THAT LISTED BELOW.
   a. LOW PRESSURE AIR TESTING FOR SECTIONS OF PIPE SHALL BE LIMITED TO LINES LESS THAN 36-INCH AVERAGE INSIDE DIAMETER.
   b. LINES 36-INCH AVERAGE INSIDE DIAMETER AND LARGER SHALL BE TESTED AT EACH JOINT. MINIMUM TIME ALLOWABLE FOR PRESSURE TO DROP FROM 3.5 POUNDS PER SQUARE INCH GAUGE TO 2.5 POUNDS PER SQUARE INCH DURING JOINT TEST SHALL BE 10 SECONDS, REGARDLESS OF PIPE SIZE.
   c. TIME ALLOWED FOR PRESSURE LOSS FROM 3.5 PSIG TO 2.5 PSIG, AT END OF THIS SECTION, ARE BASED ON EQUATION FROM TEXAS COMMISSION ON ENVIRONMENTAL QUALITY (TCEQ) DESIGN CRITERIA.

	$T = 0.0850(D)(K)/(Q)$
T =	TIME FOR PRESSURE TO DROP 1.0 POUNDS PER SQUARE INCH GAUGE IN SECONDS
K =	0.000419 DL, BUT NOT LESS THAN 1.0
D =	AVERAGE INSIDE DIAMETER IN INCHES
L =	LENGTH OF LINE OF SAME PIPE SIZE IN FEET
Q =	RATE OF LOSS, 0.0015 FT^3/MIN./SQ. FT. INTERNAL SURFACE

   d. SINCE K VALUE OF LESS THAN 1.0 SHALL NOT BE USED, THERE ARE MINIMUM TESTING TIMES FOR EACH PIPE DIAMETER AS GIVEN BELOW.
   e. FOR JOINT TEST, PIPE IS TO BE PRESSURIZED TO 3.5 PSI GREATER THAN PRESSURE EXERTED BY GROUNDWATER ABOVE PIPE. ONCE PRESSURE HAS STABILIZED, MINIMUM TIMES ALLOWABLE FOR PRESSURE TO DROP

FROM 3.5 POUNDS PER SQUARE INCH GAUGE TO 2.5 POUNDS PER SQUARE INCH GAUGE SHALL BE 10 SECONDS.

f. DOCUMENT RESULTS OF LOW PRESSURE AIR TEST USING A SANITARY SEWER LOW PRESSURE AIR TEST REPORT FORM APPROVED BY THE OWNER'S REPRESENTATIVE.

NOTES:

- WHEN TWO SIZES OF PIPE ARE INVOLVED, COMPUTE TIME BY RATIO OF LENGTHS INVOLVED.
- LINES WITH 27-INCH AVERAGE INSIDE DIAMETER AND LARGER MAY BE AIR TESTED AT EACH JOINT.
- LINES WITH AVERAGE INSIDE DIAMETER GREATER THAN 36 INCHES MUST BE AIR TESTED FOR LEAKAGE AT EACH JOINT.
- IF JOINT TEST IS USED, PERFORM VISUAL INSPECTION OF JOINT IMMEDIATELY AFTER TESTING.

I. SANITARY MANHOLE VACUUM TESTING

1. AFTER COMPLETION OF MANHOLE CONSTRUCTION, WALL SEALING, OR REHABILITATION, BUT PRIOR TO BACKFILLING, TEST MANHOLES FOR WATER TIGHTNESS USING HYDROSTATIC OR VACUUM TESTING PROCEDURES.
2. PLUG INFLUENT AND EFFLUENT LINES, INCLUDING SERVICE LINES, WITH SUITABLY-SIZED PNEUMATIC OR MECHANICAL PLUGS. ENSURE PLUGS ARE PROPERLY RATED FOR PRESSURES REQUIRED FOR TEST; FOLLOW MANUFACTURER'S SAFETY AND INSTALLATION RECOMMENDATIONS. PLACE PLUGS MINIMUM OF 6 INCHES OUTSIDE OF MANHOLE WALLS. BRACE INVERTS TO PREVENT LINES FROM BEING DISLODGED WHEN LINES ENTERING MANHOLE HAVE NOT BEEN BACKFILLED.
3. INSTALL VACUUM TESTER HEAD ASSEMBLY AT TOP ACCESS POINT OF MANHOLE AND ADJUST FOR PROPER SEAL ON STRAIGHT TOP SECTION OF MANHOLE STRUCTURE. FOLLOWING MANUFACTURER'S INSTRUCTIONS AND SAFETY PRECAUTIONS, INFLATE SEALING ELEMENT TO RECOMMENDED MAXIMUM INFLATION PRESSURE; DO NOT OVER-INFLATE.
4. EVACUATE MANHOLE WITH VACUUM PUMP TO 10 INCHES MERCURY (HG), DISCONNECT PUMP, AND MONITOR VACUUM FOR TIME PERIOD SPECIFIED BELOW.
5. A MANHOLE PASSES THE TEST IF AFTER 2.0 MINUTES AND WITH ALL VALVES CLOSED, THE VACUUM IS AT LEAST 9.0 INCHES OF MERCURY (HG).
6. DOCUMENT RESULTS OF VACUUM TESTING USING A SANITARY SEWER MANHOLE VACUUM TEST REPORT FORM APPROVED BY THE OWNER'S REPRESENTATIVE.

3.11 INSPECTION AND TESTING OF SANITARY SEWER FORCE MAINS

A. HYDROSTATIC TESTING

1. AFTER THE PIPE HAS BEEN LAID AND INITIAL BACKFILL COMPLETED, THE WATER LINE SHALL BE SUBJECTED TO A HYDROSTATIC TEST PER AWWA C600 OR AWWA C605 AT A MINIMUM PRESSURE OF 150 PSI. JOINTS SHALL REMAIN EXPOSED DURING TESTING WHENEVER POSSIBLE.
2. THE CONTRACTOR SHALL FURNISH, INSTALL, AND OPERATE, AT HIS EXPENSE, THE NECESSARY CONNECTIONS, PUMPS, METERS, AND GAUGES NECESSARY TO CONDUCT THE TEST. THE METERS USED IN THE TESTING SHALL BE TESTED, SEALED AND APPROVED AT THE CONTRACTOR'S EXPENSE PRIOR TO RUNNING ANY TEST.

3. WHERE PRACTICABLE, PIPELINES SHALL BE TESTED IN LENGTHS BETWEEN VALVES OR PLUGS OF NO MORE THAN 1,500 FEET. CONTRACTOR MUST HAVE WRITTEN APPROVAL FOR TEST SECTIONS GREATER THAN 1,500 FEET.
4. MINIMUM DURATION OF TESTING FOR EACH SECTION SHALL BE 2 HOURS WHEN JOINTS ARE EXPOSED AND 8 HOURS WHEN JOINTS ARE COVERED.
5. ALLOWABLE LEAKAGE SHALL BE AS CALCULATED BY THE FOLLOWING FORMULA:
   L=(S)(D) (P.05)/133,200
   L= ALLOWABLE LEAKAGE IN GALLONS PER HOUR
   S=LENGTH OF PIPE IN FEET
   D=INSIDE DIAMETER OF PIPE IN INCHES
   P=PRESSURE IN POUNDS PER SQUARE INCH
6. CORRECT DEFECTS, CRACKS, OR LEAKAGE BY REPLACEMENT OF DEFECTIVE ITEMS. ALL VISIBLE LEAKS AT EXPOSED JOINTS AND ALL LEAKS EVIDENT ON THE SURFACE WHERE JOINTS ARE COVERED SHALL BE REPLACED, REGARDLESS OF TOTAL LEAKAGE SHOWN.
7. REPEAT TEST UNTIL SATISFACTORY RESULTS ARE OBTAINED.
8. UPON SATISFACTORY COMPLETION OF TESTING, PLUG OPENINGS IN FORCE MAIN. USE CAST IRON PLUGS OR BLIND FLANGES TO PREVENT DEBRIS FROM ENTERING TESTED PIPELINE.

B. PIGGING TEST
1. AFTER COMPLETION OF HYDROSTATIC TESTING AND PRIOR TO FINAL ACCEPTANCE, TEST FORCE MAINS LONGER THAN 200 FEET BY PIGGING TO ENSURE PIPING IS FREE OF OBSTRUCTIONS.
2. PIGS: PROVIDE PROVING PIGS MANUFACTURED OF OPEN-CELL POLYURETHANE FOAM BODY, WITHOUT COATING OR ABRASIVES WHICH WOULD SCRATCH OR OTHERWISE DAMAGE INTERIOR PIPE WALL SURFACE OR LINING. PIGS SHALL BE ABLE TO PASS THROUGH REDUCTIONS OF UP TO 65 PERCENT OF NOMINAL CROSS-SECTIONAL AREA OF PIPE. PIGS SHALL BE ABLE TO PASS THROUGH STANDARD FITTINGS SUCH AS 45-DEGREE AND 90-DEGREE ELBOWS, CROSSES, TEES, WYES, GATE VALVES, OR PLUG VALVES, AS APPLICABLE TO FORCE MAIN BEING TESTED.

END OF SECTION 33 30 00

SECTION 33 40 00 – STORM DRAINAGE

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. THIS SECTION SPECIFIES THE REQUIREMENTS FOR FURNISHING AND PLACING DRAINAGE PIPE, LATERALS, STUBS, AND APPURTENANCES. THE PIPE SHALL BE OF THE SIZE, TYPE AND LOCATION, AND TO THE LINES, GRADES AND ELEVATIONS SHOWN ON THE PLANS AND CONSTRUCTED IN ACCORDANCE WITH THESE SPECIFICATIONS.

1.02 DEFINITIONS

A. CMP: CORRUGATED METAL PIPE.

B. HDPE: HIGH-DENSITY POLYETHYLENE PLASTIC.

C. PVC: POLYVINYL CHLORIDE PLASTIC.

D. RCB: REINFORCED CONCRETE BOX.

E. RCP: REINFORCED CONCRETE PIPE.

1.03 REGULATORY REQUIREMENTS

A. CONTRACTOR SHALL COMPLY WITH STANDARDS OF AUTHORITIES HAVING JURISDICTION FOR DRAINAGE PIPING, INCLUDING MATERIALS, INSTALLATION AND TESTING.

B. CONTRACTOR SHALL COMPLY WITH ALL STANDARD SPECIFICATIONS AND DETAILS OF AUTHORITIES HAVING JURISDICTION (HEREIN AFTER REFERRED TO AS "STANDARD SPECIFICATIONS") FOR WORK IN THE RIGHT-OF-WAY OR EASEMENTS.

C. PRIOR TO COMMENCEMENT OF WORK, THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING, AT THE CONTRACTOR’S OWN EXPENSE, ALL CONSTRUCTION PERMITS NECESSARY TO COMPLETE THE PROJECT ACCORDING TO THE PLANS AND SPECIFICATIONS.

1.04 SUBMITTALS

A. PRODUCT DATA: FOR EACH TYPE OF PRODUCT INDICATED.

B. COORDINATION DRAWINGS: FOR PIPING AND SPECIALTIES INCLUDING RELATION TO OTHER SERVICES IN SAME AREA, DRAWN TO SCALE. SHOW PIPING AND SPECIALTY SIZES AND VALVES, METER AND SPECIALTY LOCATIONS, AND ELEVATIONS.

C. FIELD QUALITY-CONTROL TEST REPORTS.

1.05 QUALITY ASSURANCE

A. PIPING MATERIALS SHALL BEAR LABEL, STAMP, OR OTHER MARKINGS OF SPECIFIED TESTING AGENCY.

B. CONTRACTOR IS RESPONSIBLE FOR PROTECTING MATERIALS PER MANUFACTURES RECOMMENDATIONS
   1. DO NOT STORE PLASTIC MANHOLES, PIPE, AND FITTINGS IN DIRECT SUNLIGHT.
   2. PROTECT PIPE, PIPE FITTINGS, AND SEALS FROM DIRT AND DAMAGE.
   3. HANDLE PRECAST STRUCTURES ACCORDING TO MANUFACTURER'S WRITTEN RIGGING INSTRUCTIONS.

C. INSTALL DRAINAGE SYSTEM THAT IS WATERTIGHT BOTH IN PIPE-TO-PIPE JOINTS AND IN PIPE TO-MANHOLE CONNECTIONS.

PART 2 – PRODUCTS

2.01 CMP PIPE

A. CORRUGATED METAL PIPE SHALL BE GALVANIZED STEEL CONFORMING TO THE REQUIREMENTS OF AASHTO M 218
   1. REFERENCE TO GAUGE OF METAL IS TO U.S. STANDARD GAUGE FOR UNCOATED SHEETS. TABLES IN AASHTO M 218 LIST THICKNESSES FOR COATED SHEETS IN INCHES.

B. COUPLING BANDS AND OTHER HARDWARE FOR GALVANIZED STEEL PIPE SHALL CONFORM TO REQUIREMENTS OF AASHTO M 36.
   1. COUPLING BANDS SHALL BE NOT MORE THAN 3 NOMINAL SHEET THICKNESSES LIGHTER THAN THICKNESS OF PIPE TO BE CONNECTED AND IN NO CASE LIGHTER THAN 0.052 INCH.
   2. COUPLING BANDS SHALL BE MADE OF SAME BASE METAL AND COATING (METALLIC OR OTHERWISE) AS PIPE.
   3. MINIMUM WIDTH OF CORRUGATED LOCKING BANDS SHALL BE AS SHOWN BELOW FOR CORRUGATIONS WHICH CORRESPOND TO END CIRCUMFERENTIAL CORRUGATIONS ON PIPES BEING JOINED:
      a. 10-1/2 INCHES WIDE FOR 2-2/3 INCH BY 1/2 INCH CORRUGATIONS.
      b. 12 INCHES WIDE FOR 3 INCH BY 1 INCH CORRUGATIONS.
   4. HELICAL PIPE WITHOUT CIRCUMFERENTIAL END CORRUGATIONS WILL BE PERMITTED ONLY WHEN IT IS NECESSARY TO JOIN NEW PIPE TO EXISTING PIPE WHICH WAS INSTALLED WITH NO CIRCUMFERENTIAL END CORRUGATIONS. IN THIS EVENT PIPE FURNISHED WITH HELICAL CORRUGATIONS AT ENDS SHALL BE FIELD JOINTED WITH EITHER HELICALLY CORRUGATED BANDS OR WITH BANDS WITH PROJECTIONS (DIMPLES). MINIMUM WIDTH OF HELICAL CORRUGATED BANDS SHALL CONFORM TO FOLLOWING:
      a. 12 INCHES WIDE FOR 1/2 INCH DEEP HELICAL END CORRUGATIONS.
      b. 14 INCHES WIDE FOR 1 INCH DEEP HELICAL END CORRUGATIONS.
   5. BANDS WITH PROJECTIONS SHALL HAVE CIRCUMFERENTIAL ROWS OF PROJECTIONS WITH ONE PROJECTION FOR EACH CORRUGATION. WIDTH OF BANDS WITH PROJECTIONS SHALL BE NOT LESS THAN FOLLOWING:
      a. 12 INCHES WIDE FOR PIPE DIAMETERS UP TO AND INCLUDING 72 INCHES. BANDS SHALL HAVE TWO CIRCUMFERENTIAL ROWS OF PROJECTIONS.
      b. 16-1/4 INCHES WIDE FOR PIPE DIAMETERS OF 78 INCHES AND GREATER. BANDS SHALL HAVE FOUR CIRCUMFERENTIAL ROWS OF PROJECTIONS.
   6. BOLTS FOR COUPLING BANDS SHALL BE 1/2 INCH DIAMETER. BANDS 12 INCHES WIDE OR LESS WILL HAVE MINIMUM OF 2 BOLTS PER END AT EACH CONNECTION, AND BANDS GREATER THAN 12 INCHES WIDE SHALL HAVE MINIMUM OF 3 BOLTS AT EACH CONNECTION.

7. GALVANIZED BOLTS MAY BE HOT DIP GALVANIZED IN ACCORDANCE WITH REQUIREMENTS OF AASHTO M 232, MECHANICALLY GALVANIZED TO PROVIDE SAME REQUIREMENTS AS AASHTO M 232, OR ELECTRO GALVANIZED PER ASTM B 633, TYPE RS.

C. FURNISH FITTINGS AND SPECIALS REQUIRED FOR BENDS, END SECTIONS, BRANCHES, ACCESS MANHOLES, AND CONNECTIONS TO OTHER FITTINGS. DESIGN FITTINGS AND SPECIALS IN ACCORDANCE WITH DRAWINGS AND ASTM A 760. FITTINGS AND SPECIALS ARE SUBJECT TO SAME INTERNAL AND EXTERNAL LOADS AS STRAIGHT PIPE.

D. FABRICATION
1. STEEL PIPE:
a. GALVANIZED STEEL PIPE SHALL BE FULL CIRCLE OR ARCH PIPE CONFORMING TO AASHTO M 36, TYPE I, TYPE IA, OR TYPE II, AS INDICATED ON DRAWINGS.
b. FABRICATION WITH CIRCUMFERENTIAL CORRUGATIONS, LAP JOINT CONSTRUCTION WITH RIVETED OR SPOTWELDED SEAMS, HELICAL CORRUGATIONS WITH CONTINUOUS HELICAL LOCK SEAM, OR ULTRA-HIGH FREQUENCY RESISTANCE BUTT-WELDED SEAMS IS ACCEPTABLE.

2.02 HDPE PIPE

A. FURNISH ANNULAR CORRUGATED PROFILE WALL POLYETHYLENE PIPE CONFORMING TO ASTM F2648 FOR GRAVITY STORM SEWER AND STORM SEWER CULVERT PIPE. JOINTS SHALL BE INSTALLED SUCH THAT CONNECTION OF PIPE SECTIONS WILL FORM CONTINUOUS LINE FREE FROM IRREGULARITIES IN FLOW LINE.

B. JOINTS
1. INTEGRAL BELL AND SPIGOT. BELL SHALL OVERLAP MINIMUM OF TWO CORRUGATIONS OF SPIGOT END WHEN FULLY ENGAGED.
2. SHALL BE WATERTIGHT ACCORDING TO THE REQUIREMENTS OF ASTM D3212.

C. GASKETS SHALL MEET REQUIREMENTS OF ASTM F 477. USE GASKET MOLDED INTO CIRCULAR FORM OR EXTRUDED TO PROPER SECTION AND THEN SPLICED INTO CIRCULAR FORM. WHEN NO CONTAMINANT IS IDENTIFIED, USE GASKETS OF PROPERLY CURED, HIGH-GRADE ELASTOMERIC COMPOUND. BASIC POLYMER SHALL BE NATURAL RUBBER, SYNTHETIC ELASTOMER, OR BLEND OF BOTH.

D. FITTINGS SHALL CONFORM TO ASTM F2306.

E. PERFORATED PIPE SHALL CONFORM TO THE REQUIREMENTS OF ASTM M252 FOR PIPE DIAMETERS 3-INCH THROUGH 10-INCH AND ASTM M294 FOR PIPE DIAMETERS 12-INCH THROUGH 60-INCH.

2.03 PVC PIPE

A. PVC PIPE SHALL CONFORM TO ASTM D3034, SDR 26. ALL DIAMETERS SHALL USE BELL AND SPIGOT ENDS FOR GASKETED JOINTS.

B. JOINTS SHALL CONFORM TO ASTM D3212 WITH A SDR MATCHING THE PIPE.

C. GASKETS SHALL MEET REQUIREMENTS OF ASTM F 477. USE ELASTOMERIC FACTORY-INSTALLED GASKETS TO MAKE JOINTS FLEXIBLE AND WATERTIGHT.

D. FITTINGS SHALL CONFORM TO ASTM D3034.

E. DO NOT USE PVC IN POTENTIALLY OR KNOWN CONTAMINATED AREAS.

F. DO NOT USE PVC IN AREAS EXPOSED TO DIRECT SUNLIGHT.

G. MAKE CURVES AND BENDS BY BENDING THE PIPE, DO NOT EXCEED MAXIMUM LIMITS OF CURVATURE RECOMMENDED BY PIPE MANUFACTURER. SUBMIT DETAILS OF OTHER METHODS OF PROVIDING CURVES AND BENDS FOR REVIEW BY THE OWNER'S REPRESENTATIVE.

2.04 RCP PIPE

A. REINFORCED CONCRETE PIPE SHALL CONFORM TO REQUIREMENTS OF ASTM C-76, WALL "B" THICKNESS FOR, CLASS III AND CLASS IV AS SHOWN ON THE PLANS OR AS NECESSARY TO MEET ASTM COVER DESIGN REQUIREMENTS.

B. REINFORCED CONCRETE ARCH PIPE SHALL CONFORM TO REQUIREMENTS OF ASTM C 506 FOR CLASS A-III. JOINTS SHALL CONFORM TO ASTM C 877.

C. REINFORCED CONCRETE ELLIPTICAL PIPE, EITHER VERTICAL OR HORIZONTAL, SHALL CONFORM TO REQUIREMENTS OF ASTM C 507 FOR CLASS VE-III FOR VERTICAL OR CLASS HE-III FOR HORIZONTAL. USE RUBBER GASKET JOINTS CONFORMING TO ASTM C 877.

D. GASKETS SHALL CONFORM TO AWWA C111, RUBBER.

E. GASKETS
   1. WHEN NO CONTAMINANT IS IDENTIFIED, FURNISH RUBBER GASKET CONFORMING TO ASTM C 443 FOR CIRCULAR REINFORCED CONCRETE PIPE AND RUBBER GASKET CONFORMING TO ASTM C 877 FOR REINFORCED CONCRETE ELLIPTICAL PIPE.
   2. USE GASKETS AS RECOMMENDED BY PIPE MANUFACTURER AND APPROVED BY THE OWNER'S REPRESENTATIVE PRIOR TO INSTALLATION IN POTENTIALLY CONTAMINATED SOIL.

2.05 RCB PIPE

A. REINFORCED CONCRETE BOXES SHALL CONFORM TO REQUIREMENTS OF ASTM C1577.

2.06 MANHOLES

A. PRECAST CONCRETE MANHOLES IN ACCORDANCE WITH THE DETAILS SHOWN ON THE DRAWINGS SHALL CONFORM TO ASTM C-478.

B. CAST-IN-PLACE-CONCRETE MANHOLES: CONSTRUCT OF REINFORCED-CONCRETE BOTTOM, WALLS, AND TOP; DESIGNED ACCORDING TO ASTM C 890 FOR A-16 (ASSHTO HS20-44), HEAVY-TRAFFIC, STRUCTURAL LOADING; OF DEPTH, SHAPE, DIMENSIONS, AND APPURTENANCES INDICATED. THE MINIMUM COMPRESSIVE STRENGTH OF CONCRETE MANHOLE SHALL BE 4,000 PSI.

C. BALLAST: INCREASE THICKNESS OF CONCRETE AS REQUIRED TO PREVENT FLOTATION.

D. ADJUSTING RINGS: INTERLOCKING RINGS WITH LEVEL OR SLOPED EDGE IN THICKNESS AND DIAMETER MATCHING MANHOLE FRAME AND COVER. INCLUDE SEALANT RECOMMENDED BY RING MANUFACTURER.

E. GRADE RINGS: REINFORCED-CONCRETE RINGS, 6- TO 9-INCH TOTAL THICKNESS, TO MATCH DIAMETER OF MANHOLE FRAME AND COVER.

2.07 PRECAST CONCRETE INLETS, HEADWALLS AND WINGWALLS

A. PROVIDE PRECAST CONCRETE MACHINE-MADE UNITS MEETING REQUIREMENTS OF ASTM C 76 REGARDING REINFORCED CONCRETE, CEMENT, AGGREGATE, MIXTURE, AND CONCRETE TEST. MINIMUM 28-DAY COMPRESSIVE STRENGTH OF CONCRETE SHALL BE 4,000 PSI.

B. REINFORCING STEEL SHALL CONFORM TO REQUIREMENTS OF ASTM A615, GRADE 60.

C. MARK DATE OF MANUFACTURE AND NAME OR TRADEMARK OF MANUFACTURER CLEARLY ON INSIDE OF INLET, HEADWALL, OR WINGWALL.

2.08 PVC INLETS

A. PVC SURFACE DRAINAGE INLETS SHALL INCLUDE THE DRAIN BASIN TYPE AS INDICATED ON THE DRAWINGS. THE DUCTILE IRON GRATES FOR EACH OF THESE FITTINGS ARE TO BE CONSIDERED AN INTEGRAL PART OF THE SURFACE DRAINAGE INLET AND SHALL BE FURNISHED BY THE SAME MANUFACTURER.

B. PVC INLETS SHALL BE MANUFACTURED FROM PVC PIPE STOCK, UTILIZING A THERMOFORMING PROCESS TO REFORM THE PIPE STOCK TO THE SPECIFIED CONFIGURATION. THE DRAINAGE PIPE CONNECTION STUBS SHALL BE MANUFACTURED FROM PVC PIPE STOCK AND FORMED TO PROVIDE A WATERTIGHT CONNECTION WITH THE SPECIFIED PIPE SYSTEM. THIS JOINT TIGHTNESS SHALL CONFORM TO ASTM D3212 FOR JOINTS FOR DRAIN AND SEWER PLASTIC PIPE USING FLEXIBLE ELASTOMERIC SEALS. THE FLEXIBLE ELASTOMERIC SEALS SHALL CONFORM TO ASTM F477. THE PIPE BELL SPIGOT SHALL BE JOINED TO THE MAIN BODY OF THE DRAIN BASIN OR CATCH BASIN. THE RAW MATERIAL USED TO MANUFACTURE THE PIPE STOCK THAT IS USED TO MANUFACTURE THE MAIN BODY AND PIPE STUBS OF THE SURFACE DRAINAGE INLETS SHALL CONFORM TO ASTM D1784 CELL CLASS 12454.

C. THE GRATES AND FRAMES FURNISHED FOR ALL PVC INLETS SHALL BE DUCTILE IRON AND SHALL BE MADE SPECIFICALLY FOR EACH BASIN SO AS TO PROVIDE A ROUND BOTTOM FLANGE THAT CLOSELY MATCHES THE DIAMETER OF THE INLET. GRATES FOR DRAIN BASINS SHALL BE CAPABLE OF SUPPORTING H-20 WHEEL LOADS. DUCTILE IRON USED IN THE MANUFACTURE OF THE CASTINGS SHALL CONFORM TO ASTM A536 GRADE 70-50-05. GRATES AND COVERS SHALL BE PROVIDED PAINTED BLACK.

2.09 MORTAR

A. MORTAR SHALL CONFORM TO ASTM C 476.

2.10 CLEANOUTS

A. CLEANOUTS IN ACCORDANCE WITH THE DETAILS SHOWN ON THE DRAWINGS SHALL CONSIST OF PVC BODY WITH PVC THREADED PLUG. INCLUDE PVC SEWER PIPE FITTING AND RISER TO CLEANOUT OF SAME MATERIAL AS SEWER PIPING.

2.11 RIMS, GRATES AND FRAMES

A. CASTINGS FOR MANHOLE AND INLET RIMS, COVERS, GRATES AND FRAMES SHALL CONFORM TO ASTM A 48, CLASS 35B GRAY IRON OR BETTER QUALITY.

2.12 MANUFACTURERS

A. USE APPROVED AMERICAN MANUFACTURERS.

PART 3 – EXECUTION

3.01 PREPERATION

A. PROTECT STRUCTURES, UTILITIES, SIDEWALKS, PAVEMENTS, AND OTHER FACILITIES FROM DAMAGE AND DISPLACEMENT.

B. VERIFY ALL EXISTING UTILITIES PRIOR TO BEGINNING CONSTRUCTION. INFORM THE OWNER'S REPRESENTATIVE IF EXISTING UTILITIES ARE NOT AS SHOWN IN THE PLANS.

C. PERFORM WORK IN ACCORDANCE WITH OSHA STANDARDS.

D. DRAINAGE TO THE SITE AND ADJACENT LANDOWNERS SHALL NOT BE OBSTRUCTED WITHOUT PRIOR APPROVAL OF THE OWNER'S REPRESENTATIVE AND THE AUTHORITY HAVING JURISDICTION. AT NO ADDITIONAL COST TO THE OWNER THE CONTRACTOR SHALL INSTALL NECESSARY PIPING AND ACCESSORIES SO AS NOT TO DISRUPT DRAINAGE FROM OTHER FACILITIES OR LANDOWNERS WHETHER OR NOT INDICATED ON THE PLANS.

E. BEFORE INSTALLATION, INSPECT EACH PIPE, FITTING AND STRUCTURE FOR DEFECTS. REJECT DEFECTIVE, DAMAGED OR UNSOUND PIPE, FITTINGS OR STRUCTURES AND REMOVE THEM FROM SITE.

3.02 GENERAL

A. NO PIPE SHALL BE INSTALLED IN THE TRENCH UNTIL EXCAVATION HAS BEEN PROPERLY CONSTRUCTED PER THE PLANS AND DETAILS TO AT LEAST TWO (2) PIPE LENGTHS BEYOND THE SECTION OF PIPE BEING INSTALLED AND THE BOTTOM OF THE TRENCH HAS BEEN PROPERLY SHAPED.

B. PIPE SHALL BE SO LAID THAT AFTER THE SEWER IS COMPLETED THE INTERIOR SURFACE SHALL CONFORM ACCURATELY TO THE GRADES AND ALIGNMENTS FIXED AND GIVEN IN THE PLANS.

C. ALL SEWERS MUST BE LAID ACCURATELY TO LINE AND GRADE, WITH TONGUE OR SPIGOT END DOWNSTREAM. ESTABLISH REQUIRED UNIFORM LINE AND GRADE IN TRENCH FROM BENCHMARKS IDENTIFIED BY THE OWNER'S REPRESENTATIVE. USE LASER BEAM EQUIPMENT TO ESTABLISH AND MAINTAIN PROPER LINE AND GRADE OF WORK.

D. PIPES SHALL BE FITTED TOGETHER AND MATCHED SO THAT WHEN LAID, THEY FORM A SEWER WITH A SMOOTH AND UNIFORM INVERT.

E. A MINIMUM CLEARANCE OF TWELVE (12) INCHES MUST BE MAINTAINED BETWEEN THE DRAINAGE SYSTEM AND ALL OTHER LINES.

F. OUTFALL PIPES SHALL BE AS DETAILED ON THE DRAWINGS AND CONFORM TO THE REQUIREMENTS OF THE AUTHORITY HAVING JURISDICTION.

G. WHERE CONDITIONS ARE SUCH THAT RUNNING OR STANDING WATER OCCURS IN THE TRENCH BOTTOM OR THE SOIL IN THE TRENCH BOTTOM DISPLAYS A "QUICK" TENDENCY, THE WATER SHALL BE REMOVED BY PUMPS AND SUITABLE MEANS SUCH AS WELL POINTS OR PERVIOUS UNDERDRAIN BEDDING UNTIL THE PIPE HAS BEEN INSTALLED AND THE BACKFILL HAS BEEN PLACED TO A SUFFICIENT HEIGHT TO PREVENT PIPE FLOTATION. CARE SHOULD BE TAKEN THAT ANY UNDERDRAIN IS OF PROPER GRADATION AND THICKNESS TO PREVENT MIGRATION OF MATERIAL BETWEEN THE UNDERDRAIN, PIPE EMBEDMENT AND NATIVE SOILS IN THE TRENCH BELOW AND AT THE SIDES OF THE PIPE.

H. DO NOT ALLOW SAND, DEBRIS, RUNOFF OR OTHER FOREIGN MATERIALS TO ENTER SEWER SYSTEM.

3.03 EARTHWORK

A. CONFORM TO APPLICABLE PROVISIONS OF SECTION 31 23 33 TRENCHING, BACKFILLING AND COMPACTION.

B. BACKFILL EXCAVATED AREAS IN SAME DAY EXCAVATED. WHEN NOT POSSIBLE, COVER EXCAVATED AREAS USING STEEL PLATES ON PAVED AREAS AND OTHER PROTECTIVE MEASURES ELSEWHERE.

C. PLACE MATERIAL IN UNIFORM LAYERS OF PRESCRIBED MAXIMUM LOOSE THICKNESS AND WET OR DRY MATERIAL TO APPROXIMATELY OPTIMUM MOISTURE CONTENT. COMPACT TO PRESCRIBED DENSITY WATER TAMPING IS NOT ALLOWED.

D. WHEN TRENCHES EXCEED FIVE FEET IN DEPTH CONTRACTOR SHALL UTILIZE TRENCH SAFETY MEASURES PER SECTION 31 41 33 TRENCH SAFETY.

3.04 PIPE CUTTING

A. CUT PIPE 12 INCHES AND SMALLER WITH STANDARD WHEEL PIPE CUTTERS. CUT PIPE LARGER THAN 12 INCHES IN MANNER APPROVED BY THE OWNER’S REPRESENTATIVE. MAKE CUTS SMOOTH AND AT RIGHT ANGLES TO AXIS OF PIPE. BEVEL PLAIN END WITH HEAVY FILE OR GRINDER TO REMOVE SHARP EDGES.

3.05 PIPE INSTALLATION BY OPEN CUT

A. INSTALL PIPE IN ACCORDANCE WITH PIPE MANUFACTURER'S RECOMMENDATIONS AND AS SPECIFIED IN FOLLOWING PARAGRAPHS.

B. INSTALL PIPE ONLY AFTER EXCAVATION IS COMPLETED, BOTTOM OF TRENCH FINE GRADED, BEDDING MATERIAL IS INSTALLED.

C. INSTALL PIPE TO LINE AND GRADE INDICATED. PLACE PIPE SO THAT IT HAS CONTINUOUS BEARING OF BARREL ON BEDDING MATERIAL AND IS LAID IN TRENCH SO INTERIOR SURFACES OF PIPE FOLLOW GRADES AND ALIGNMENT INDICATED. PROVIDE BELL HOLES WHERE NECESSARY.

D. FORM CONCENTRIC JOINT WITH EACH SECTION OF ADJOINING PIPE SO AS TO PREVENT OFFSETS.

E. KEEP INTERIOR OF PIPE CLEAN AS INSTALLATION PROGRESSES. REMOVE FOREIGN MATERIAL AND DEBRIS FROM PIPE.

F. PROVIDE LUBRICANT, PLACE AND DRIVE HOME NEWLY LAID SECTIONS SO AS TO ELIMINATE DAMAGE TO SECTIONS. INSTALL PIPE TO "HOME" MARK WHERE PROVIDED.

G. KEEP EXCAVATIONS FREE OF WATER DURING CONSTRUCTION AND UNTIL FINAL INSPECTION.

H. WHEN WORK IS NOT IN PROGRESS, COVER EXPOSED ENDS OF PIPES WITH APPROVED PLUG TO PREVENT FOREIGN MATERIAL FROM ENTERING PIPE.

3.06 PIPE INSTALLATION OTHER THAN OPEN CUT

A. CONTRACTOR SHALL UTILIZE METHODS OF PIPE INSTALLATION OTHER THAN OPEN CUT AS SHOWN ON THE DRAWINGS OR AS OTHERWISE REQUIRED TO INSTALL THE SEWER.

B. PIPE SHALL BE OF THE SIZE, TYPE, AND CLASS SPECIFIED ON THE PLANS, OR OTHER TYPES AS MAY BE SPECIFIED BY THE ENGINEER OR DESIGNATED ON THE PLANS.

C. JACKING
   1. IF THE GRADE OF THE PIPE AT THE JACKING END IS BELOW THE GROUND SURFACE, SUITABLE PITS OR TRENCHES SHALL BE EXCAVATED FOR THE PURPOSE OF CONDUCTING THE JACKING OPERATIONS AND FOR PLACING END JOINTS OF THE PIPE. WHEREVER END TRENCHES ARE CUT IN THE SIDES OF THE EMBANKMENT OR BEYOND IT, SUCH WORK SHALL BE SHEETED SECURELY AND BRACED IN A MANNER SATISFACTORY TO THE OWNER'S REPRESENTATIVE TO PREVENT EARTH CAVING.
   2. WHERE PIPE IS REQUIRED TO BE INSTALLED UNDER RAILROAD EMBANKMENTS OR UNDER HIGHWAYS, STREETS, OR OTHER FACILITIES BY JACKING OR BORING METHODS, CONSTRUCTION SHALL BE MADE IN SUCH A MANNER THAT WILL NOT INTERFERE WITH THE OPERATION OF THE RAILROAD, STREET, HIGHWAY, OR OTHER FACILITY, AND SHALL NOT WEAKEN OR DAMAGE ANY EMBANKMENT OR STRUCTURE. DURING CONSTRUCTION OPERATIONS, BARRICADES AND LIGHTS TO SAFEGUARD TRAFFIC AND PEDESTRIANS SHALL BE FURNISHED AND MAINTAINED, AS DIRECTED BY THE OWNER'S REPRESENTATIVE, UNTIL SUCH TIME AS THE BACKFILL HAS BEEN COMPLETED AND THEN SHALL BE REMOVED FROM THE SITE.
   3. HEAVY DUTY JACKS SUITABLE FOR FORCING THE PIPE THROUGH THE EMBANKMENT SHALL BE PROVIDED. IN OPERATING JACKS, EVEN PRESSURE SHALL BE APPLIED TO ALL JACKS USED. A SUITABLE JACKING HEAD, USUALLY OF TIMBER, AND SUITABLE BRACING BETWEEN JACKS AND JACKING HEAD SHALL BE PROVIDED SO THAT PRESSURE WILL BE APPLIED TO THE PIPE UNIFORMLY AROUND THE RING OF THE PIPE. A SUITABLE JACKING FRAME OR BACK STOP SHALL BE PROVIDED. THE PIPE TO BE JACKED SHALL BE SET ON GUIDES,

PROPERLY BRACED TOGETHER, TO SUPPORT THE SECTION OF THE PIPE AND TO DIRECT IT IN THE PROPER LINE AND GRADE. THE WHOLE JACKING ASSEMBLY SHALL BE PLACED SO AS TO LINE UP WITH THE DIRECTION AND GRADE OF THE PIPE. IN GENERAL, EMBANKMENT MATERIAL SHALL BE EXCAVATED JUST AHEAD OF THE PIPE AND MATERIAL REMOVED THROUGH THE PIPE, AND THE PIPE FORCED THROUGH THE EMBANKMENT WITH JACKS, INTO THE SPACE THUS PROVIDED.

4. THE CONTRACTOR SHALL FURNISH FOR THE OWNER'S REPRESENTATIVE'S REVIEW, A PLAN SHOWING HIS PROPOSED METHOD OF HANDLING, INCLUDING THE DESIGN FOR THE JACKING HEAD, JACKING SUPPORT OF BACK STOP, ARRANGEMENT AND POSITION OF JACKS, PIPE GUIDES, ETC., COMPLETE IN ASSEMBLED POSITION. THE REVIEW OF THIS PLAN BY THE OWNER'S REPRESENTATIVE'S WILL NOT RELIEVE THE CONTRACTOR FROM HIS RESPONSIBILITY TO OBTAIN THE SPECIFIED RESULTS.
5. THE EXCAVATION FOR THE UNDERSIDE OF THE PIPE, FOR AT LEAST ONE THIRD OF THE CIRCUMFERENCE OF THE PIPE, SHALL CONFORM TO THE CONTOUR AND GRADE OF THE PIPE. A CLEARANCE OF NOT MORE THAN TWO INCHES (2") MAY BE PROVIDED FOR THE UPPER HALF OF THE PIPE. THIS CLEARANCE IS TO BE TAPERED OFF TO ZERO AT THE POINT WHERE THE EXCAVATION CONFORMS TO THE CONTOUR OF THE PIPE. THE DISTANCE THAT THE EXCAVATION SHALL EXTEND BEYOND THE END OF THE PIPE DEPENDS ON THE CHARACTER OF THE MATERIAL, BUT IT SHALL NOT EXCEED TWO FEET (2') IN ANY CASE. THIS DISTANCE SHALL BE DECREASED ON INSTRUCTIONS FROM THE ENGINEER, IF THE CHARACTER OF THE MATERIAL BEING EXCAVATED MAKES IT DESIRABLE TO KEEP THE ADVANCE EXCAVATION CLOSER TO THE END OF THE PIPE.
6. THE PIPE, PREFERABLY, SHALL BE JACKED FROM THE LOW OR DOWNSTREAM END. LATERAL OR VERTICAL VARIATION IN THE FINAL POSITION OF THE PIPE FROM THE LINE AND GRADE ESTABLISHED WILL BE PERMITTED AT THE DISCRETION OF THE OWNER'S REPRESENTATIVE PROVIDED THAT SUCH VARIATION SHALL BE REGULAR, ONLY IN ONE DIRECTION AND THAT THE FINAL GRADE OF FLOW LINE SHALL BE IN THE DIRECTION INDICATED ON THE PLANS.
7. IF THE CONTRACTOR DESIRES, HE MAY USE A CUTTING EDGE OF STEEL PLATE AROUND THE HEAD END OF THE PIPE EXTENDING A SHORT DISTANCE BEYOND THE END OF THE PIPE WITH INSIDE ANGLES OR LUGS TO KEEP THE CUTTING EDGE FROM SLIPPING BACK ONTO PIPE.
8. WHEN JACKING OF PIPE IS ONCE BEGUN, THE OPERATION SHALL BE CARRIED ON WITHOUT INTERRUPTION, INSOFAR AS PRACTICABLE, TO PREVENT THE PIPE FROM BECOMING FIRMLY SET IN THE EMBANKMENT.
9. ANY PIPE DAMAGED IN JACKING OPERATIONS SHALL BE REMOVED AND REPLACED BY THE CONTRACTOR AT NO ADDITIONAL COST TO THE OWNER.
10. THE PITS OR TRENCHES EXCAVATED TO FACILITATE JACKING OPERATIONS SHALL BE BACKFILLED IN ACCORDANCE WITH THE DETAILS FOR BACKFILLING SEWER LINES SHOWN IN THE DRAWINGS IMMEDIATELY AFTER THE JACKING OF THE PIPE HAS BEEN COMPLETED.

D. BORING
1. THE BORING SHALL PROCEED FROM A PIT PROVIDED FOR THE BORING EQUIPMENT AND WORKMEN. EXCAVATION FOR PITS AND INSTALLATION OF SHORING SHALL BE AS OUTLINED ABOVE UNDER 3.5.C. THE LOCATION OF THE PIT SHALL MEET THE APPROVAL OF THE OWNER'S REPRESENTATIVE. THE HOLES ARE TO BE BORED MECHANICALLY. THE BORING SHALL BE DONE USING A PILOT HOLE. BY THIS METHOD APPROXIMATELY A TWO INCH (2") PILOT HOLE SHALL BE BORED THE ENTIRE LENGTH OF THE CROSSING AND SHALL BE CHECKED FOR LINE AND GRADE ON THE OPPOSITE END OF THE BORE FROM THE WORK PIT.

2. THIS PILOT HOLE SHALL SERVE AS THE CENTERLINE OF THE LARGER DIAMETER HOLE TO BE BORED. EXCAVATED MATERIAL WILL BE PLACED NEAR THE TOP OF THE WORKING PIT AND DISPOSED OF AS REQUIRED. THE USE OF WATER OR OTHER FLUIDS IN CONNECTION WITH THE BORING OPERATION WILL BE PERMITTED ONLY TO THE EXTENT TO LUBRICATE CUTTINGS. JETTING WILL NOT BE PERMITTED.
3. IN UNCONSOLIDATED SOIL FORMATIONS A GEL FORMING COLLOIDAL DRILLING FLUID CONSISTING OF AT LEAST 10% OF HIGH GRADE CAREFULLY PROCESSED BENTONITE MAY BE USED TO CONSOLIDATE CUTTINGS OF THE BIT, SEAL THE WALLS OF THE HOLE, AND FURNISH LUBRICATION FOR SUBSEQUENT REMOVAL OF CUTTINGS AND INSTALLATION OF THE PIPE IMMEDIATELY THEREAFTER.
4. ALLOWABLE VARIATION FROM LINE AND GRADE SHALL BE AS SPECIFIED UNDER 3.5.C. ABOVE. OVER CUTTING IN EXCESS OF ONE INCH (1") SHALL BE REMEDIED BY PRESSURE GROUTING THE ENTIRE LENGTH OF THE INSTALLATION.

3.07 MANHOLES, INLETS, JUNCTION BOXES AND OTHER STRUCTURES

A. STRUCTURES SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE DETAILS SHOWN ON PLANS AT LOCATIONS SHOWN ON THE PLANS AND TO THE DEPTH INDICATED THEREON.

B. JOINTS BETWEEN PRECAST CONCRETE SECTIONS SHALL BE MADE BY UNIFORMLY PLACING "RAM-NEK" FLEXIBLE PLASTIC GASKETS OR APPROVED EQUAL ON ALL FACES OF THE LOWER PART OF THE JOINT AND LOWERING THE UPPER RING EVENLY INTO PLACE TO PRODUCE UNIFORM BEARING AND COMPRESSION ON THE SEALER.

C. THE CONSTRUCTION OF STRUCTURES SHALL BE DONE AS SOON AS PRACTICAL AFTER SEWER LINES INTO OR THROUGH THE MANHOLE ARE COMPLETED.

D. ALL SEWERS SHALL BE CUT NEATLY AT THE INSIDE FACE OF THE WALLS OF THE MANHOLE AND POINTED UP WITH MORTAR.

E. AFTER THE MASONRY WORK HAS BEEN COMPLETED TO THE PROPER ELEVATION, THE CAST IRON MANHOLE COVER FRAME SHALL BE SET IN A FULL MORTAR BED AND ADJUSTED TO THE ELEVATION ESTABLISHED ON THE DRAWINGS.

F. ALL MANHOLES ARE TO BE BACKFILLED PER THE DETAILS SHOWN IN THE DRAWINGS AND THE REQUIREMENTS OF SECTION 31 23 33 – TRENCHING, BACKFILL AND COMPACTION.

3.08 FRAMES, GRATES, RINGS AND COVERS

A. CASTING SHALL CONFORM TO THE TYPE SHOWN ON THE DRAWINGS AND SHALL BE CLEAN CASTINGS, FREE FROM SAND OR BLOW HOLES OR OTHER DEFECTS. MATERIALS SHALL BE NOT LESS THAN CLASS 30B GRAY IRON CONFORMING TO ASTM A-48.

B. SURFACES OF THE CASTINGS SHALL BE FREE FROM BURNT-ON SAND AND SHALL BE REASONABLY SMOOTH.

C. BEARING SURFACES BETWEEN MANHOLE RINGS AND COVERS AND FRAMES SHALL BE CAST OR MACHINED WITH SUCH PRECISION THAT UNIFORM BEARING SHALL BE PROVIDED THROUGHOUT THE PERIMETER AREA OF CONTACT.

3.09 UNDERDRAIN SYSTEM

A. PIPE SHALL BE LAID PER PARAGRAPH 3.1 AND PER THE DETAILS ON THE PLANS.

B. PRIOR TO PLACING GRANULAR BACKFILL AND BEDDING, LINE TRENCH WITH DRAINAGE FABRIC ACCORDING TO THE DETAILS.

C. GRANULAR BEDDING SHALL BE PREPARED TO A DEPTH OF 2 TO 4 INCHES BELOW THE PIPE INVERT. THE PIPE SHALL BE LAID WITH THE PERFORATIONS FACING DOWN. THE GRANULAR BACKFILL SHALL THEN BE PLACED TO THE DEPTH SHOWN ON THE DETAILS. THE FILTER FABRIC SHALL THEN BE WRAPPED AROUND THE GRANULAR MATERIAL WITH A MINIMUM OVERLAP AT THE TOP OF 6 INCHES.

D. WHERE VERTICAL PIPE RISERS PENETRATE THE GRANULAR BACKFILL TO THE SURFACE, THE DRAINAGE FABRIC SHALL BE CUT IN AN 'X' TO ACCOMMODATE THE PIPE PENETRATION AND THEN THE FABRIC SHALL BE SEALED WITH A HEAVY DUTY TAPE TO THE PIPE IN THE MANNER TO INSURE THE INTEGRITY OF THE FILTER FABRIC.

3.10 CLEANING AND INSPECTION

A. CLEAN AND INSPECT NEW PIPING SYSTEMS, AND PARTS OF EXISTING SYSTEMS THAT HAVE BEEN ALTERED, EXTENDED, REPAIRED, OR OTHERWISE IMPACTED BY THE CONSTRUCTION.

B. SCHEDULE CLEANING AND INSPECTIONS BY THE OWNER’S REPRESENTATIVE AND AUTHORITIES HAVING JURISDICTION WITH AT LEAST 48 HOURS' ADVANCE NOTICE.

C. CLEANING:
   1. TAKE PRECAUTIONS TO PROTECT STORM SEWER MAINS AND STRUCTURES FROM DAMAGE THAT MIGHT BE INFLICTED BY THE IMPROPER SELECTION OF CLEANING PROCESSES OR IMPROPER USE OF EQUIPMENT. WHEN USING HYDRAULICALLY-PROPELLED DEVICES TAKE PRECAUTIONS TO ENSURE THAT THE WATER PRESSURE CREATED DOES NOT CAUSE DAMAGE TO OR FLOODING OF PUBLIC OR PRIVATE PROPERTY.
   2. EXERCISE CARE TO PREVENT CONTAMINATION OF THE POTABLE WATER SYSTEM. USE AN APPROPRIATELY SIZED BACKFLOW PREVENTER AS REQUIRED BY THE AUTHORITY HAVING JURISDICTION WHEN DRAWING WATER FROM A PUBLIC HYDRANT.
   3. DEBRIS DISPOSAL: REMOVE SOIL, SAND, ROCKS, CONSTRUCTION DEBRIS AND OTHER SOLID OR SEMI-SOLID MATERIAL RESULTING FROM THE CLEANING OPERATION AT THE DOWNSTREAM STRUCTURE OF THE SECTION BEING CLEANED. PASSING DEBRIS FROM ANY SECTION TO ANY OTHER SECTION IS NOT ALLOWED. LOAD DEBRIS FROM THE STRUCTURES INTO AN ENCLOSED CONTAINER PERMITTED FOR WASTE HAULING. REMOVE SOLIDS AND SEMI-SOLIDS RESULTING FROM CLEANING OPERATIONS FROM THE SITE AND DISPOSE OF LAWFULLY AT THE END OF EACH WORK DAY. DO NOT ACCUMULATE DEBRIS OR LIQUID WASTE ON THE SITE.

D. INSPECT ALL STRUCTURES AND INTERIOR OF PIPING TO DETERMINE WHETHER LINE DISPLACEMENT OR OTHER DAMAGE HAS OCCURRED. INSPECT AFTER APPROXIMATELY 24 INCHES OF BACKFILL IS IN PLACE, AND AGAIN AT COMPLETION OF PROJECT.

E. REPAIR OR REPLACE DEFECTIVE PIPING OR STRUCTURES AS REQUIRED BY THE OWNER'S REPRESENTATIVE AND REPEAT INSPECTIONS UNTIL RESULTS ARE SATISFACTORY.

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